POWER SUPPLY DEVICES

Modular construction
in 19” slide-in-technology

Power supply devices
in thyristor technology

GENERAL INFORMATION GFS GROUP

We – the G f S Group – are a modern, medium-sized business company, with worldwide sales of rectifier sets and charging equipments.

Through our technical know how and our long lasting experience in the different world markets, we have developed to a leading business company in Europe in the field of chargers and power supply technology.

G f S was founded in 1984. The bellow mentioned three companies pertaining to our group are responsible for the production of the following products:

Chargers for traction batteries
Power supply devices / equipment
Emergency lighting equipment
ZSV-equipment for application in hospitals
Rectified alternating power supply devices / Power inverters
Sheet steel casings
High performance- and air chamber transformers
Electronic control and monitoring units
Electronic hand dryers

Due to permanent further development in the equipment sector under application of ultra-modern electronic components and due to our modern production lines we have become one of the leading companies, spezialized in above products.

Here our production sites:

GfS–Gesellschaft für Stromversorgungstechnik in 79232 March-Buchheim
With development/ construction / technical equipment project planning / Purchasing department / sales and production of power supply equipment , emergency lighting devices as well as special devices.

GfE Gesellschaft für Elektrotechnik mbH in 79232 March-Buchheim
Our second subsidiary, produces electronic monitoring systems, control units, control components and devices.

GfS-Elektro Gmbh in 07381 Pößneck/Thüringen
Our newly built, modern subsidiary, produces all sheet steel casings, modern air chamber transformers and chargers for craft-/ traction batteries.

GENERAL INFORMATION GFS GROUP

Products of the GFS group

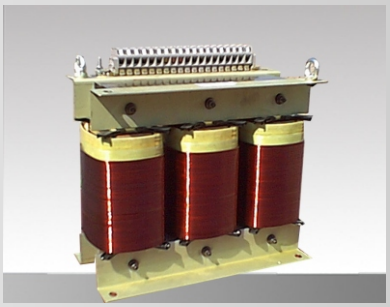
Central battery system

Emergency power supply

Control and regulation devices

Power supply for AC and DC

Charging system for traction battery



Transformer

Steel cabinet

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Power supply devices

Modular construction in 19“ slide-in-technology

- **Synchronized power supply devices**
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- **Power supply systems**

Battery charger / Rectifier type: PSR 06 - 600W

GENERAL PRODUCT INFORMATION

Through an advanced switching mechanism concept, the devices dispose of a wide voltage range, a low power loss and a very low construction volume.

The input current has a sinusoidal regulation (cos phi = 1). Changes in the output voltage through load alternation or changes in the input voltage can be regulated in best time. The output is short-circuit-proof due to a constant current regulation.

The combinatorial circuit parts distinguish themselves through:

- User friendly, 19“- compatible slide-in system
- Front connection technology
- Convection cooling
- Temperature compensation of the charging voltage
- Digital display of the output voltage, output current and setting parameters

The combinatorial circuit parts of the PSR type range are also available in wall-casings

STANDARD CONFIGURATION

LED-indicators	Mains voltage O.K. (green), output undervoltage „U<“ (green), output overvoltage „U>“ (red), constant current operation (yellow), collective operational fault (red)
Digital Display	Output voltage, output current
Signal contacts	General fault
Surveys	Output voltage high / low, output voltage, output current, short circuit
Features	Strong charging, temperature-controlled charging voltage, external sensor lead for the output voltage, external On / Off

Battery charger / Rectifier type: PSR 06 - 600W

TYPES

Type	PSR 06/24-20	PSR 06/48-10	PSR 06/60-8.2	PSR06/108-4.5
Nominal voltage	**24 V**	**48 V**	**60 V**	**108 V**
Equalize charge voltage U_{A1} ± 1%	27,2 V	54,5 V	68,1 V	122,6 V
Setting range	23,4 -28,8 V	46,6 - 57,6 V	58,5 - 72 V	105 - 130 V
Boost charge voltage U_{A2} ± 1%	28,8 V	57,6 V	72,0 V	129,6 V
Setting range	24 - 30 V	48 - 60 V	60 - 73 V	108 - 135 V
Nominal current ± 2 %	**20 A**	**10 A**	**8,2 A**	**4,5 A**
Setting range	10 - 20 A	5 - 10 A	4,1 - 8,2 A	2,3 - 4,5 A
Dimensions (HxWxD) in mm	71x262x285	71x262x285	71x262x285	71x262x285
Weight	5,3 Kg	5,3 Kg	5,3 Kg	5,3 Kg
Dimensions wall casing	285x280x95	285x280x95	285x280x95	285x280x95
Weight wall casing	5,3 Kg	5,3 Kg	5,3 Kg	5,3 Kg

TECHNICAL INFORMATION

AC Input

Nominal voltage	230 V + 15 % / - 20 %
Nominal current	2,7 A
Input frequency	47 - 63 Hz
Power factor	>0,95 at < 25 % P_{Nom} / >0.97 at25 - 50 % P_{Nom}
	>0,99 at 50 - 100 % P_{Nom}
Efficiency	88%
Internal fusing	6 A gL

DC Output

Charge line	IU acc. to DIN 41772 / DIN 41773
Voltage ripple	20 mV_{SS}
Noise voltage acc. To CCITT	At 24 V - 1 mV_{eff} / at 48 - 108 V - 1,8 mV_{eff}
Dynamic behaviour	< 3 % at a load change with transfer character
	10 % - 90 % - 10 % I_{Nom}, transient time t ≤ 1ms
Short circuit protection	Constantly short -circuit-proof 1 x I_{Nom}
Parallel operation	< 100 load distribution ± 10%

Environment

Ambient temperature	Operation - 10 °C till + 40 °C
	Storage - 30 °C up to + 50 °C
Climatic conditions	IEC 721 - 3 - 3 class 3K3 / 3Z1 / 3B1 / 3C2 / 3S2 / 3M2
Humidity class	F
Altitude	< 1000 m over NN

General Information

Audible noise	< 40 dB (A) at 1 m distance
Cooling	Convection cooling
Construction	1/6 19" part-insertion (6 HE) for integration into rack
	according to DIN 41496 , front connectors
Lacquering	RAL 7032 frontplate, anodized casing
Safety	EN 60950 , VDE 0100 part 410 , VDE 110 , EN 50178
	EN 60146
Emitted interference	EN 55011 / EN 55022 limit value class "B"
Interference immunity	EN 61 000 - 4 part 2 - 5

Battery charger / rectifier type: PSS 18 - 1800W

GENERAL PRODUCT INFORMATION

A combination of modern AC to DC switching power conversion technology and a flexible 19” compatible mechanic like the PSS gives many advantages and is suitable for a wide range of applications.

These power supplies are designed for the following applications:

A secured DC power supply during the parallel stand-by operation of rectifier and battery
Direct feeding of DC-users
Telecommunication and information technique
Channel signal technique
Process control technology of the chemical industry
Steerings, e.g. in low voltage switchgears
Home requirement devices for power plants and transformation plants
Railed vehicles and vessels
Industry

Through an advanced switching concept the devices dispose of a wide input-voltage-area, a power loss and a low construction volume.

The entry current has a sinusoidal regulation (cos phi = 1). Changes in the output voltage through load alternation or changes in the input voltage can be regulated in best time. The output is short-circuit-proof due to a constant current regulation.

Upon indication of the current value in the digital display, all device parameters can be entered in a user-friendly way through the frontal keys. The intern micro processor controls and signalizes the status of the mains voltage, of the output voltage and of the device temperature.

Standard devices dispose of a CAN-interface, through which the communication and monitoring via our monitoring- and control unit MU1000C can take place.

STANDARD CONFIGURATION

LED-Display	Mains voltage O.K. (green), output voltage U_{A1} O.K. (green), output voltage U_{A2} O.K. (green), output undervoltage „U<“ (green), output overvoltage „U>“ (red), constant current operation (yellow), collective operational fault (red)
Digital Display	Output voltage, output current
Signal contacts	Collective operational fault message , voltage too low
Surveys	Output voltage high / low, output voltage, output current, short circuit
Features	Potential free collective operational fault message and message „U<“, measurement connection for active current breakdown, discharge specimen/strong charging, remote controlled ON / OFF function, temperature-compensated charging voltage regulation, external sensor lead for the output voltage, message for optocoupler “UA available”, “mains available” and “constant current operation”

Battery charger / rectifier type: PSS 18 - 1800W

TYPES

Type	PSS18/24-40	PSS18/48-30	PSS18/60-25	PSS108/13,4-40	PSS18/216-6.7
Rated voltage	**24 V**	**48 V**	**60 V**	**108 V**	**216 V**
Maintenance charging voltage U_{A1} ± 1%	27,2 V	54,5 V	68,1 V	122,6 V	245,2 V
Setting range	23,4 -28,8 V	46,6 - 57,6 V	58,5 - 72 V	105 - 130 V	211 - 260 V
Strong charging voltage U_{A2} ± 1 %	28,8 V	57,6 V	72,0 V	129,6 V	259,2 V
Setting range	24 - 30 V	48 - 60 V	60 - 73 V	108 - 135 V	216 - 270 V
Characteristic curve U_{A3} ± 1 % discharge probe	22,2 V	44,4 V	55,5 V	99,9 V	200 V
Setting range	20,4 - 24 V	40,8 - 48 V	51 - 60 V	91,8 - 108 V	184 - 216 V
Rated current ± 2 %	**40 A**	**30 A**	**25 A**	**13,4 A**	**6,7 A**
Setting range	20 - 40 A	15 - 30 A	12,5 - 25 A	6,7 - 13,4 A	3,4 - 6,7 A
Measurements (BxHxT) in mm	142 x 262 x 285	142 x 262 x 285	142 x 262 x 285	142 x 262 x 285	142 x 262 x 285
Weight	7,6 Kg	7,6 Kg	7,6 Kg	7,6 Kg	7,6 Kg

TECHNICAL INFORMATION

Input alternating voltage

Rated voltage	230 V + 15 % / - 20 %
Rated current	at 24 V - 5,2 A / at 48 - 216 V - 7,9 A
Frequency	47 - 63 Hz
Power factor	>0,95 at < 25 % P_{Nom} / >0.97 at 25 - 50 % P_{Nom}
	>0,99 at 50 - 100 % P_{Nom}
Efficiency	91%
Fuse protection	16 A gL

Direct voltage output

Charging characteristic	IU according to DIN 41772 / DIN 41773
Voltage waviness	20 mV_{SS}
Noice voltage acc. to CCITT	at 24 V - 1 mV_{eff} / at 48 – 216V - 1,8 mV_{eff}
Dynamic performance	< 3 % at a load change with transfer character
	10 % - 90 % - 10 % I_{Nom}, transient time t ≤ 1ms
Short circuit performance	Constantly short-circuit-proof 1 x I_{Nom}
Parallel operation	< 100 load distribution ± 10%

Ambient conditions

Ambient temperature	Operation - 10 °C up to + 40 °C
	Storage - 30 °C up to + 50 °C
Ambient conditions	IEC 721 - 3 - 3 class 3K3 / 3Z1 / 3B1 / 3C2 / 3S2 / 3M2
Humidity class	F
Position height	< 1000 m over NN

General Information

Noise level	< 40 dB (A) in 1 m distance
Cooling system	Convetion colling
Design	1/3 19" part-insertion (6 HE) for integration into rack according to DIN 41496 , front connectors
Lacquering	RAL 7032 frontplate, anodized casing
Security	EN 60950 , VDE 0100 partl 410 , VDE 110 , EN 50178 EN 60146
Emitted interference	EN 55011 / EN 55022 limit value class "B"
Interference resistance	EN 61 000 - 4 part 2 - 5

Battery charger / Rectifier type: PSS 30 - 3000W

GENERAL PRODUCT INFORMATION

Rectifiers of the series PSS distinguish themselves through the application of modern switching topologies combined with well-engineered 19”-compatible slide-in modus.

The devices are applicable among other things in the following areas:

A secured DC power supply during the parallel stand-by operation of rectifier and battery
Direct feeding of DC-users
Telecommunication and information technique
Channel signal technique
Process control technology of the chemical industry
Steerings, e.g. in low voltage switchgears
Home requirement devices for power plants and transformation plants
Railed vehicles and vessels
Industry

Through an advanced switching concept the devices dispose of a wide input-voltage-area, a low power loss and a low construction volume.

The entry current has a sinusoidal regulation (cos phi = 1). Changes in the output voltage through load alternation or changes in the input voltage can be regulated in best time. The output is short-circuit-proof due to a constant current regulation.

Upon indication of the current value in the digital display, all device parameters can be entered in a user-friendly way through the frontal keys. The intern micro processor controls and signalizes the status of the mains voltage, of the output voltage and of the device temperature.

Standard devices dispose of a CAN-interface, through which the communication and monitoring via our monitoring- and control unit MU1000C can take place.

