UPS SYSTEMS

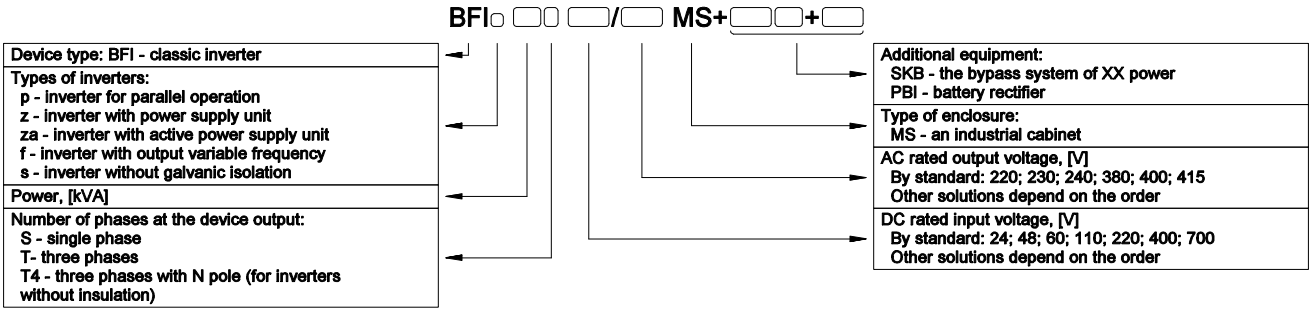
The UPS system is an Uninterruptible Power Supply. In each field of industry, there is a group of devices that play a crucial role for a specific process. These critical devices must be provided with appropriate power supply parameters to ensure correct course of the technological process, regardless of the parameters of the mains, and, in the case of break of the power supply network voltage, to ensure uninterrupted continuation of operation in a given time, i.e., until the network voltage appears again or until creating conditions for safe completion of the process. This function is provided by a guaranteed power supply system based on the BFIz type inverter. The UPS systems are complex systems tailored to the needs of the client. They consist of the BFIz inverters, the SKB static switches, the PBI rectifiers including batteries, the ATSE systems, or guaranteed voltages distribution boards.

THE CHARACTERISTICS OF THE UPS SYSTEM:

- perfectly sinusoidal output voltage shape;
- high voltage and output frequency stability;
- possible 100 % asymmetrical load (for three-phase systems);
- start-up on a battery is possible (Black start);
- a possibility to operate at any type of load (inductive or capacitive) – cos φ of the loads allowed within the entire possible range;
- autonomous controllers of particular functional systems to increase the UPS system's design reliability;
- easy operation:
  - a central inverter START/STOP switch;
  - access to the control and monitoring elements from the front;
  - access to phase connections and potential-free terminals from the front;
  - legible and user-friendly communication;
- uninterrupted automatic bypass;
- uninterrupted manual bypass;
- high short-circuit current (high selectivity of protection tripping);
- electromagnetic compatibility (EMI filters), resistance to disturbances;
- galvanic isolation of loads from the DC sources;
- an advanced charging and accumulator batteries monitoring system;
- independent battery rectifier dedicated to accumulator batteries;
- protection against excessive discharge of the supply battery;
- low ripple and low level of higher harmonics of the battery's current;
- the battery's temperature management and temperature compensation of the battery charging voltage;
- control of the battery charging current;
- over-voltage, over-current, short-circuit protection, etc.;
- advanced communication between the user and the device, a keyboard, a control console with an LCD screen and LEDs, potential-free contacts of relays, a sound signal informing about an alarm situation, archiving of data, and an event buffer. Integrated RS485, USB and Ethernet communication interfaces allow communicating using the serial transmission protocol: Modbus RTU, Modbus TCP, IEC 60870-5-103, IEC 61850, SNMP, APS6000, other.

View of the UPS system cabinet

METHOD OF DESIGNATION OF THE UPS SYSTEM:



The basic functional element in the UPS system produced in APS Energia is the BFIz type inverter in a standard design or the BFIz inverter in the special HC design.