STANDARD CONFIGURATION

LED-Display	Mains voltage O.K. (green), output voltage U_{A1} O.K. (green), output voltage U_{A2} O.K. (green), output undervoltage „U<“ (green), output overvoltage „U>“ (red), constant current operation (yellow), collective operational fault (red)
Digital Displayq	Output voltage, output current
Signal contacts	Collective operational fault message, voltage too low
Surveys	Output voltage high / low, output voltage, output current, short cirucit
Features	Potential free collective operational fault message and message „U<“, measurement connection for active current breakdown, discharge specimen/strong charging, remote controlled ON / OFF function, temperature-compensated charging voltage regulation, external sensor lead for the output voltage, message for optocoupler “UA available”, “mains available” and “constant current operation”

Battery charger / rectifier type: PSS 30 - 3000W

TYPES

Type	PSS30/24-80	PSS30/48-50	PSS30/60-40	PSS30/108-22.3	PSS30/216-11.1
Rated voltage	**24 V**	**48 V**	**60 V**	**108 V**	**216 V**
Maintenance charging voltage U_{A1} ± 1%	27,2 V	54,5 V	68,1 V	122,6 V	245,2 V
Setting range	23,4 -28,8 V	46,6 - 57,6 V	58,5 - 72 V	105 - 130 V	211 - 260 V
Strong charging voltage U_{A2} ± 1 %	28,8 V	57,6 V	72,0 V	129,6 V	259,2 V
Setting range	24 - 30 V	48 - 60 V	60 - 73 V	108 - 135 V	216 - 270 V
Characteristic curve U_{A3} ± 1% / Discharge test	22,2 V	44,4 V	55,5 V	99,9 V	200 V
Setting range	20,4 - 24 V	40,8 - 48 V	51 - 60 V	91,8 - 108 V	184 - 216 V
Rated current ± 2 %	**80 A**	**50 A**	**40 A**	**22.3 A**	**11.1 A**
Setting range	40 - 80 A	25 - 50 A	20 – 40 A	11 – 22.3 A	5.5 – 11.1 A
Measurements (BxHxT) in mm	142x262x285	142x262x285	142x262x285	142x262x285	142x262x285
Weight	12,4 Kg	12,4 Kg	12,4 Kg	12,4 Kg	12,4 Kg

TECHNICAL INFORMATION

Input alternating voltage

Rated voltage	230 V + 15 % / - 20 %
Rate current	at 24 V – 10,9 A / at 48 - 216 V - 12,9 A
Frequency	47 - 63 Hz
Power factor	>0,95 at < 25 % P_{Nomn} / >0.97 bei 25 - 50 % P_{Nom}
	>0,99 at 50 - 100 % P_{Nom}
Efficiency	91%
Fuse protection	25 A gL

Direct voltage output

Charging characteristics	IU according to DIN 41772 / DIN 41773
Voltage waviness	20 mV_{SS}
Noise voltage acc. to CCITT	At 24 V - 1 mV_{eff} / at 48 – 216V - 1,8 mV_{eff}
Dynamic performance	< 3 % at a load change with transfer character
	10 % - 90 % - 10 % I_{Nom}, transient time t ≤ 1ms
Short circuit performance	Constantly short-circuit-proof 1 x I_{Nom}
Parallel operation	< 100 load distribution ± 10%

Ambient conditions

Ambient temperature	Operation - 10 °C up to + 40 °C
	Storage - 30 °C up to + 50 °C
Ambient conditions	IEC 721 - 3 - 3 class 3K3 / 3Z1 / 3B1 / 3C2 / 3S2 / 3M2
Humidity class	F
Position height	< 1000 m over NN

General Information

Noise level	< 40 dB (A) at 1 m distance
Cooling system	Air blast cooling (revolution controlled)
Design	1/3 19" part insertion (6 HE) for integration into rack
	According to DIN 41496 , front connectors
Lacquering	RAL 7032 frontplate, anodized casing
Security	EN 60950 , VDE 0100 part 410 , VDE 110 , EN 50178
	EN 60146
Emitted interference	EN 55011 / EN 55022 limit value class "B"
Interference resistance	EN 61 000 - 4 part 2 – 5

Battery charger / Rectifier type: PSR-T Series

GENERAL PRODUCT INFORMATION

A combination of modern AC to DC switching power conversion technology and a flexible 19“ compatible mechanic like the PSRT gives many advantages and is suitable for a wide range of applications. Power supply modules of series PSR-T are optimized for telecommunication applications. Due to the high flexibility for mounting of complete prewired subracks in system cabinets this system is very easy in use, during commissioning and maintenance. Modules can be exchanged during system operation. The total system output power can be increased by plugin of new modules in prewired slots during operation. During start-up the rectifiers read all necessary operation parameters via CAN bus from control unit . A fully equipped 19” subrack has an maximal output current of up to 320A @ 48V. The combination of an active power factor correction unit and a soft-switching DC to DC-converter provides a wide input voltage range, high efficiency, small dimensions, and low weight. The input current is sinusoidal with cos = 1 . A constant voltage and current control circuit performs correction of output voltage deviations due to input voltage or load transients within less than 1.5 ms and permits constant current operation down to continuous short circuit. A microcontroller unit with two control keys and digital displays on the front panel provides continuous monitoring of input and output voltage, output current, temperature, and offers easy adjustment and programming of output parameters and monitoring thresholds (optional). An CAN-bus interface allows remote control of output voltage and current from real time transmission of all parameters and measurement values to central supervisory unit (MU1000C or MU2000C). CAN bus is very secure serial bus with enhanced failure correction.

The devices are applicable among other things in the following areas:

Single phase module with inusoidal input current

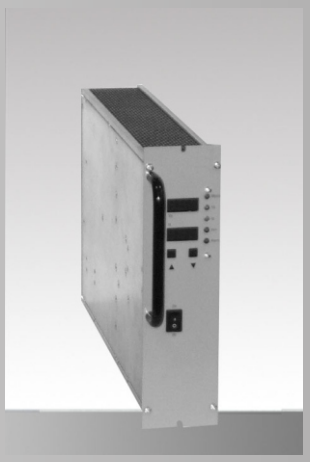
Special in– and output side OVP

Flexible 1/6-19“-module system ”Hot-Plug-In“

Temperature compensation of the charge voltage, natural convection cooling

Digital display for output voltage, current and adjust ments values (optional)

CAN-bus interface



STANDARD CONFIGURATION

LED indicators	Mains (green); U_0 (green); I_0 (yellow); U> (red); Alarm (red)
Digital display	Output voltage, output current (optionally)
Relay contacts	“General fault”
Monitoring	Output voltage high / low, output voltage, output current, short circuit
External functions	Boost charge and battery test function, temperature compensation of charge voltage, remote ON / OFF via CAN interface and control unit; external sense links for output voltage
Communication	CAN-bus interface for communication with central monitoring unit (MU1000C/ MU2000C)

Battery charger / Rectifier type: PSR-T Series

TYPES

Type	PSR-T10/48-21	PSR-T16/48-33	PSR-T27/48-56
Category	Primary Switch Mode Rectifier		
AC INPUT			
Nominal voltage	230 V AC +/-20% (high voltage version –25/+30%) 47-63 Hz		
Nominal current	5.0 A AC	7.7 A AC	12.9 A AC
Power factor	> 0.95 at Pnom < 25% ; > 0.97 at 50% > Pnom > 25% ; > 0.99 at 100% > Pnom 50%		
Efficiency	≥91%	≥ 91%	≥ 91%
Fusing	6 A gL	10A gL	16 A gL
DC OUTPUT			
Nominal voltage	**48 V DC**	**48 V DC**	**48 V DC**
V DC Nominal current	**21.0 A DC**	**33.0 A DC**	**56.0 A DC**
Charge line	IU-line acc. to DIN 41772 / DIN 41773		
Charge line U_{A1}			
Charge line U_{A1} Equalize charge	54.5 V DC ±1% (46.6 to 57.6 V adjustable)		
With MU: Boost charge	57.6 V DC ±1% (48 to 60 V adjustable on control unit)		
With MU: Battery test	44.4 V DC ±1% (40.8 to 48 V adjustable on control unit)		
Voltage ripple	≤ 20 mVss		
Psophometric ripple acc. to CCITT	≤ 1.8 mVeff		
Dynamic behaviour	< 3% Unom for load transients between 10% - 90% - 10% Inom recovery time t = 1 ms		
Short circuit protection	Continuous short circuit proof, 1x Inom		
Parallel operation	< 100 pieces		
Internal decoupling circuit	minus pole		
Internal Output fuse	25A	35A	80A
MECHANICAL CONSTRUCTION			
Construction	1/6-19“ cassette for mounting in subracks acc. to DIN 41 494, rear connectors		
Dimensions [mm] W / H / D	71 / 262 / 220	71 / 262 / 420	71 / 262 / 420
Weight [kg]	3.5	8.5	11.5
Cooling	Natural convection	Temperature controlled fan cooling	
Protection class	IP20 (mech.); 1 (electr.)		
Surface	Front panel: powder coating RAL 7032, constructive parts: anodised		

Ambient conditions

Ambient temperature	Operation - 10 °C up to + 40 °C Storage - 30 °C up to + 50 °C
Ambient conditions	IEC 721 - 3 - 3 class 3K3 / 3Z1 / 3B1 / 3C2 / 3S2 / 3M2
Humidity class	F
Position height	< 1000 m over NN

General Information

Noise level	< 30 dB (A) at 1 m distance
Security	EN 60950 , VDE 0100 part 410 , VDE 110 , EN 50178 EN 60146
Emitted interference	EN 55011 / EN 55022 limit value class "B"
Interference resistance	EN 61 000 - 4 part 2 – 5

Battery charger / Rectifier type: PSR-T80 Series

GENERAL PRODUCT INFORMATION

A combination of modern AC to DC switching power conversion technology and a flexible 19“ compatible mechanic like the PSRT gives many advantages and is suitable for a wide range of applications. Power supply modules of series PSR-T are optimized for telecommunication applications. Due to the high flexibility for mounting of complete prewired slots in system cabinets this system is very easy in use, during commissioning and maintenance. Modules can be exchanged during system operation. The total system output power can be increased by plugin of new modules in prewired slots during operation. During start-up the rectifiers read all necessary operation parameters via CAN bus from control unit . A fully equipped 19” cabinet has an maximal output current of up to 1660A @ 48V. The combination of an active power factor correction unit and a soft-switching DC to DC-converter provides a wide input voltage range, high efficiency, small dimensions, and low weight. With an optional PFC plug-in module the input current is sinusoidal with cos = 1 . A constant voltage and current control circuit performs correction of output voltage deviations due to input voltage or load transients within less than 1.5 ms and permits constant current operation down to continuous short circuit.
A microcontroller unit with two control keys and digital displays on the front panel provides continuous monitoring of input and output voltage, output current, temperature, and offers easy adjustment and programming of output parameters and monitoring thresholds.
An CAN-bus interface allows remote control of output voltage and current from real time transmission of all parameters and measurement values to central supervisory unit (MU1000C or MU2000C). CAN bus is very secure serial bus with enhanced failure correction.

The devices are applicable among other things in the following areas:

Three - phase module with sinusoidal input current

Special in– and output side OVP

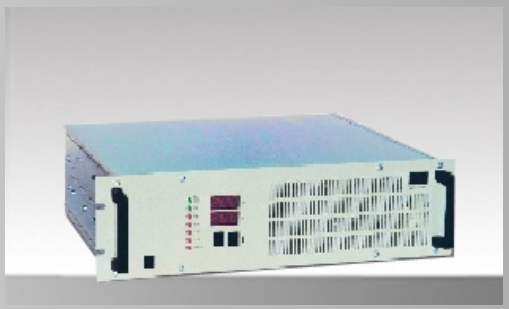
Hot-swappable module with back-plane connection

High Power density and low weight

Digital display for output voltage, current and adjustments values (optional)

Optional plug-in module for PFC

CAN-bus interface



STANDARD CONFIGURATION

LED indicators	Mains (green); U_0 (green); I_0 (yellow); U> (red); Alarm (red)
Digital display	Output voltage, output current (optionally)
Relay contacts	“General fault”
Monitoring	Output voltage high / low, output voltage, output current, short circuit
External functions	Boost charge and battery test function, temperature compensation of charge voltage, remote ON / OFF via CAN interface and control unit; external sense links for output voltage
Communication	CAN-bus interface for communication with central monitoring unit (MU1000C/ MU2000C)

Battery charger / Rectifier type: PSR-T80 Series

GENERAL PRODUCT INFORMATION

Type	PSR-T80/48-166	PSR-T80/60-133	PSR-T80/108-74	PSR-T80/216-37
Category	Primary Switch Mode Rectifier			
AC Input				
Nominal voltage	3x 440 V AC +/-20% 47-63 Hz			
Nominal current	7.3 A AC	7.3 A AC	7.3 A AC	7.3 A AC
Power factor	> 0.93; with optional PFC: >0,93 at Pnom < 25% ; > 0.97 at 50% > Pnom > 25% ; > 0. 99 at 100%			
Efficiency	≥ 91%	≥ 91%	≥ 91%	≥ 91%
Fusing	6A gL	6A gL	6A gL	6A gL
DC Output				
Nominal voltage	**48 V DC**	**60 V DC**	**108 V DC**	**216 V DC**
Nominal current	**166 A DC**	**133 A DC**	**74 A DC**	**37 A DC**
Charge line	IU-line acc. to DIN 41772 / DIN 41773 , power regulated			
Charge line U A1 : Equalize charge	54,5 V DC ±1% (46.6 to 57.6 V adjustable)	68,1 V DC ±1% (57 to 72 V adjustable)	122,6 V DC ±1% (105 to 129 V adjustable)	215,2 V DC ±1% (210 to 259 V adjustable)
With MU: Boost charge	57,6 V DC ±1% (48 to 60V adjustable on control unit)	72 V DC ±1% (60 to 75V adjustable on control unit)	129,6 V DC ±1% (108 to 135V adjustable on control unit)	259,2 V DC ±1% (216 to 270V adjustable on control unit)
With MU: Battery test	44,4 V DC ±1% (40,8 to 48V adjustable on control unit)	55,5 V DC ±1% (51 to 60V adjustable on control unit)	99,9 V DC ±1% (91 to 108V adjustable on control unit)	199,8 V DC ±1% (183 to 216V adjustable on control unit)
Voltage ripple	≤ 20 mV_{ss}	≤ 20 mV_{ss}	≤ 100 mV_{ss}	≤ 200 mV_{ss}
Psophometric ripple acc. to CCITT	≤ 1.8 mVeff	≤ 1.8 mVeff	not applicable	not applicable
Dynamic behaviour	< 3% Unom for load transients between 10% - 90% - 10% Inom recovery time t = 1 ms			
Short circuit protection	Continuous short circuit proof, 1x Inom			
Parallel operation	< 100 pieces			
Internal decoupling circuit	minus pole	plus pole	plus pole	plus pole
Mechanical Construction				
Construction	19“ rack for mounting in prewired 19” slots with backplane			
Dimensions [mm] W / H / D	483 / 133 / 420	483 / 133 / 420	483 / 133 / 420	483 / 133 / 420
Weight [kg]	28	28	26	26
Cooling	Forced fan cooling (temperature controlled, monitored)			
Protection class	class IP20 (mech.); 1 (electr.)			
Surface	Front panel: powder coating RAL 7032, constructive parts: anodised			

Ambient conditions

Ambient temperature	Operation - 0 °C up to + 40 °C Storage - 30 °C up to + 70 °C
Ambient conditions	IEC 721 - 3 - 3 class 3K3 / 3Z1 / 3B1 / 3C2 / 3S2 / 3M2
Humidity class	F
Position height	< 1000 m over NN

General Information

Noise level	< 40 dB (A) at 1 m distance
Security	EN 60950 , VDE 0100 part 410 , VDE 110 , EN 50178 EN 60146
Emitted interference	EN 55011 / EN 55022 limit value class "B"
Interference resistance	EN 61 000 - 4 part 2 – 5

Inverter type: PWS 0,5 - 2 KVA

GENERAL PRODUCT INFORMATION

Inverters of the type range PWS work with primary pulse latitude modulation with downstream isolating transformer and are available both in well-engineered 19”-compatible slide-in modus as well as in a wall casing. The devices are predestinated for application in the performance range up to 40kVA as AC-power supply in the areas of electricity supply, industry, shipbuilding and as rail current supply.

Through the combination of a robust construction, with a high capacity of overstress, almost user-defined output frequency and galvanically isolated from input and output, PWS-inverted rectifiers are applicable in a very universal, efficient and reliable way. The parallel switching of the modules offers highest flexibility at the realization of power supply with higher performance in connection with a (n+1)- redundancy.

PWS-inverted rectifiers are prepared for both, the one-on-one operation as well as for the application with an electronic change-over facility (UNB) and for additional monitoring and controlling units.

Inverters of the PWS 0,5-2KVA – type range are also available in wall casings

STANDARD CONFIGURATION

LED-Display	Operation, U_{off}, U_{ON}>, U_{on}<, overload, failure, over-temperature, collector allert
Signal contacts	Potential-free collective operational fault
Surveys	Input undervoltage control with cutoff Automatic re-activation Input overvoltage control with cutoff Automatic re-activation Output voltage Over temperature with cutoff Overload without cutoff

Inverter type: PWS 0,5 - 2 KVA

TYPES

Type	PWSx-0.5	PWSx-1.0	PWSx-1.5	PWSx-2.0
Rated voltage input (x)	24V / 108V / 216V	24V / 108V / 216V	24V / 108V / 216V	24V / 108V / 216V
Rated voltage output	230V 50Hz	230V 50Hz	230V 50Hz	230V 50Hz
Output rating at cos phi = 0,8	**500 VA**	**1000VA**	**1500VA**	**2000VA**
Rated current	2,17 A	4,35 A	6,52 A	8,7 A
Measurements (BxHxT) mm	483x177x460	483x177x460	483x177x460	483x221x460
Weight	14 Kg	20 Kg	24 Kg	29 Kg
Measurements wall casing	400x400x210	400x600x210	400x600x210	600x800x300
Weight	18 Kg	24 Kg	32 Kg	37 Kg
Category	Primary synchronized sinus inverter			

TECHNICAL INFORMATION

Performance g cos phi = 0,8	**500 VA**	**1000 VA**	**1500 VA**	**2000 VA**
DC Voltage input				
At 24 V (+20 / -15 %) rated current	19,6 A	38,8 A	58,2 A	77,6 A
At 108 V (+20 / -15 %) rated current	4,2 A	8,2 A	12,4 A	16,3 A
At 216 V (+20 / -15 %) rated current	2,1 A	4,1 A	6,2 A	8,2 A
Fuse protection at 24 V external	25 A	50 A	80 A	100 A
Fuse protection at 108 V external	6 A	10 A	16 A	20 A
Fuse protection at 216 V external	4 A	6 A	10 A	10 A

Efficiency at 24 V	85 - 86 %
Efficiency at 108 V	89 - 90 %
Efficiency at 216 V	89 - 91 %
Switch-on current	$\leq$ rated current

Output signal voltage

Rated voltage	230 V sinusoidal
Offset	$\pm$ 0,5 % static
Transient time	$\leq$ 0,3 ms at load changes of 10 - 90 - 10 %
Frequency	50 Hz $\pm$ 0,05 %
Synchronization range	45 -65 Hz
Distortion factor	$\leq$ 3 % at linear load
Crest factor	$\leq$ 2,5
Performance factor	0,5 ind. - 1 - 0,5 kap.
Overstressing	160 % for 1 minute, 130 % for 10 min without cutoff
Short circuit behavior	Constantly short-circuit proof2 - 2,5 x I_{Nom} for approx. 2,5 s
Parallel operation	max 12 pieces , load distribution approx.5 % I_{Nom}

Ambient conditions

Ambient temperature	Operation - 10 °C at + 40 °C Storing - 30 °C at + 50 °C
Ambient conditions	IEC 721 - 3 - 3 class 3K3 / 3Z1 / 3B1 / 3C2 / 3S2 / 3M2
Humidity class	F
Position height	$\leq$ 1000 m over NN

General information

Noise level	< 40 dB (A) at 1 m distance
Cooling	Air blast cooling (revolution controlled) with temperautre control
Cooling at 500 VA	Convection cooling
Design	19“ complete insertion with connectors on the backside
Protection class	IP 20 / class 1
Lacquering	RAL 7032 front plate, anodized casing
Security	EN 60950 , VDE 0100 part 410 , VDE 110 , EN 50178, EN 60146
Emitted interference	EN 55011 / EN 55022 limit value class "B"
Interference resistance	EN 61 000 - 4 part 2 - 5

Inverter type: PWS 2,5 - 5 KVA

GENERAL PRODUCT INFORMATION

Inverters of the type range PWS work with primary pulse latitude modulation with downstream isolating transformer and are available in both, well-engineered 19”-compatible slide-in modus as well as in a wall casing. The devices are predestinated for application in the performance range up to 40kVA as AC-power supply in the areas of electricity supply, industry, shipbuilding and as rail current supply.

Through the combination of a robust construction, with a high capacity of overstress, almost user-defined output frequency and galvanically isolated from input and output, PWS-inverted rectifiers are applicable in a very universal, efficient and reliable way. The parallel switching of the modules offers highest flexibility at the realization of power supply with higher performance in connection with a (n+1)- redundancy.

PWS-inverted rectifiers are prepared for both, the one-on-one operation as well as for the application with an electronic change-over facility (UNB) and for additional monitoring and controlling units.

Inverters of the PWS 2,5-5KVA – type range are also available in wall casings

STANDARD CONFIGURATION

LED-Display	Operation, U_{off}, U_{ON}>, U_{on}<, overload, failure, over-temperature, collector allert
Signal contacts	Potential-free collective operational fault
Features	Input undervoltage control with cutoff Automatic re-activation Input overvoltage control with cutoff Automatic re-activation Output voltage Over temperature with cutoff Overload without cutoff

Inverter type: PWS 2,5 - 5 KVA

TYPES

Type	PWSx-2.5	PWSx-3.0	PWSx-4.0	PWSx-5.0
Rated voltage input (x)	24V / 108V / 216V	24V / 108V / 216V	108V / 216V	108V / 216V
Rated voltage output	230V 50Hz	230V 50Hz	230V 50Hz	230V 50Hz
Output rating at cos phi = 0,8	**2500 VA**	**3000VA**	**4000VA**	**5000VA**
Rated current	10,8 A	13,0 A	17,4 A	21,7 A
Measurements (BxHxT) mm	483x177x460	483x177x460	483x221x460	483x221x460
Weight	34 Kg	39 Kg	46 Kg	52 Kg
Measurements wall casing	600x800x300	600x800x300	600x800x300	600x800x300
Weight	42 Kg	47 Kg	58 Kg	64 Kg
Category	Primary synchronized sinus inverter			

TECHNICAL INFORMATION

Performance g cos phi = 0,8	**2500 VA**	**3000 VA**	**4000 VA**	**5000 VA**
DC Voltage input				
At 24 V (+20 / -15 %) rated current	96,9 A	116,3 A		
At 108 V (+20 / -15 %) rated current	20,4 A	24,2 A	32,2 A	40 A
At 216 V (+20 / -15 %) rated current	10,2 A	12,1 A	16,1 A	20 A
Fuse protection at 24 V external	125 A	125 A		
Fuse protection at 108 V external	25 A	35 A	50 A	50 A
Fuse protection at 216 V external	16 A	16 A	20 A	25 A

Efficiency at 24 V	85 - 86 %
Efficiency at 108 V	89 - 90 %
Efficiency at 216 V	89 - 91 %
Switch-on current	$\leq$ rated current

Output signal voltage

Rated voltage	230 V sinusoidal
Offset	$\pm$ 0,5 % static
Transient time	$\leq$ 0,3 ms at load changes von 10 - 90 - 10 %
Frequency	50 Hz $\pm$ 0,05 %
Synchronization range	45 -65 Hz
Distortion factor	$\leq$ 3 % at linear load
Crest factor	$\leq$ 2,5
Performance factor	0,5 ind. - 1 - 0,5 kap.
Overstressing	160 % for 1 minute, 130 % for 10 min without cutoff
Short circuit behavior	Constantly short-circuit proof 2 - 2,5 x I_{Nom} für ca 2,5 s
Parallel operation	max 12 pieces, load distribution approx. 5 % I_{Nom}

Ambient conditions

Ambient temperature	Operation - 10 °C at + 40 °C Storing - 30 °C up to + 50 °C
Ambient conditions	IEC 721 - 3 - 3 class 3K3 / 3Z1 / 3B1 / 3C2 / 3S2 / 3M2
Humidity class	F
Position height	$\leq$ 1000 m over NN

General information

Noise level	< 40 dB (A) at1 m distance
Cooling	Air blast cooling (revolution controlled) with temperature control
Cooling at 500 VA	Convection cooling
Design	19“ complete insertion with connectors on the backside
Protection class	IP 20 / class 1
Lacquering	RAL 7032 front plate, anodized casing
Security	EN 60950 , VDE 0100 part 410 , VDE 110 , EN 50178, EN 60146
Emitted interference	EN 55011 / EN 55022 limit value class "B"
Interference resistance	EN 61 000 - 4 part 2 - 5

Inverters type: UNV-C 1,2 - 2,5 KVA

GENERAL PRODUCT INFORMATION

Inverters of the series UNV distinguish themselves through the application of modern switching topologies combined with a well-engineered 19”-compatible slide-in modus
The devices are ideally applicable to the low and middle performance range as AC-power supply in the areas of telecommunication, industry and rail current supply.

Through the combination of high-frequency isolated transformers galvanically isolated from input and output, UNV-inverted rectifiers are applicable in a very flexible, efficient and reliable way. The standard parallel switching of the modules offers highest flexibility at the realization of power supply with higher performance in connection with a (n+1)- redundancy.

UNV-inverted rectifiers are prepared for both, the one-on-one operation as well as for the application with an electronic change-over facility (UNB) and for additional controlling units. Remote monitoring and parameter query are realized through the CAN interface. Each inverter offers a fully functional range, also at one-on-one operation.