The HC version BFIz inverters feature higher selected operation parameters compared to the standard BFIz type inverters, and are dedicated to operation in facilities that require the highest reliability and highest quality power supply parameters. Significantly higher-than-standard short-circuit current parameters (up to 9×In) ensure highly selective tripping of protection in distribution boards supplied by the inverter's voltage. The systems operate in a basic online configuration. The HC inverter is characterised by a high overload capacity, which is particularly required when supplying loads of high start-up currents (e.g., electric motors), and a high crest factor (up to 5:1) particularly important when supplying pulse loads.

In contrast to inverter systems, the UPS system also has its own battery, which is charged by the PBI type buffer rectifier. Use of the buffer rectifier instead of the inverter power supply unit to charge the battery depends on the battery's life. Depending on the capacity of the battery selected according to the requirements of the client, the UPS system may have more than one PBI type rectifier module, which will impact the overall dimensions of the finished device.

Moreover, depending on the requirements of the project and/or the battery type, may be situated in a battery cabinet or on a battery rack. In the case of UPS systems of low power and battery capacity, the battery may be placed in the UPS cabinet.

UPS SYSTEM – TECHNICAL CHARACTERISTIC – STANDARD PARAMETERS

PARAMETER		VALUE
AC POWER SUPPLY OF THE UPS SYSTEM (mains)*		
Input voltage:	single-phase	220 / 230 / 240 V
	three-phase	380 / 400 / 415 V
Input voltage tolerance		+10 % to -15 %
Frequency of input voltage		50 / 60 Hz
Input voltage frequency tolerance		±10 %
DC POWER SUPPLY OF THE UPS SYSTEM		
Input voltage		24 / 48 / 60 / 110 / 220 / 400 / 700 V
Input voltage tolerance		±15 %*
AC POWER SUPPLY OF THE BYPASS (backup mains)**		
Input voltage:	single-phase	220 / 230 / 240 V
	three-phase	380 / 400 / 415 V
Input voltage tolerance		±15 %
Frequency of input voltage		50 / 60 Hz
Input voltage frequency tolerance		±10 %
AC OUTPUT OF THE UPS		
Output voltage:	single-phase	220 / 230 / 240 V
	three-phase	380 / 400 / 415 V
Output voltage frequency		50 / 60 Hz*

UPS SYSTEM – TECHNICAL CHARACTERISTIC – STANDARD PARAMETERS – CONTINUED

PARAMETER	VALUE
AC OUTPUT OF THE INVERTER	
Voltage stability (static)	±1 %
Voltage stability (dynamic)	± 5 % within 10 ms
Voltage waveform	sinusoidal
THDu voltage distortion (linear load)	<2 %
THDu voltage distortion (non-linear load)	<5 %
Output voltage frequency tolerance	±0.1 %
Overload capacity at resistance load	<110 % constant, ≤125 % 10 min, ≤150 % 1 min (<110 % constant, ≤125 % 10 min, ≤250 % 15 s for the HC version)***
Short-circuit current	3×In (up to 9×In for the HC version)***
Crest factor	3:1 (optionally up to 5:1)
Cos φ range	from 0.7 to 1.0
Inverter efficiency	85 to 95 %
Electromagnetic compatibility	EN IEC 62040-2
Available menu language versions	PL | EN | CZ | RU
AC OUTPUT OF THE STATIC SWITCH**	
Frequency synchronisation range	±5Hz or ±3Hz
Switching time: synchronised lines	up to 5 ms
non-synchronised lines	up to 10 ms
Short-circuit current	3kA (max. efficient value)
Power losses	<2 %
Bypass system efficiency	>99%
DC OUTPUT OF THE BUFFER RECTIFIER	
Output voltage	24 / 48 / 60 / 110 / 220 / 400 / 700 V
Output voltage stability**	±0.6 %
Output voltage ripple****	±0.6 %
Range of correction of the buffer charging voltage	between -10 and +50 °C
Temperature compensation of the buffer charging voltage**	0 to 10 mV/°C/cell
Overload capacity	1.1×In for 3 sec
Output current stability***	±1 %
Output current ripple***	±1 %
Battery charging characteristics	IU as per DIN 41773
Battery charging mode: buffer	2.2 to 2.4 V/cell
automatic	2.4 V/cell
supervised	2.7 V/cell
BATTERY	
Battery technology	VRLA: AGM / GEL / Ni-Cd
Voltage of 1 monoblock	2/6/12V
OPERATING ENVIRONMENT	
Operating temperature (EN 50178 class 3k3)	+5 to +40 °C*
Storage temperature (EN 50178 class 1k4)	-25 to +55 °C*
Humidity (EN 50178 class 3k3)	5 to 85 % (non-condensing)*
Access to the device	operation and maintenance from the front*
Cable entry	from the bottom / from the top****
Maximum height above the sea level without change of the rated parameters	1,000 m ASL
Anti-seismic design	up to 6 MSK (up to 9 MSK for the HC version of the inverter)***