The inverters of the series UNV distinguish themselves through:

- Active input filter to reduce the psoph. waviness according to CCITT-A
- Large input voltage range
- User-friendly 19“ - system, „Hot-Plug-In“-ability
- Excellent efficiency and a very good dynamic behaviour
- High power density, low weight
- Parallel- and also three-phase-operation possible
- Digital displays to show all relevant device parameters
- CAN-interface

STANDARD CONFIGURATION

LED-Display	Operation, U_{OFF}, U_{ON}>, U_{ON}<, overload, over temperature, collective failure
Digital display	2 x 3 Digits, output voltage, output current, frequency, input voltage, input current, temperature, output real power, output idle power, cos j
Signal contacts	Potential-free collective failure
Protection fuse	Mechanic coupled input and output MCB, input under voltage cut-off, input over voltage cut-off, over temperature cut-off, overload / short-circuit cut off
External synchronization	Parallel operation and switching as a three-phase-system without additional complements or defined master possible.
Micro-processor monitoring / controlling	Programmable control and protection fuse for all system parameters configuration through frontal keyboard and digital display
Communication	CAN-interface for communication with electronic change over facility UNB

Inverters type: UNV-C 1,2 - 2,5 KVA

TYPES

Type	UNVx-1.2C	UNVx-1.8C	UNVx-2.5C
Rated voltage input (x)	48V / 60V / 108V	48V / 60V / 108V	48V / 60V / 108V
Rated voltage output	230V 50Hz	230V 50Hz	230V 50Hz
Output rating at cos phi = 0,8	**1200 VA**	**1800VA**	**2500VA**
Rated current	5,2 A	7,8 A	10,9 A
Weight	8,5 kg	12,5 kg	13 kg
Measurements (BxHxT) mm	142x262x285	142x262x405	142x262x405
Category	Primary synchronized inverter in HF-Technology		

TECHNICAL INFORMATION

Performance cos phi = 0,8	**1200 VA**	**1800 VA**	**2500 VA**
DC voltage input			
At 48 V (42-75V) / rated current	22,7 A	34 A	47 A
At 60 V (42-75V) / rated current	18,2 A	27,2 A	37,6 A
At 108 V (77-138V) / rated current	9,8 A	14,7 A	20,4 A
Fuse protection	MCB 1 - pole	MCB 1- pole	MCB 1 -pole

Efficiency	$\geq$ 90 %
Switch-on current	$\leq$ rated current
Input noise voltage	< 1,8 mV psophometric (CCITT A - filter)

Output signal voltage

Rated voltage	230 V sinusoidal
Voltage range	200 - 252 V adjustable
Offset	$\pm$ 0,5 % static
Transient time	$\leq$ 0,3 at load changes von 10 - 90 - 10 %
Frequency	50 or 60 Hz programmable
Synchronization range	45 -65 Hz
Distortion factor	$\leq$ 2 % at linear load
Crest factor	$\leq$ 3
Performance factor	0,5 ind. - 1 - 0,5 cap. ampliation possible
Overstressing	130 % for 1 minute
Short circuit behaviour	Constantly short-circuit-proof - 3x I_{Nom} for 2,5 s

Ambient conditions

Ambient temperature	Operation - 10 °C up to + 40 °C Storing - 30 °C up to + 50 °C
Ambient conditions	IEC 721 - 3 - 3 class 3K3 / 3Z1 / 3B1 / 3C2 / 3S2 / 3M2
Humidity class	F
Position height	$\leq$ 1000 m over NN

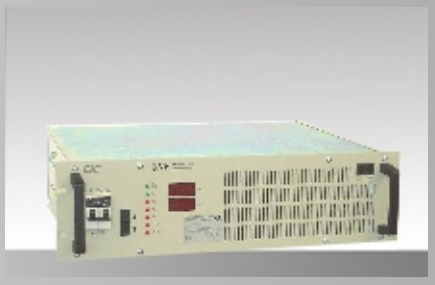
General information

Noise level	< 40 dB (A) at 1 m distance
Cooling	Air blast cooling (revolution controlled) with temperature control
Design	1/3 19“ part insertion (6 HE) for installation into the rack according to DIN 41496, with front connectors
Protection class	IP 20 / class 1
Lacquering	RAL 7032 front plate, anodized casing
Security	EN 60950 , VDE 0100 part 410 , VDE 110 , EN 50178, EN 60146
Emitted interference	EN 55011 / EN 55022 limit value class "B"
Interference	EN 61 000 - 4 part 2 - 5

Inverter type: UNV-F 1,2 - 5 KVA

GENERAL PRODUCT INFORMATION

Inverters of the series UNV distinguish themselves through the application of modern switching topologies combined with a well-engineered 19”-compatible slide-in modus
The devices are ideally applicable to the low and middle performance range as AC-power supply in the areas of telecommunication, industry and rail current supply.



Through the combination of high-frequency isolated transformers galvanically isolated from input and output, UNV-inverted rectifiers are applicable in a very flexible, efficient and reliable way. The standard parallel switching of the modules offers highest flexibility at the realization of power supply with higher performance in connection with a (n+1)- redundancy.

UNV-inverted rectifiers are prepared for both, the one-on-one operation as well as for the application with an electronic change-over facility (UNB) and for additional controlling units. Remote monitoring and parameter query are realized through the CAN interface. Each inverter offers a fully functional range, also at one-on-one operation.

The inverters of the series UNV distinguish themselves through:

- Active input filter to reduce the psoph. waviness according to CCITT-A
- Large input voltage range
- User-friendly 19“ - system, „Hot-Plug-In“-ability
- Excellent efficiency and a very good dynamic behaviour
- High power density, low weight
- Parallel- and also three-phase-operation possible
- Digital displays to show all relevant device parameters
- CAN-interface

STANDARD CONFIGURATION

LED-Display	Operation, U_{OFF}, U_{ON}>, U_{ON}<, overload, over temperature, collective operational fault
Digital Display	2 x 3 Digits, output voltage, output current, frequency, input voltage, input current, temperature, output real power, output reactive power , cos j
Signal contacts	Potential-free collective operational fault
Protection fuste	Mechanically coupled input and output-MCB, input undervoltage switch-off,, input overvoltage shutoff, over temperature shutoff, over load-/short-circuit shutoff
External synchronization	Parallel operation and switching mechanism as a three-phase-system without additional components or defined master possible.
Microprocessor monitoring / control	Programmable control and protection for all system parameters, configuration through front keyboard and digital display
Communication	CAN-interface for communication with electronic switching device UNBg UNB

Inverters type: UNV-F 1,2 - 5 KVA

TYPES

Type	UNVx-1.2F	UNVx-1.8F	UNVx-2.5F	UNVx-3.3F	UNVx-5.0F
Rated voltage input (x)	48V / 60 / 108V	48V / 60 / 108V	48V / 60 /108V	48V / 108V	48V / 108V
Rated voltage output	230V 50Hz	230V 50Hz	230V 50Hz	230V 50Hz	230V 50Hz
Output rating at cos phi = 0,8	**1200 VA**	**1800VA**	**2500VA**	**3300VA**	**5000VA**
Rated current	5,2 A	7,8 A	10,9 A	14,3 A	**21,7**
Weight	10 kg	18 kg	22 kg	27 kg	38 kg
Measurements (BxHxT) mm	483x133x360	483x133x360	483x133x360	483x133x360	483x133x400
Category	Primary synchronized sinus inverter in HF-technology				

TECHNICAL INFORMATION

Performance cos phi = 0,8	**1200 VA**	**1800 VA**	**2500 VA**	**3300 VA**	**5000 VA**
DC voltage input					
At 48 V (42-75V) / rated current	22,7 A	34 A	47 A	62 A	94 A
At 60 V (42-75V) / rated current	18,2 A	27,2 A	37,6 A	49,6 A	75,2 A
At 108 V (77-138V) / rated current	9,8 A	14,7 A	20,4 A	27 A	41 A
Fuse protection	MCB1- anodized	MCB1-anodized	MCB1-anodized	MCB1-nodized	external

Efficiency ≥ 90 %
Switch-on current ≤ rated current
Input noise voltage < 1,8 mV psophometric (CCITT A - filter)

Output signal voltage

Rated voltage 230 V sinusoidal
Voltage range 200 - 252 V adjustable
Offset ± 0,5 % static
Transient time ≤ 0,3 ms bei load changes von 10 - 90 - 10 %
Frequency 50 oder 60 Hz programmable
Synchronization range 45 -65 Hz
Distortion factor ≤ 2 % at linear load
Crest factor ≤ 3
Performance factor 0,5 ind. - 1 - 0,5 cap. Ampliation possible
Overstressing 130 % for 1 minute
Short circuit behaviour Constantly short-circuit-proof - 3x I_{Nom} forr 2,5 s

Ambient conditions

Ambient temperature Operation - 10 °C up to + 40 °C
Storing - 30 °C up to + 50 °C
Ambient conditions IEC 721 - 3 – 3 class 3K3 / 3Z1 / 3B1 / 3C2 / 3S2 / 3M2
Humidity class F
Position height ≤ 1000 m over NN

General information

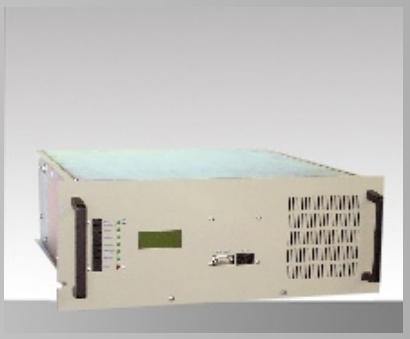
Noise level < 40 dB (A) at 1 m distance
Cooling Air blast cooling (revolution-controlled) with temperature controlhung
Design 19 " Complete insertion (6 HE) for installation into the rack
Acc. to DIN 41496, with front connectors
Protection class IP 20 / class 1
Lacquering RAL 7032 front plate, anodized casing
Security EN 60950 , VDE 0100 Teil 410 , VDE 110 , EN 50178, EN 60146
Emitted interference EN 55011 / EN 55022 limit value class "B"
Interference EN 61 000 - 4 part 2 - 5

Electronic changeover facility type: UNB 5- 40 KVA

GENERAL PRODUCT INFORMATION

Electronic changeover facilities of the type range UNB distinguish themselves through the application of most modern
Micro control technique for the control and synchronization combined with a multifunctional 19“-compatible slide-in modus.

These modular devices are appliable in the performance range up to 40kVA in UNV- and PWS-inverter systems to increase the availability in the areas of power supply for telecommunication, industry and railway.



The microprocessor controlled mains synchronisation guarantees the synchronized operation of the inverters in both, the one-on-one and the parallel operation. The current availability of the connected inverters is constantly controlled. All control functions and system parameters can be shown in an especially user-friendly way through the front keyboard and the alpha numeric display.

The electronic changeover facilities distinguish themselves through:

- Large synchronization range possible
- User-friendly 19“-system, „Hot-Plug-In“-ability
- Parameter recitation of all power supply modules through CAN-Bus
- Text display to show measurements and parameters
- Optimized mains synchronization
- Applicable in inverter-systems up to 40 kVA

STANDARD CONFIGURATION

LED-Display	Operation, source 1 available, source 2 available, synchronization, load on the inverter, load on the mains, collective operational fault
Control	Source 1 and source 2 with switching of the load, synchronization, over temperature and air failure
Alpha numeric display	LCD, 16x4 signs, with background lighting
Signal contact	Potential-free collective operational fault signal
Micro processor monitoring / control	Programmable control functions for all system parameters, configuration through front keyboard and clear-text display
Communication	CAN-Interface to communicate with the inverter UNV

Electronic changeover facility type: UNB 5- 40 KVA

TYPES

Type	UNB 5.0-x	UNB 12.5-x	UNB 23.0-x	UNB 40.0-x
Rated voltage input (x)	24V/48V/60V/108V/216V	24V/48V/60V/108V/216V	24V/48V/60V/108V/216V	24V/48V/60V/108V/216V
Rated voltage output	220/230/240 V	220/230/240 V	220/230/240 V	220/230/240 V
Output rating	**5 KVA**	**12,5 KVA**	**23 KVA**	**40 KVA**
Weight	10 kg	10,5 kg	12 kg	15 kg
Measurements (BxHxT) mm	483x133x360	483x133x360	483x177x460	483x177x460

TECHNICAL INFORMATION

AC voltage input (Bypass)

Rated voltage	220 / 230 / 240 V adjustable
Voltage allowance	± 20 %
Frequency	47 - 53 respectively 57 - 63 Hz switchable
Efficiency	≥ 99 %

AC voltage output

Rated voltage	220 / 230 / 240 V adjustable
Switching waves	± 5 %... ± 20 % adjustable
Frequency	47 -53 respectively 57 - 63 Hz switchable
Overstressing	1000 % für 10 ms
Switching time	≤ 3 ms
Security	External with rated current, Characteristic gL

Battery rated voltage

Type programme	24 V / 48 V / 108 V / 216 V
External fuse protection	24-60 V -> 2 A gL, 108 / 216 V -> 1 A gL

Ambient conditions

Ambient temperature	Operation - 10 °C up to + 40 °C Storing - 30 °C up to + 50 °C
Ambient conditions	IEC 721 - 3 – 3 class 3K3 / 3Z1 / 3B1 / 3C2 / 3S2 / 3M2
Humidity class	F
Position height	≤ 1000 m over NN

General information

Noise level	< 40 dB (A) at 1 m distance
Cooling	Air blast cooling (revolution-controlled) with temperature control
Cooling at 500 VA	Convection cooling
Design	19“ complete slide in with connectors at the backside
Protection fuse	IP 20 / class 1
Lacquering	RAL 7032 front plate, anodized casing
Security	EN 60950 , VDE 0100 part 410 , VDE 110 , EN 50178, EN 60146
Emitted interference	EN 55011 / EN 55022 limit value class "B"
Interference	EN 61 000 - 4 part 2 - 5

DC/DC - Convertor Type: PSC 06 - 600W

GENERAL PRODUCT INFORMATION

DC/DC – convertors of the range PSC distinguish themselves through the application of most modern switching topologies combined with well-engineered 19“-compatible slide-in mechanics.

The devices are applicable in the lower performance range in the following sectors:

As a secured DC-power supply in stand-by parallel operation of convertor and battery
Direct feeding of DC-users
Telecommunication and information technique
Rail-signal technique
Process control technique of the chemical industry
Monitoring e.g. in low voltage equipment, home requirement equipment for power plants and
Transformer stations
Rail vehicles and vessels
Industry

Through an advanced switching concept the devices are provided with a wide range of input voltage, low power loss and a very low construction volume.

Output voltage changes through load changes or input voltage changes are ex-regulated within best time. The output is constantly short-circuit proof through a constant current regulation.