* – it is possible to design different parameters upon agreement with the manufacturer;

** – only for the UPS systems equipped with the Static Switch bypass system (SKB or MWB);

*** – see chapter "Inverter module of increased short-circuit current"

**** – only for installation in the industrial cabinet (MS enclosure type).

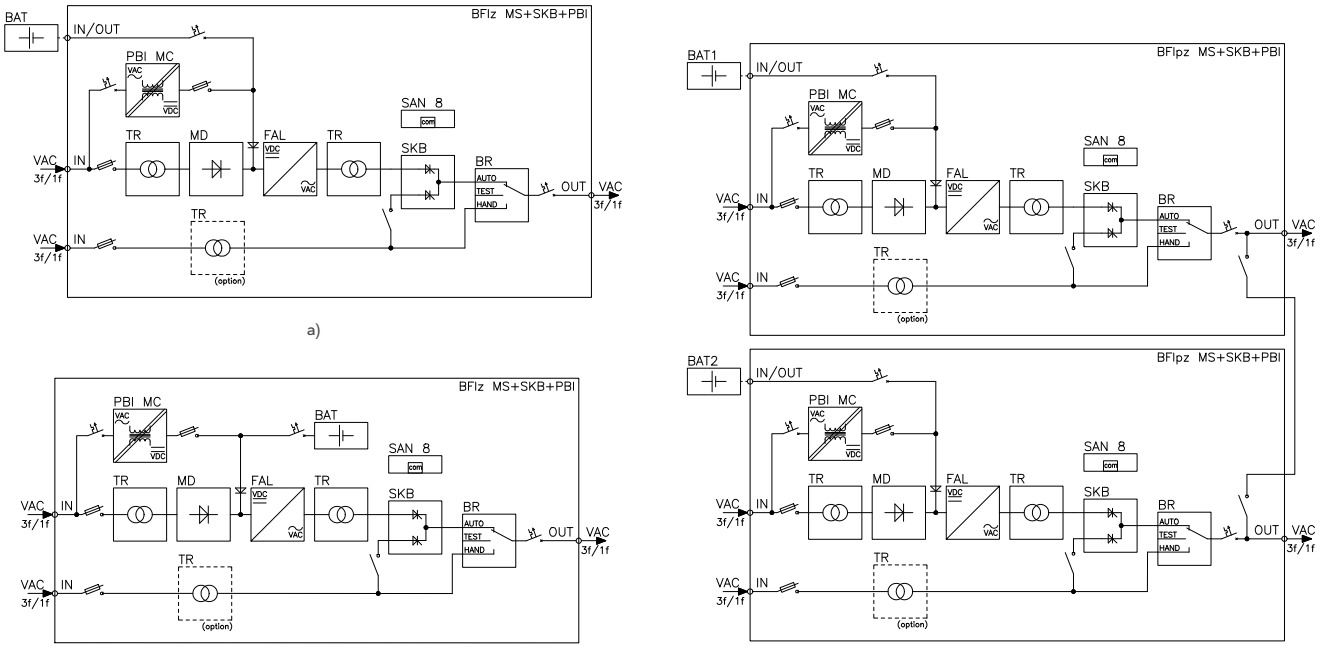


Fig. 87. Block diagram of the UPS system cabinet:
a) for autonomous operation based on the BFIz inverter cabinet with an external battery;
cabinet with a battery inside the UPS cabinet;
erter cabinet with an external battery.