STANDARD CONFIGURATION

LED alarm indication	Input voltage O.K. (green); I_A (yellow); U< (green); U> (red); alarm (red)
Digital display	Output current, output voltage
Relay contacts	Accummulative alarm
Signal contacts / external functions	Potential-free collective operational fault and message U< Measurement connection for active current breakdown Strong charging; temperature compensated charging voltage regulation External sensor lead for output voltage; external ON / OFF message through octocoupler U_A available and constant current operation

DC/DC - Convertor Type: PSC 06 - 600W

TYPES

Type	PSC06/x/24-20	PSC06/x/48-10	PSC06/x/60-8.2	PSC06/x/110-4.5
Rated voltage input (x)	110V / 220V	110V / 220V	110V / 220V	110V / 220V
Rated voltage output	**24 V**	**48V**	**60V**	**110V**
Output rating	**20 A**	**10 A**	**8,2 A**	**4, 5 A**
Weight	71x262x285	71x262x285	71x262x285	71x262x285
Measurements (BxHxT) mm	5,3 Kg	5,3 Kg	5,3 Kg	5,3 Kg
Type	Primary synchronized DC / DC - Convertor			

TECHNICAL INFORMATION

Gs-rated voltage	**24 V**	**48 V**	**60 V**	**110 V**
Characteristic curve U_{A1} ± 1% / conservation charging	27,2 V	54,5 V	68,1 V	122,6 V
adjustable	23,4 -28,8 V	46,6 - 57,6 V	58,5 - 72 V	105 - 130 V
Characteristic curve U_{A2} ± 1 % / Strong charging	28,8 V	57,6 V	72,0 V	129,6 V
adjustable	24 - 30 V	48 - 60 V	60 - 73 V	108 - 135 V
Gs – rated current ± 2 %	20 A	10 A	8,2 A	4,5 A
adjustable	10 - 20 A	5 - 10 A	4,1 - 8,2 A	2,3 - 4,5 A

AC voltage input

Rated voltage 1	110 V DC + 15 / - 20 %
Rated voltage 2	220 V DC + 15 / - 20 %
Rated current	at 110 V 4,9 A / at 220 V 2,5 A
Efficiency	88%
Security	at 110 V 10 A gL / at 220 V 6 A gL

AC voltage output

Charging characteristic curve	IU according to DIN 41772 / DIN 41773
Voltage waviness	20 mV_{SS}
Noise potential according to CCITT	At 24 V - 1 mV_{eff} / at 48 - 110 V - 1,8 mV_{eff}
Dynamic performance	< 3 % at cond. Jump load changes
	10 % - 90 % - 10 % I_{Nom}, transient time ≤ 1ms
Short-circuit performance	Constantly short-circuit-proof 1 x I_{Nom}
Parallel operation	< 100 load breakdown ± 10%

Ambient conditions

Ambient temperature	Operation - 10 °C up to + 40 °C
	Storing - 30 °C up to + 50 °C
Ambient conditions	IEC 721 - 3 - 3 class 3K3 / 3Z1 / 3B1 / 3C2 / 3S2 / 3M2
Humidity class	F
Position height	< 1000 m over NN

General information

Noise level	< 40 dB (A) at 1 m distance
Cooling	Convection cooling
Design	1/6 19" partial insertion (6 HE) for integration into the rack
	According to DIN 41496 , front plug connection
Protection class	IP 20 / class 1
Lacquering	RAL 7032 front plate, anodized casing
Security	EN 60950 , VDE 0100 Teil 410 , VDE 110 , EN 50178
	EN 60146
Emitted interference	EN 55011 / EN 55022 limit value class "B"
Interference	EN 61 000 - 4 part 2 - 5

DC/DC - Convertor Type: PSC 18 - 1800W

GENERAL PRODUCT INFORMATION

DC/DC – convertors of the range PSC distinguish themselves through the application of most modern switching topologies combined with well-engineered 19“-compatible slide-in mechanics.

Through an advanced switching concept the devices are provided with a wide range of input voltage, low power loss and a very low construction volume.

Output voltage changes through load changes or input voltage changes are ex-regulated within best time. The output is constantly short-circuit proof through a constant current regulation.

All device parameters can be applicated in a user-friendly way at display of the current value in the digital display through the front keyboard. The intern micro processor controls and signalizes the condition of the mains voltage, the output voltage as well as the device temperature.

As a standard configuration, the devices are equipped with a CAN-interface, through which the communication and monitoring via our monitoring- and control unit MU1000C can take place.

Die DC/DC-converters distinguish themselves through:

- „Hot-Plug-In“-ability
- 1/3-19“-System
- Temperature-conducted charging voltage regulation
- Digital display of the output voltage/-current and adjustment parameters
- CAN-interface

STANDARD CONFIGURATION

LED-Alarm indication	Input voltage O.K. (green); U_{A1} (green); U_{A2} (green); I_A (yellow); U< (green); U> (red); alarm (red)
Digital display	Output current, output voltage
Relay contacts	„Collective alarm“ and „U_A<“
Control displays	Output voltage, output current, output overstressing, output undervoltage, short-circuit
Signal contacts	Potential-free collective operational fault and message U<
External functions	Measurement connection for active current breakdown, discharging probe/ strong charging; remote control monitored ON / OFF function, temperature compensated charging voltage regulation, external sensor lead for output voltage; message on octocoupler U_A available, “mains available” and “constant current operation”
Communication	CAN-interface for communication with superior control unit

DC/DC - Convertors Type: PSC 18 - 1800W

TYPES

Type	PSC18/x/24-40	PSC18/x/48-30	PSC18/x/60-25	PSC18/x/110-13,4	PSC18/x/2200-6,7
Nominal voltage input (x)	110V / 220V	110V / 220V	110V / 220V	110V / 220V	110V / 220V
Nominal voltage output	**24 V**	**48V**	**60V**	**110V**	**220V**
Nominal current	**40 A**	**30 A**	**25 A**	**13,4 A**	**6,7 A**
Measurements (BxHxT)mm	142x262x285	142x262x285	142x262x285	142x262x285	142x262x285
Weight	7,6 Kg	7,6 Kg	7,6 Kg	7,6 Kg	7,6 Kg
Category	Primary synchronized DC / DC - convertors				

TECHNICAL INFORMATION

Gs-nominal voltage	24 V	48 V	60 V	110 V	220 V
Charge line U_{A1} ± 1% (equalize charge)	27,2 V	54,5 V	68,1 V	122,6 V	245,2 V
adjustable	23,4 -28,8 V	46,6 - 57,6 V	58,5 - 72 V	105 - 130 V	211 - 260 V
Charge line U_{A2} ± 1 % / (bost charge)	28,8 V	57,6 V	72,0 V	129,6 V	259,2 V
adjustable	24 - 30 V	48 - 60 V	60 - 73 V	108 - 135 V	216 - 270 V
Charge line U_{A3} ± 1% / (battery test)	22,2 V	44,4 V	55,5 V	99,9 V	200 V
ajustable	20,4 - 24 V	40,8 - 48 V	51 - 60 V	91,8 - 108 V	184 - 216 V
Gs – nominal current ± 2 %	40 A	30 A	25 A	13,4 A	6,7 A
adjustable	20 - 40 A	15 - 30 A	12,5 - 25 A	6,7 - 13,4 A	3,4 - 6,7 A
DC input +15 / -20 %					
At 110 V / nominal current	9,8 A	14,5 A	15,2 A	14,9 A	14,9 A
At 220 V / nominal current	4,9 A	7,3 A	7,6 A	7,4 A	7,4 A

Efficiency	90 - 91 %
Fusing	16 A gL

DC output

Charge line characteristic	IU acc. to DIN 41772 / DIN 41773
Voltage ripple	20 mV_{SS}
Psophometric ripple	at 24 V - 1 mV_{eff} / at 48 - 220 V - 1,8 mV_{eff}
Dynamic behaviour	< 3 % for load transients
	10 % - 90 % - 10 % I_{Nom}, recovery time t ≤ 1ms
Short circuit protection	Constantly short circuit proof 1 x I_{Nom}
Parallel operation	< 100 load sharing ± 10%

Environmnet

Ambient temperature	Operation - 10 °C to + 40 °C
	Storage - 30 °C to + 50 °C
Climatic conditions	IEC 721 - 3 - 3 class 3K3 / 3Z1 / 3B1 / 3C2 / 3S2 / 3M2
Humidity class	F
Altitude	< 1000 m a.s.i.

General information

Audible noise	< 40 dB (A) in 1 m distance
Cooling	Air blast cooling (revolution controlled)
Construction	1/3 19" partial insertion (6 HE) for integration into the rack
	acc. to DIN 41496 , front connectors
Protection class	IP 20 / class 1
Surface	RAL 7032 front panel, anodised housing
Safety	EN 60950 , VDE 0100 part 410 , VDE 110 , EN 50178
	EN 60146
EMC	EN 55011 / EN 55022 class "B"
Interference immunity	EN 61 000 - 4 part 2 - 5

DC/DC - Convertor Type: PSC 30 - 3000W

GENERAL PRODUCT INFORMATION

DC/DC – convertors of the range PSC distinguish themselves through the application of most modern switching power conversion technology combined with well-engineered 19“-compatible slide-in mechanic.

Due to an advanced switching concept the devices provide a wide input voltage range, high efficiency, small dimensions and a low weight.

A constant voltage and current control circuit performs correction of output voltage deviations due to input voltage or load transients within best time and permits constant current operation down to continuous short circuit.

A microcontroller unit with two control keys and digital displays on the front panel provides continuous monitoring of input and output voltage, output current and temperature, and offers easy adjustment and programming of output parameters and monitoring thresholds.

An optional CAN-bus interface allows remote control of output voltage and current from real time transmission of all parameters and measurement values to central supervisory unit (MU1000C).

Die DC/DC-convertors distinguish themselves due to the following features:

- Flexible 1/3-19“-system „Hot-Plug-In“
- Temperature compensation of the charge voltage
- Digital display for output voltage, current and adjustment values
- CAN-bus interface

STANDARD CONFIGURATION

LED indicators	Input voltage O.K. (green); U_{A1} (green); U_{A2} (green); I_A (yellow); U< (grün); U> (red); alarm (red)
Digital display	Output voltage, output current
Relay contacts	„General fault“ and „U_A<“
Monitoring	Output voltage, output current, output over voltage, output under voltage, short circuit
External functions	Active current sharing, boost charge and battery test function, temperature compensation of charge voltage, external sense links for output voltage, remote ON/OFF, optocoupler signal „U_A O.K. , “mains O.K.” and “constant current operation”
Communication	CAN-bus interface for communication with central monitoring unit (MU1000C, optional)

DC/DC - Convertors Type: PSC 30 - 3000W

TYPES

Type	PSC30/x/24-80	PSC30/x/48-50	PSC30/x/60-40	PSC30/x/110-22,3	PSC30/x/220-11,1
Nominal voltage input (x)	110V / 220V	110V / 220V	110V / 220V	110V / 220V	110V / 220V
Nominal voltage output	**24 V**	**48V**	**60V**	**110V**	**220V**
Nominal current	**80 A**	**50 A**	**40 A**	**22,3A**	**11,1 A**
Measurements (BxHxT) mm	142x262x405	142x262x405	142x262x405	142x262x405	142x262x405
Weight	12,4 Kg	12,4 Kg	12,4 Kg	12,4 Kg	12,4 Kg
Category	Primary switched rectifier				

TECHNICAL INFORMATION

Gs-nominal voltage	**24 V**	**48 V**	**60 V**	**110 V**	**220 V**
Charge line U_{A1} ± 1% / (equalize charge)	27,2 V	54,5 V	68,1 V	122,6 V	245,2 V
adjustable	23,4 -28,8 V	46,6 - 57,6 V	58,5 - 72 V	105 - 130 V	211 - 260 V
Charge line U_{A2} ± 1 % / (boost charge)	28,8 V	57,6 V	72,0 V	129,6 V	259,2 V
adjustable	24 - 30 V	48 - 60 V	60 - 73 V	108 - 135 V	216 - 270 V
Charge line U_{A3} ± 1% / (battery test)	22,2 V	44,4 V	55,5 V	99,9 V	200 V
adjustable	20,4 - 24 V	40,8 - 48 V	51 - 60 V	91,8 - 108 V	184 - 216 V
Gs – nominal current ± 2 %	80 A	50 A	40 A	22,3 A	11,1 A
adjustable	40 - 80 A	25 - 50 A	20 - 40 A	11 - 22,3 A	5,5 - 11,1 A
DC input +15 / -20 %					
At 110 V / nominal current	20,1 A	24,2 A	24,3 A	24,8 A	24,7 A
At 220 V / nominal current	10,1 A	12,2 A	12,2 A	12,4 A	12,3 A

Efficiency	at 24 V > 87 % / at 48 V - 216 V > 91 %
Fusing	at 110 V input 40 A gL / at 220 V input 25 A gL

DC output

Charge line characteristic	IU acc. to DIN 41772 / DIN 41773
Voltage ripple	20 mV_{SS}
Psophometric ripple	at 24 V - 1 mV_{eff} / at 48 - 220V - 1,8 mV_{eff}
Dynamic behaviour	< 3 % for load transients
	10 % - 90 % - 10 % I_{Nom}, recovery time t ≤ 1ms
Short circuit protection	Constantly short circuit proof 1 x I_{Nom}
Parallel operation	< 100 load sharing ± 10%

Environment

Ambient temperature	Operation - 10 °C to + 40 °C
	Storage - 30 °C to + 50 °C
Climatic conditions	IEC 721 - 3 – 3 class 3K3 / 3Z1 / 3B1 / 3C2 / 3S2 / 3M2
Humidity class	F
Altitude	< 1000 m over NN

General Information

Audible noise	< 40 dB (A) in 1 m distance
Cooling	Air blast cooling (revolution controlled)
Construction	1/3 19" partial insertion (6 HE) for integration into the rack
	acc. to DIN 41496 , front connectors
Protection class	IP 20 / class 1
Surface	RAL 7032 front panel, anodized housing
Safety	EN 60950 , VDE 0100 part 410 , VDE 110 , EN 50178
	EN 60146
EMC	EN 55011 / EN 55022 class "B"
Interference immunity	EN 61 000 - 4 part 2 - 5

Monitoring unit type: MU 1000C

GENERAL PRODUCT INFORMATION

The monitoring, controlling and signalling unit MU 1000C is applicable especially to power supply systems with combined battery backup. Together with CAN-bus connected PSR- and PSS rectifiers all main system parameters can be controlled and indicated. Battery monitoring and test, boost charge controlling, earth fault monitoring, low battery voltage protection (contactor controlling), analogue measuring inputs for three DC voltages and three DC currents, with temperature compensation of the charge voltage, 9 digital inputs and parameter programming via RS232 interface and PC are examples of the extensive standard functions.