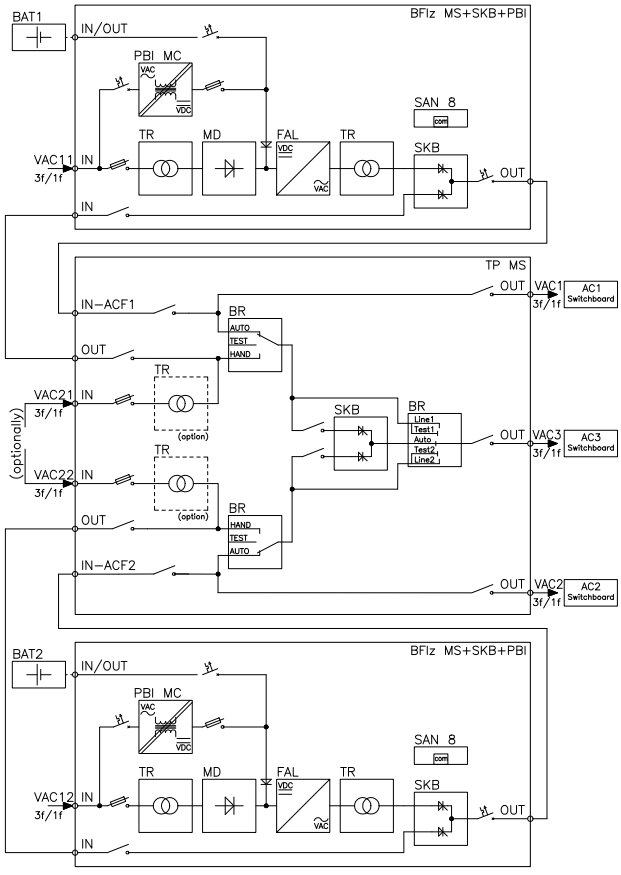


Fig. 88. Block diagram of the UPS system cabinet with an additional SKB system in the TP cabinet.

The UPS system layout presented in Fig. 88 is a special case. This system consists of two inverter cabinets with own automatic bypasses and batteries with the buffer rectifiers to charge them and an additional TP type switching cabinet which contains the SKB type Static Switch system.

Each UPS cabinet operates in the autonomous mode to supply its own section of loads with the guaranteed AC voltage. The additional Static Switch system in the TP cabinet plays the role of the "third line" and ensures an uninterrupted operation of the electric devices of its own section of loads in the case of voltage break in one of the power supply fields.

KEY OF THE ABBREVIATIONS USED IN THE DIAGRAMS IN THE CHAPTER

BAT – battery	PBI – rectifier
BR – maintenance bypass	SAN 8 – console
INV – inverter	SKB – automatic bypass
IN – power supply	TR – transformer
com – communication	VAC – alternating current (AC)
MD – diode bridge	VDC – direct current (DC)
OUT – output	

UPS SYSTEM EQUIPMENT:

1. MAIN AC/DC/AC POWER CONVERTER – THE BFIz TYPE INVERTER

The double power conversion system (classification according to EN 62040-3 – VFI), which converts alternating current to direct current to supply the intermediate DC voltage bus and generate a pure alternating voltage sinusoid of high own output electric parameters adjustment regime.

Components:

DSP microprocessor controller: Inverter control, operating parameters configuration, alarm states indication, external communication;

Power supply system: Depending on the type of the battery and the requirements of the client, it may have a form of a 6-impulse or 12-impulse rectifier or an active power supply with sinusoidal current draw.

Voltage inverter: A converter controlled on the basis of IGBT transistors with the Pulse Width Modulation in standard or special HC design;

Isolating output transformer: Galvanic isolation of primary and secondary voltage circuits.