In order to monitor and control PSR- and PSS-rectifier modules, the MU 1000C uses a CAN-bus interface. No money and time wasting in the wiring of signalling contacts within the power supply system and between single modules anymore. The output measuring values and the operation state of all CAN-bus connected rectifiers, DC/DC-converters and inverters are shown in the alphanumeric display.
The digital inputs of the unit can be used for monitoring of internal or external signal contacts (for example fuse monitoring). The reading of all inputs is individually programmable.
Different relay outputs (with extension board MU1000C-I/O in total 10) are available for remote signalling of single or general faults. Single faults and their connections can be assigned to each relay output. In addition to internal text messages various front side LED's indicate the state of main system parameters (2 LED's are free programmable).
For remote control and maintenace a modem interface is available (optional). In case of system faults the modem automatically calls to a pre-programmed phone number to send a fault message direct to the system operator.

STANDARD CONFIGURATION

Alphanumeric display	LCD, 2x16 characters, rear illuminated
LED - Signale	Operating, $U>U_{min}$, $U>U_{max}$, isolation fault, S1/S2 (free programmable LEK indications), alarm A (general fault, urgent alarm), alarm B (free programmable linkage of single faults, non urgent alarm)
Relay outputs	4 relay contacts, error messages free programmable, extension to 10 free programmable relays (Option: MU1000C-I/O)
Configuration/interfaces	RS232-interface, CAN-interface
Communication	CAN-bus interface for communication with PSS/PSR-rectifier modules, UNV-inverter modules and UNB modules, RS232 interface for remote modem control (optional) and programming of all functions and parameters via PC via PC
Functions	Boost charge controlling (current, voltage and time dependent), battery test
Microprocessor controlling	Programmable monitoring functions with history function, real time clock, , device parameters via front keays and alphanumeric display
Languages	German, English, Swedish, Italian, Polish, Russian, Hungarian

Monitoring unit: MU 1000C

TYPES

Type	*MU1000C-I*	*MU1000C-II*
Input voltage	18-80 V	80-300 V
Measuring voltage	18-80 V	80-300 V
Dimensions (BxHxT) mm	142x129x70	142x129x70
Power consumption	3 W	3 W
Category	Microprocessor based controlling monitoring and signaling unit	

TECHNICAL INFORMATION

ANALOGUE MEASURING INPUTS

Voltage inputs	3 accuracy 1%; 3 x mains voltage and frequency (with option MU 1000C-MM only) temperature in case of connected temperature sensor
Current inputs	3 (1 x 60 mV for battery charge / discharge current measurement; (2 x 60 mV) 3 x mains current
Temperature input	1 (for connection with temperature sensor CM335)
PE - connector	1 (isolation fault)

DIGITAL MEASURING INPUTS

Signaling inputs	8 (free programmable)

ENVIRONMENT

Ambient temperature	Operation: -10°C to +40°C Storage: -30°C bis +50°C
Climatic conditions	IEC 721-3-3 class 3K3/3Z1/3B1/3C2/3S2/3M2
Humidity class	F
Altitude	≤1000 m over NN, extension possible
Audible noise	< 40 dB (A) in 1 m distance

MECHANICAL CONSTRUCTION

Construction	Built-in module for front panel mounting, rear sideconnectors
Weight	Approx. 1 kg
Protection class	IP20 (mech.); 1 nach EN 60950 (electr.)
Surface	Front panel RAL 7032

COMPLIANCES

Certification	CE-mark
Safety	EN 60950; VDE 0100 part 410; VDE 0110, EN 50178, EN 60146
EMV	EN 55022 class „B“, EN 61000-4 part 2-5

Options:

Temperature sensor CM335 with 2m cable and cable shoe

Software MU1000C-configurator for parametry

Extension board MU1000C-MM for 1-phase or 3-phase mains controlling (voltage, frequency and current), IP00

Extension board MU1000C-I/O for 6 additional potential-free outputs and 8 digital inputs (free programmable), IP20

Extension board MU1000C-BM for 2nd 3rd battery circuit (battery voltage, unsymmetry measuring, and battery charge/discharge current), IP20

MU1000C-CM; software modem, module incl. V90 modem for data transfer

MU1000C-NM; network interface for direct connection to an ethernetwork for remote maintenance

CAN distribution board, board with 5 CAN stockets for connection to power supply modules in the cabinet

Built-in panel 19" x 3HE or 1/3-19" x 6HE

Monitoring unit type: MU 2000C

GENERAL PRODUCT INFORMATION

The monitoring, controlling and signalling unit MU2000C is applicable especially to power supply systems with combined battery backup. Together with CAN-bus connected PSR- and PSS-rectifiers all main system parameters can be controlled and indicated. Battery monitoring and test, boost charge controlling, earth fault monitoring, low battery voltage protection (contactor controlling), analogue measuring inputs for three DC voltages and three DC currents, with temperature compensation of the charge voltage, 8 digital inputs and parameter programming via RS232 interface and PC are examples of the extensive standard functions .
In order to monitor and control PSR- and PSS-rectifier modules the MU2000C uses a CAN-bus interface. No money and time wasting in the wiring of signalling contacts within the power supply system and between single modules anymore. The output measuring values and the operation state of all CAN-bus connected rectifiers, DC/DC-converters and inverters are shown in the alphanumeric display.
The digital inputs of the unit can be used for monitoring of internal or external signal contacts (for example fuse monitoring). The reading of all inputs is individually programmable. Different relay outputs (with extension board MU2000C-I/O in total 10) are available for remote signalling of single or general faults. Single faults and their connections can be assigned to each
relay output. In addition to internal text messages various front side LED's indicate the state of main system parameters (2 LED's are free programmable).
For remote control and maintenance a modem interface is available (optional). In case of system faults the modem automatically calls to a pre-programmed phone number to send a fault message direct to the system operator.

STANDARD CONFIGURATION

Alphanumeric display	LCD, 2x32 characters, rear illuminated
LED indications	operating, alarm A.alarm B,U<Umin, U>Umax, T>T, isolation fault, collective fault Signal 1-3 (free programable) can communication
Relay outputs	4 relay contacts, error Messages free programmable, extension to 10 free programmable relays (with option: MU2000C-I/O)
Configuration / interfaces	RS232 interface, CAN interface
Communication	CAN-bus interface for communication with PSS/PSR-rectifier modules, UNV –inverter modules and UNB modules RS232 interface for remote modem control (optional) and programming via PC SNMP via Ethernet
Functions	boost charge controlling (current-, voltage– and time dependent) battery test (voltage– and time dependent) controlling of voltage drop-down diodes; battery low protection battery midpoint voltage monitoring 2x isolation fault monitoring Free programmable threshholds as written message
Microprocessor controlling	programmable monitoring functions with history function, real time clock, device parameters via front keys and alphanumeric display
Languages	German, English,

Monitoring unit type: MU 2000C

TYPES

Type	*MU2000C-I*	*MU2000C-II*
Input voltage	18-80 V	80-300 V
Measuring voltage	18-80 V	80-300 V
Dimensions (BxHxT) mm	483x45x120	483x45x120
Power consumption	3 W	3 W
Category	Microprocessor based controlling monitoring and signaling unit	

TECHNICAL INFORMATION

ANALOGUE MEASURING INPUTS

Voltage inputs	8 accuracy 1% 3 x mains voltage and frequency (with option MU2000C-MM only) temperature in case of connected temperature sensor
Current inputs	4 (1 x ± 60 mV) 3 x mains current (option MU2000C-MM)
Temperature input	3 (for connection with temperature sensor LM335)
PE - connector	2 isolation fault

DIGITAL MEASURING INPUTS

Signalling inputs	8 (free programmable indication with definition)

ENVIROMENT

Ambient temperature	Operation: -10°C to +40°C Storage: -30°C to +50°C
Climatic conditions	IEC 721-3-3 class 3K3/3Z1/3B1/3C2/3S2/3M2
Humidity class	F
Altitude	≤ 1000 m a.s.l., extension possible
Audible noise	< 30 dB (A) in 1 m distance

MECHANICAL CONSTRUCTION

Construction	built-in module for front panel mounting, rear side connectors
Dimensions W / H / D (mm)	483 / 45 / 120
Weight	appr. 3 kg
Protection class	IP20 (mech.); 1 acc. to EN 60950 (electr.)
Surface	front panel RAL 7032

COMPLIANCES

Certification	CE-mark
Safety	EN 60950; VDE 0100 part 410; VDE 0110, EN 50178, EN 60146
EMC	EN 55022 class „B“, EN 61000-4 part 2-5

Options:

Temperature sensor LM335 with 2 m cable and cable shoe

Software MU2000C-configurator for parametry

Extension board MU2000C-MM for 1-phase or 3-phase mains controlling (voltage, frequency and current), IP00

Extension board MU2000C-I/O for 6 additional potential-free outputs and 8 digital inputs (free programmable), IP20

Extension board MU2000C-BM for 2nd and 3rd battery circuit (battery voltage, unsymmetry measuring, and battery charge/discharge current), IP20

MU2000C-CM, software modem, module incl. V90 modem for data transfer

MU2000C-SNMP, network interface for direct connection to an ethernetwork for remote maintenance

CAN distribution board, board with 5 CAN sockets for connection to power supply modules in the cabinet

AC / DC - Systems

GENERAL PRODUCT INFORMATION

Converter systems

DC-PSC system, DC power system for higher loads with parallel operating PSC units and battery buffering.
Advantages of this modular way of construction:

- Easy availability of n+1 redundancy
- Low maintenance and service costs
- Easy exchange of the modules during operation of the Hot Plug In possible
- Individual system technique, adapted to the customers' wishes
- High power density, especially at 24V and 48V
- Planning of reserved places for later power increase possible
- Reaching of high power through parallel switching of almost as much modules as desired

For controlling all parameters it is advantageous to use the monitoring unit MU 1000 C, which communicate with the modules per CAN bus interface. Further it is possible to operate with remote control with the monitoring unit's RS232 interface.

Inverter systems

For higher power there are especially suitable inverter systems in a cabinet fitting.

At this concept, several inverters can be used for the feeding of the nominal load, working in parallel operation. The application of an additional inverter serves to increase the availability (n+1 – redundancy).. A further increase of the availabilty is reached due to the integrated electronical switching device type UNB. A likewise integrated Bypass – switch serves for the manual main-switching for maintenance and service purposes.

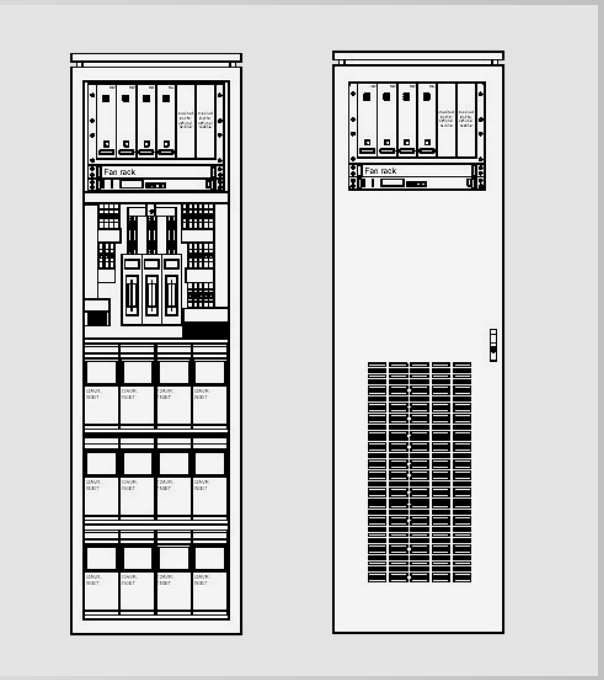
DC/DC Converter systems

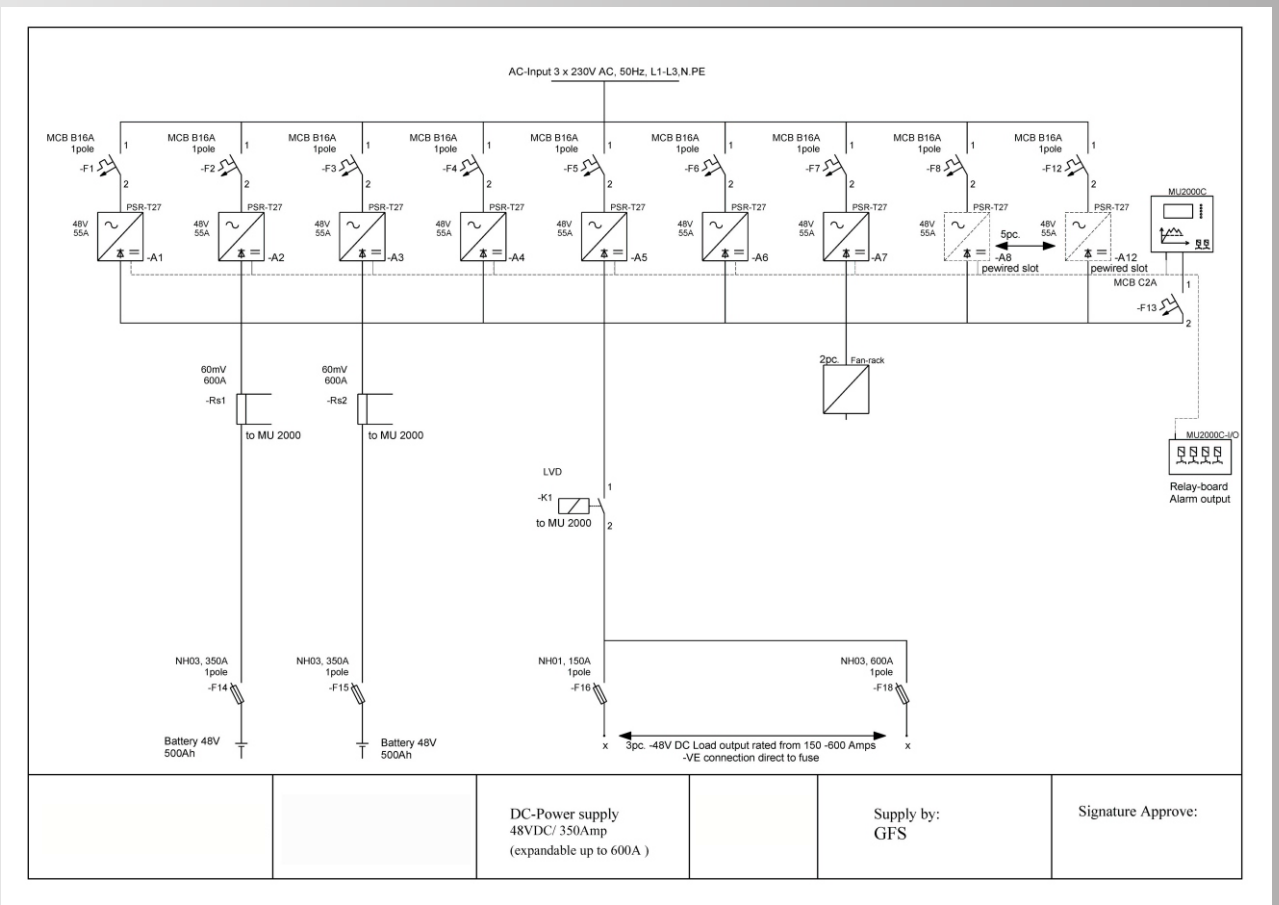
Due to the application of our DC/DC converters, a secure DC bar (for e.g. in power plants or in the industrial sector)) can produce another secure DC DC voltage (for e.g. 48 V for a post-switched telecommunication device). Here we have the same advantages indicated in the inverter area.

Combined systems

Through the application of a modular construction, various different combinations of our modules can be integrated in one system. Therefore the customers' individual wishes can optimally be taken into account and implemented in a complete system.

AC / DC - Systems





Telecommunication - Inverter case system TIPS

GENERAL PRODUCT INFORMATION

Inverter case systems of the type range TIPS48 are especially developed modular compact AC-power supply devices for the telecommunication market, which distinguish themselves through easy installation, operation, maintenance and high availability.

In this modular concept, at each case there are used 4 inverters for the feeding of the nominal load. 1 additional inverter-slot place serves to increase the availability (n+1-redundancy). The inverters are feeded from an external battery. Single feed-cables (a separated secured feed line for each inverter) or a group-feeding (a secured battery feed line) is possible.

In order to continue increasing the availability, we have integrated an electronic change over facility as well as a mechanical bypass switch in the system. In the converter precedence operation, the electric change over facitility changes over to the replacement net in case of overload or failure of the converter. (e.g. deep discharge of the battery). This ensures that the load continues to be feeded without interruption. After successful debugging the change over facility changes back automatically to the converter precedence operation. The manual bypass switch serves to connect the electronic change over facility (e.g. for maintenance purposes) at the concurrent feeding of the load of the replacement net.

All important system parameters are shown and controlled in the device-specific displays. The internal communication between the individual power supply modules and the change over facility is done through a CAN-bus. This bus permanently controls the status and the availability of the single converters and passes on failures to the electronic change over facility.

Type	*TIPS48/230-10.0*	*TIPS48/230-12.5*	*TIPS48/230-20.0*
DC voltage input – nominal voltage	48 V DC –15 / +20%	48 V DC –15 / +20%	48 V DC –15 / +20%
DC voltage input – nominal current	188 A	235 A	375 A
AC voltage input – nominal voltage	230V AC ± 10%	230V AC ± 10%	230V AC ± 10%
AC voltage input – nominal current	43,5 A	54,3 A	87,0 A
AC voltage output – nominal voltage	230 V AC 1 % (converter operation) 230 V AC 10 % (mains operation)		
AC voltage output – nominal current	43,5 A	54,3 A	87,0 A
Nominal output capacity	**10 kVA (8 kW)**	**12,5 kVA (10 kW)**	**20 kVA (16 kW)**
Nominal current	43,5 A	54,3 A	87,0 A

STANDARD CONFIGURATION

LED indication (converter)	Operation, U_{OFF}, U_{IN}>, U_{IN}<, overload, over temperature, accumulative failure
Digital display (inverter)	Output voltage, output current, frequency, input voltage, input current
LED indications (EUE)	Operation, source 1 available, source 2 available, dubbing, load on the inverter, load on the mains, accumulative failure
Digital display (EUE)	Inverter output parameter, inverter operation status, EUE – mains voltage, EUE – mains frequency, failure messages at the LCD text display
Potential free message relais	Accumulative failure

Power supply devices

in thyristor technology

For DC- and AC consumer loads
Rectifier and Battery Charger
Inverter
UPS - systems

FIELDS OF APPLICATION

Power supply for

- Railway installations
- Remote control devices
- Power plants
- Monitoring systems

General Product Information

FIELDS OF APPLICATION

All the fields of industry and of public life have application for electrical devices and machinery, which have to be protected by a substitute power supply against a mains failure. The battery supported DC- and AC Power Supply find application in several fields of the industry, for e.g. in:

- Production factories
- Power plants
- Railway installations
- Remote control installations
- Signalling installations
- Control- & Recording devices
- EDP-systems
- Hospitals
- Petrochemical plants
- Airports and in many other important industrial fields

TECHNOLOGY

The power supply units produced according to the latest technology operate with a regulated IU-characteristic according to DIN 41773 standard for Lead- Acid batteries and DIN 41775 standard for NiCd-batteries. The output voltage is hereby maintained constant at the adjusted constant voltage value with a deviation of ± 1% within a charge range of 0 to 100 % of the nominal current of the device. Fluctuations in the mains voltage ± 10% and fluctuations in the mains frequency ± 4% are stabilised.
These emergency power supply units essentially comprise the rectifier, the Lead-Acid or NiCd batteries connected in parallel and depending on the requirement, the necessary additional devices.

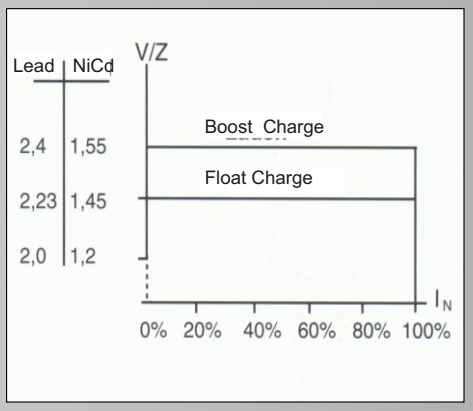
STAND-BY PARALLEL OPERATION

The stand-by parallel operation consists of the battery, the power supply unit and the DC- load connected in parallel. In the normal operation, when the mains is present, the power supply units feed the DC- load and the battery is charged parallel. Due to the regulated IU-characteristic, after the battery is completely charged, the charging current is automatically regulated down to the float charge current necessary for the battery. The given constant voltage is thereby regulated to 100% UK ± 1%. In the case of a mains failure, the battery takes over, without any interruption, the supply to the DC- load. In the case of mains reversal, the battery is automatically charged and power supply unit with distribution board after it is completely charged, it is maintained to the float charge value. The load is simultaneously feeded from the power supply unit.
The nominal current of the power supply unit should be such that 10 A/100 Ah battery capacity as well as the current for feeding the load is available.

General Product Information

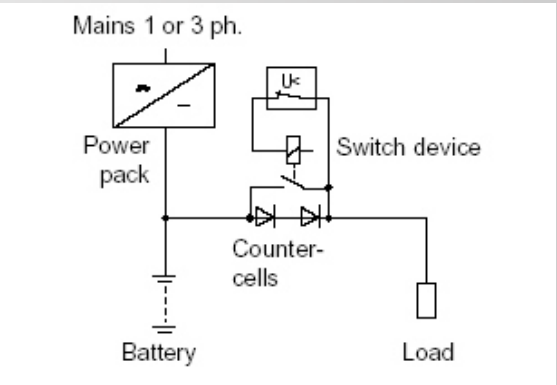
STOCK- AND SUPPLEMENT CELL TECHNOLOGY

In case of larger power demands, particularly requirements with 110 V and 220 V, the stock cell and supplement cell technology is used for adapting the consumer load voltage. The power supply unit consists of the rectifier and the booster as well as the switch over device. The rectifier feeds the load and charges the stock cells. The boost charging stage feed the supplement cells. Both the devices operate with an IU-characteristic. After a mains failure the supplement cells are switched on or off either directly or depending on the voltage of the load. The battery is distributed in the stock and supplement cells in a ratio of about 10:1. Due to this, the voltage of the load is in a smaller range of voltage.



COUNTER CELL TECHNOLOGY

Silicon counter cells are connected between the loads and the battery in order to reduce the voltage of the load. The counter cell consists of a corresponding number of diodes connected in series, which are operated in the low-resistance direction. The counter cell is to be designed for the max. load current and for the desired potential drop. The switching-on or by-passing of the counter cells is done selectively depending on the mains- or load-voltage. If a very high voltage accuracy is required, the counter-cell can be switched on or off even in several stages.



DC/DC - CONVERTER

In order to maintain the load voltage constant at 100 %, UN ± 1 % during charging and discharging, DC/DC converters are connected in each load output. These DC/DC-converters operate as Upward/Downward regulators.
DC/DC-converter for 400 W (24 V 15 A).

Constant voltage values:
2.4 V/Z ± 1% supply voltage for fluid batteries
2.35 V/Z ± 1 % supply voltage for maintenance free batteries
1.55 V/Z ± 1 % supply voltage for NiCd batteries
2.23 V/Z ± 1 % continuous charging voltage for fluid batteries
2.27 V/Z ± 1 % continuous charging voltage for maintenance free batteries
1.45 V/Z ± 1 % continuous charging voltage for NC batteries

POWER SUPPLY EQUIPEMENT

in extended cabinet version with battery compartment to include the emergency power battery

Industry using DC- loads or systems, which, during the malfunction of the general mains supply, take over the supply to the DC- consumer loads e.g. monitoring installations.

Our compact power supply unit consist of a regulated IU- battery charger, which maintains the batteries at the status of complete charge and supplies the present DC- consumer loads. During malfunction of the mains, the battery automatically and without any interruption takes over the power supply to the DC- consumer load.

SMALL POWER PACKS WITHOUT BATTERY COMPARTMENT

Type designation Without instruments	Battery voltage V	Output current A	Constant voltage V	Cabinet	Dimensions		
					Height	Width	Depth
E 230 G 24/3 IU	24	3	26.8	C1	115	130	165
E 230 G 24/5 IU	24	5	26.8	C2	140	160	220
E 230 G 24/10 IU	24	10	26.8	WS00	190	350	250

POWER PACKS IN CASING WITH BATTERY COMPARTMENT

Type designation		Battery voltage V	Output current A	Nominal load VA	Constant voltage V	Cabinet IP 21	Weight kp
E 230 G 24/2.5	IU-K	24	2.5	110	26.8	WS 2-K	25
E 230/G 24/5	IU-K	24	5	220	26,8	WS 2-K	27
E 230 G 24/10	IU-K	24	10	410	26,8	WS 2-K	28
E 230 G 24/20	IU-K*	24	20	830	26,8	WS 2-K	32
E 230 G 60/5	IU-K*	60	5	540	67	WS 2-K	29
E 230 G 60/10	IU-K*	60	10	1080	67	WS 2-K	35

TECHNICAL DATA

The devices are equipped with a moving coil ammeter and a voltmeter Kl 1.5. The built-in battery is protected by 2-pole fuse. There are 2 battery cables leading from the power supply unit into the battery compartment for connecting to the battery. Connection clamps for the load are provided at the unit (* thyristor-regulated version).

Secondary switch mode devices with IU-characteristic

Input voltage	230 V ± 10 % 50 Hz
Constant voltage	2.23 V/Z ± 1 % 0-100 % IN
Current of the power pack	100 % + 30 % power restricted
Smoothing the output voltage	to 2-5 %
Ambient temp.	0 - 35° C
Regulating speed	max. 500 ms

Dynamic behaviour for load changing of 20-80 and 80-20 % IN

Cabinet: The WS 2-K cabinets are vertical cabinets with battery compartment. The cabinet is powder painted or painted with 2-component colour. Protection class IP 21.

Dimensions:

Cabinet	height 750	width 550	depth 430 mm
Battery compt.	height 300	width 470	depth 340 mm

Additional equipment:

The following units can be built into the device optional.

- Input mains monitoring
- DC- output monitoring
- Battery monitoring
- 2-pol. Load connection terminals (max. 6 circuits)
- DO1 fuses up to 16 A or 2 pole fuse automat up to 16 A.

Thyristor regulated devices with IU-constant voltage characteristic

TECHNICAL DATA

Regulated devices with IU-characteristic according to DIN 41773-fig 1 reversible to monitored IUI-characteristic.