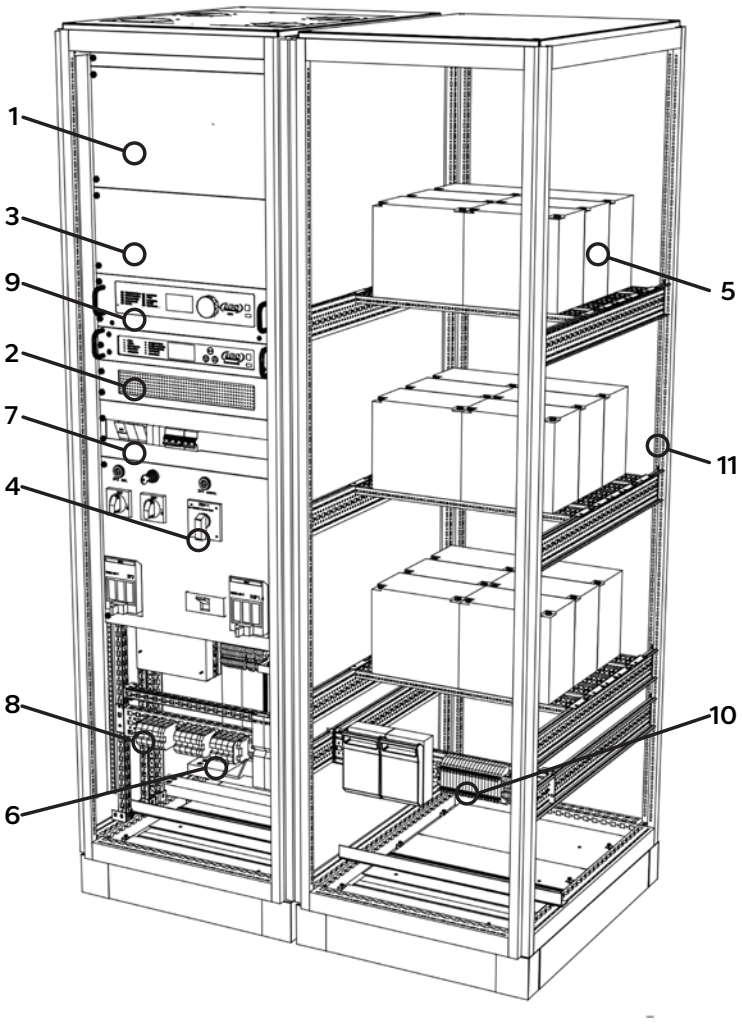
2. BATTERY RECTIFIER

The PBI type transistor, autonomous, dedicated pulse battery rectifier guarantees perfect battery charging and operating parameters. The standard time until achieving full battery charge up to 6–8 hours; the time may be adjusted by the user.

Components:

DSP microprocessor controller: Inverter control, controlling the battery charging process (in accordance with EUROBAT), an active dynamic battery recharging algorithm, battery temperature regulation, and charging voltage temperature correction. Adjustment and limitation of the battery charging current, control of the battery state. Configuration of the operating parameters, indication of the alarm states of the rectifier.

Console (AC-CON): The console consists of an LCD, LED synoptic, and a three-button keyboard or a digital potentiometer. The console informs the personnel about the state of the battery and operation of the converter.



3. BYPASS SYSTEM

The internal connections and switches system that allows feeding voltage from the reserve mains to the circuits of the loads, bypassing the UPS in the case of failure or to carry out checks or other maintenance activities.

Components:

The SKB (Static Switch) automatic bypass: The microprocessor bypass system ensuring uninterrupted (<5 ms) switching of circuits to supply from a reserve network in emergency situations. Voltage on the reserve line is measured continuously; switching to the reserve line is allowed when the parameters are within the tolerance.

Components:

- DSP microprocessor controller,
- non-contact switching thyristor links.

4. MAINTENANCE BYPASS

A mechanical power source switch of such a layout of contacts and guides is used to ensure that switching to reserve power supply (bypass) lines takes place in an uninterrupted manner.

5. ACCUMULATOR BATTERY

The accumulator battery is a reserve (emergency) source of power for the UPS. Sealed, unattended VRLA type batteries in 12V blocks are most commonly used. In the BFIz type industrial UPS systems, it is possible to use various types of batteries depending on the type of electrolyte: (AGM, GEL, liquid electrolyte) or depending on the technology (acid and lead, Ni-Cd, other). The battery consists of cells connected in series in a single or multiple chain. The capacity of the battery may be selected in a wide range from 10 Ah to 1,000 Ah. The time of autonomous battery operation may last from several minutes to several hours depending on the UPS power and the battery's capacity.

Most commonly, the rated accumulator battery voltage is 220 V DC; depending on the project, it may be 700, 400, 110, 60, 48, 24 V DC.

The accumulator battery is protected by a double-pole fuse disconnecting switch.