Input connection	Type E Single phase AC- voltage 230 V 50 Hz Type D Three phase AC- voltage 400 V 50 Hz
Constant voltage	UK ± 1 % bei 0-100 % IN
Charging current	IN ± 2 %
Mains voltage	UN ± 10 %
Form factor app.	1.1 for rotary current app. 1.4 for AC
Degree of interference	Interference "N" according to VDE 0875
Efficiency	approx. 75 - 95 % for 1-phase systems approx. 70-90 % for 3-phase systems
Smoothing of the Output voltage	to 5% eff. without batteries connected in parallel
Cabinet	IP 21
Finish	RAL 7032/7016 (2-coloured)
Operating temp.	-5°C upto 40°C at max. erected height 1000 m asl
Noise level	max. 60 dB(A) measured at 1 m distance

SINGLE PHASE DEVICES IN THYRISTOR TECHNOLOGY

Type designation	Nominal voltage of battery V	Nominal output Current A	Nominal output connection kVA	Cabinet	Weight kp
E 24/5	24	5	0.25	WS 1	22
E 24/10	24	10	0.5	WS 1	25
E 24/20	24	20	1.0	WS 1	31
E 24/30	24	30	1.5	WS 1	35
E 24/40	24	40	2.0	WS 2	46
E 24/50	24	50	2.5	WS 2	51
E 48/15	48	15	1.4	WS 1	33
E 48/20	48	20	1.8	WS 2	48
E 48/25	48	25	2.3	WS 2	51
E 48/30	48	30	2.8	WS 2	54
E 60/5	60	5	0.8	WS 1	24
E 60/10	60	10	1.2	WS 1	31
E 60/15	60	15	1.65	WS 2	42
E 60/20	60	20	2.25	WS 2	48
E 60/25	60	25	2.83	WS 2	54
E 60/30	60	30	3.48	WS 2	62
E 110/5	110	5	1.0	WS 1	32
E 110/10	110	10	2.02	WS 2	46
E 110/15	110	15	2.9	WS 2	54
E 110/20	110	20	4.04	WS 2	62
E 220/5	220	5	2.0	WS 2	46
E 220/10	220	10	4.0	WS 2	62

THREE PHASE DEVICES IN THYRISTOR TECHNOLOGY

Type designation	Nominal voltage of the battery V	Nominal output current A	Nominal output power kVA	Cabinet	Weight kp
D 24/60	24	60	2.6	WS 2	68
D 24/80	24	80	3.6	WS 2	73
D 24/100	24	100	4.5	WS 2	89
D 24/120	24	120	5.4	WS 2	97
D 24/150	24	150	6.75	ST 5.21	168
D 24/200	24	200	9.6	ST 5.21	172
D 48/40	48	40	3.6	WS 2	75
D 48/50	48	50	4.5	WS 2	89
D 48/60	48	60	5.4	WS 2	95
D 48/80	48	80	7.2	ST 5.21	168
D 48/100	48	100	9.0	ST 5.21	175
D 48/120	48	120	10.8	St 5.21	184
D 48/150	48	150	13.5	ST 5.21	198
D 48/200	48	200	18.0	ST 5.21	231
D 60/40	60	40	4.5	WS 2	78
D 60/50	60	50	5.6	WS 2	92
D 60/60	60	60	6.75	ST 5.21	163
D 60/80	60	80	9.0	ST 5.21	175
D 60/100	60	100	11.2	ST 5.21	185
D 60/120	60	120	13.5	ST 5.21	192
D 60/150	60	150	16.9	ST 5.21	208
D 60/200	60	200	22.4	ST 5.21	237
D 110/30	110	30	5.4	ST 5.21	188
D 110/40	110	40	7.2	ST 5.21	209
D 110/50	110	50	9.6	ST 5.21	227
D 110/60	110	60	10.8	ST 5.21	233
D 110/80	110	80	14.4	ST 5.21	261
D 110/100	110	100	18.0	ST 5.21	296
D 110/120	110	120	21.6	ST 5.21	326
D 110/150	110	150	27.0	ST 10.21	375
D 110/200	110	200	36.0	ST 10.21	422
D 220/20	220	20	7.0	ST 5.21	199
D 220/30	220	30	10.5	ST 5.21	215
D 220/40	220	40	14.0	ST 5.21	255
D 220/50	220	50	17.5	ST 5.21	277
D 220/60	220	60	21.0	ST 5.21	301
D 220/80	220	80	28.0	ST 10.21	362
D 220/100	220	100	35.0	ST 10.21	403
D 220/120	220	120	42.0	ST 10.21	449
D 220/150	220	150	52.5	ST 10.21	502
D 220/200	220	200	70.0	ST 11.21	590
D 220/250	220	250	87.5	ST 11.21	648
D 220/300	220	300	105	ST 11.21	734
D 220/400	220	400	140	ST 11.21	899

THYRISTOR REGULATION

All the devices are delivered with a thyristor regulator in 3-pulse technique. Optional, (specify while ordering) all the three phase devices can be delivered in 6- or 12-pulse technique.
Specify the additional and monitoring units acc. to page 9 and 10. Special design is available on your demand.

AC – POWER SUPPLY EQUIPEMENT

Single phase inverters are used in all the fields, where AC loads have to be supplied continuously during a mains failure. The inverter converts the DC- voltage of the battery into a sine wave AC- voltage with constant frequency.

Inverter with sine-wave output voltage

Input voltage:	220 V DC ± 20 %
Output voltage:	230 V AC ± 2.5 %
Frequency:	50 Hz ± 0.1%
AC output current:	IN ± 2,5 %
Ambient temperature:	10 - 40°C
Efficiency	app. 90%

Non linear distortion factor < 5%

Sound intensity:	< 55 dB(A) measured in 1 m distance

Increased overload capacity
Extended short circuit current
for tripping fuses (app. 3 x IN) cos phi ind. and cap. 0.5-1
Modern circuit layout with IGBTs
Monitoring of total discharge and output voltage.
Indication via optical and potential-free contacts.
Mounting plate or cabinet design.
CE – standard
Suitable for applications according to VDE 0108

Options:
Static bypass switch and manual bypass switch.
Short circuit ability (8x IN) for requirements acc. VDE 0107
Overload capacity (5x IN) for requirements acc. VDE 0107
DC- input voltages between 24-600 V

TYPE TABLE

Type designation	Input voltage V	Non load current App. (A)	Input current App. (A)	Output power (VA)	Mounting plate	Type of cabinet IP 21
WG0.5/220s	220 V	0.25	2.7	500VA	1	WS 1
WG1.0/220s	220 V	0.25	5.2	1000VA	1	WS1
WG1,5/220s	220 V	0.25	7.9	1500 VA	1	WS1
WG2.0/220s	220 V	0.3	10.2	2000VA	1	WS1
WG3.0/220s	220 V	0.3	15	3000VA	2	WS2
WG4.0/220s	220 V	0.35	20	4000VA	2	WS2
WG5.0/220s	220 V	0.38	26	5000VA	-	ST5.21
WG6.0/220s	220 V	0.4	31	6000VA	-	ST5.21
WG8.0/220s	220 V	0.5	41	8000VA	-	ST8.21
WG10.0/220s	220 V	0.6	52	10000VA	-	ST8.21
WG12.0/220s	220 V	0.6	62	12000VA	-	ST8.21
WG15.0/220s	220 V	0.7	78	15000VA	-	ST10.21
WG20.0/220s	220 V	0.9	105	20000VA	-	ST10.21
WG25.0/220s	220 V	1.0	130	25000VA	-	ST11.21
WG30.0/220s	220 V	1.4	156	30000VA	-	ST11.21
WG40.0/220s	220 V	1.8	210	40000VA	-	ST11.21
WG50.0/220s	220 V	2.0	260	50000VA	-	ST11.21+ST10.21
WG60.0/220s	220 V	2.8	312	60000VA	-	ST11.21+ST10.21

Dimensions of the mounting plate

Gr. 1	360 mm broad x 570 mm long
Gr. 2	740 mm broad x 522 mm long

OPTIONAL – AND MONITORING UNITS

If required that devices have to be monitored, it is possible to adapt the additional required functions of the standard unit by incorporating the various monitoring units. The basic design of the devices can be extended by incorporating the different monitoring units and accessories.

Depending on the application of the power supply unit, it is practical to use special defined monitoring units or accessories. For e.g. if the consumer load voltage has to be maintained within a certain voltage range, then silicon counter-cells with a selection switch or units with supplement cell technology can be used.

CONSTANT VOLTAGE CHARGING DEVICE WITH MICROPROCESSOR - CONTROL UNIT

(Optional available for all power supply equipment page 5+6).
A central microprocessor control unit with clear text indication can be incorporated for controlling and monitoring the charger and the battery as well as for the indication of measured values and of failure.

The control unit monitors all the functions of the device. A fault is indicated by LED and remote signalling via the potential-free contact.

Fault messages in clear text:

- Voltage too high
- Voltage too low
- Emptying
- Battery circuit error
- No charge
- Power failure
- Internal fault in micro processor unit
- Voltage in battery operation too high
- Voltage in battery operation too low
- Insulation error
- Fault in inverter
- Excessive temperature
- Heavy charging
- Installation is not ready for operation according to continuous operation testing or function test

Operating messages in 8 light diodes:

- Malfunction
- Ready for operation
- Battery operation
- Network operation
- Consumer ON
- Test operation
- Emptying

SILICON COUNTER CELLS

Silicon counter cells can be connected between the battery and the consumer load in order to decrease the load voltage. When the load voltage drops the silicon counter cells are automatically by-passed. Theload voltage then corresponds to the battery voltage. When the load voltage increases again, the counter cells are connected between battery and the load. The counter cells by-passing and connection depends on the load voltage. It is also possible to connect the counter-cells depending on the input mains voltage.

The counter cells and the switch over devices can be selected according the specified requirement. During the equipment layout calculation, it is necessary to keep in mind that the drop per diode is between 0.7 to 0.9 V. The mean value is calculated 0.8 V as. The silicon counter cells can even be designed as one or multiple stage unit. While ordering please specify whether the plus- or minus pole is earthed. If the information is not provided, the counter-cells will be connected in the minus pole as standard. Each counter cell output is protected by a 2 pole fuse.

Steel sheet cabinet in IP 21 design

TECHNICAL SPECIFICATIONS

All the casings listed below are powder-coated and anneal-lacquered.

Lacquer: in RAL 7032. All casings correspond to protective system IP 21.

All doors are hung-in from the right. Doors of the floor-standing casing can be opened to an angle of 180°.
Casing plinths of 100 or 200 mm can be supplied to match up with other casings. All casings can be supplied in other colours for extra charge.

APPLIANCE CASING

Cabinet Type	Type	Dimensions (mm))		
		Height	Width	Depth
Wall-vertical cabinet	WS 1	400	550	430
Vertical cabinet	WS 2	750	550	430
Vertical cabinet	WS 3	1200	600	430
Vertical cabinet	ST 5.21	1400	800	600
Vertical cabinet	ST 8.21	1800	800	600
Vertical cabinet	ST 10.21	1800	1000	800
Vertical cabinet	ST 11.21	1800	1000	800
Vertical cabinet	ST 9.21	2000	900	600
19" Vertical cabinet without door	STZ 8.2	1800	600	600

COMBINATION CASING

Housing type	Dimensions (mm)			Battery dimensions (mm)			max. departure to be installed
	heigth	width	depth	heigth	width	depth	
STK8.20	1800	600	450	600	550	380	2
STK8.21	1800	800	600	600	750	550	3
STK9.21	2000	900	600	600	850	550	6
Each casing is supplied with 2 grid bases for installing batteries.							

BATTERY CASING

Type	Dimensions H x W x D (mm)	Battery compartment H x W x D (mm)
BS 4	1200 x 600 x 430	990 x 580 x 360
BS 5.20	1400 x 600 x 600	1190 x 550 x 550
BS 5.21	1400 x 800 x 600	1190 x 750 x 550
BS 8.20	1800 x 600 x 600	1590 x 550 x 550
BS 8.21	1800 x 800 x 600	1590 x 750 x 530
BS 9.21	2000 x 900 x 600	1790 x 850 x 550
BS 10.21	1800 x 800 x 800	1590 x 750 x 750
BS 11.21	1800 x1000x 800	1590 x 900 x 750
Each casing is supplied with 2 grid bases for installing batteries (Bearing capacity 250 kp). Further battery grid bases or battery steps can be supplied at extra charge.		

PRODUCT INFORMATION

All casings are powder-coated and lacquered with a two-component lacquer. The cable can be inserted into the floor-standing casing on the top or bottom (at the back). In the case of wall-mounted casings the cable is inserted only on the top. In the case of emergency light devices, the standard cable is inserted on the top (at the back). For transport in the case of all floor-standing casings the front and rear lining plate can be unscrewed.

PRODUCT INFORMATION

The following products are being manufactured by us:

- Rectifiers for charging traction batteries with
  a) Pulse-characteristic
  b) IUIa-characteristic
  c) Wa- and WoWa-characteristic
- Additional emergency power supply equipments (ZSV-equipments) according to VDE 0107 / 10.94
- Emergency lighting systems according to VDE 0108 / 10.89
- Small charging equipments for the charge of maintenance free batteries with IU or IUoU-characteristic
- Battery casings
- Transformers and reactors up to 250kVA capacity
- Electronic control and monitoring units
- Infrared monitored hand dryers
- Special chargers, with special configuration (depending on individual requirements)
- USV-equipments

Guarantee conditions:

For parts proven to be damaged, there will be sent a replacement free of charge within two years after invoice date, providing that the damaged equipment is sent back to us free of charge. In case of repairs at the operation site of the charger, there will be charged the driving time, working time as well as expenses. Eventually deviating conditions and agreements are only valid, if confirmed in written form. Constructive design changes can be done by us wihtout notice.