6. CONNECTION TERMINAL

It contains power line and output circuits connections appropriate for the designed current and wiring.

7. PROTECTION FIELD

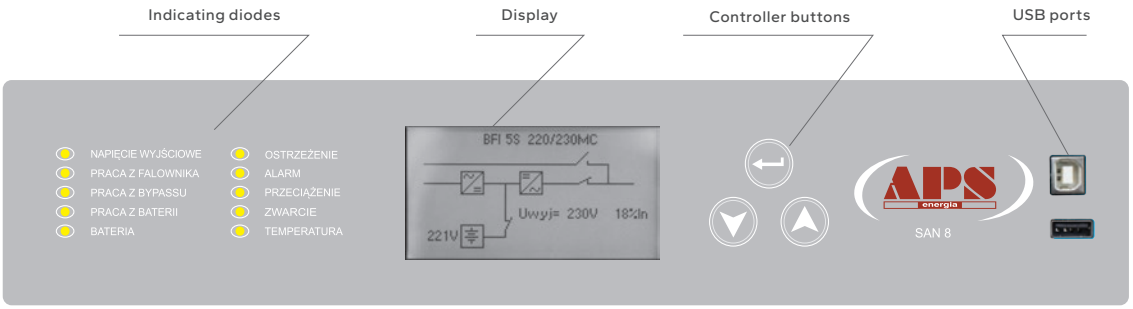
Includes over-current and over-voltage protections.

8. BINARY SIGNALS TERMINAL

The UPS BFIz inverter and rectifier are equipped with binary inputs and outputs, and an auxiliary voltage source that feeds signals to these inputs. Potential-free contacts transfer binary information about the state of the device, operating conditions, and alarms. You may assign different functions to the binary inputs to change the operation of the inverter and the rectifier.

9. SAN 8 AUTOMATIC MONITORING SYSTEM

The SAN 8 monitoring section ensures monitoring, recording, and visualisation of all system operating states, and alerts in case of alarm conditions. Indication of alarm conditions is implemented by potential-free contacts and transmission of data via RS, LSN communication ports using transmission protocols. The communication console presents current parameters and voltage and output currents, voltages of the mains, the battery's voltage and current, the ambient temperature, and data important from the point of view of the reliability of the system.



View of the UPS system SAN 8 console

10. ACCUMULATOR BATTERIES VOLTAGES TERMINAL

To facilitate the assessment of the state of the battery, and, in the case of damage, locate the defective cell, the voltage of each cell is output to the battery voltages terminal. The terminal enables quick measurement of voltage at each cell.

11. ENCLOSURE

Industrial cabinet (one or several). The structure of the cabinets is welded and protected against corrosion with metallic coatings and powder coating.

EMI FILTERS

Single- or multi-stage filters at the input and output of each element of the system reduce the level of conducted disturbances, limit the UPS's disturbance emissions, and improve the resistance to disturbances of the device itself.

PROTECTIONS:

- Over-voltage (B+C), over-current, short-circuit protections, etc.
- Protection against excessive discharge of the supply battery.
- Protections of the internal systems against:
  - increase of voltage on the transistors;
  - power surges caused by dynamic changes of the load;
  - internal short-circuits.

COOLING SYSTEM

The systems are cooled by air circulation forced by roof fans; the air flows into the device through the air inlet located in the lower part of the enclosure. Air filters are located directly behind it. The multi-stage rotational speed is adjusted by the internal temperature function of the device. Additionally to the ventilation, each module is independently cooled with own fans.

SPECIAL DESIGNS OF THE UPS SYSTEM

Special designs:	Upon request, it is possible to adapt the devices to special requirements of a given project in relation to:
	• greater powers of the UPS;
	• the range of the DC rated voltages of the battery;
	• standard of the AC voltages and frequencies;
	  • single-phase inverters: (110 V, 115 V, 120 V, 127V, 50 / 60 Hz);
	  • three-phase inverters: : (3×190 V, 3×200 V, 3×208V, 3×220 V, 50 / 60 Hz);
	• extension of the range of AC input voltages;
	• environmental requirements related to ambient temperature (-20 °C ÷ +55 °C), presence of aggressive factors, etc.;
	• enclosure design, including seismic resistant designs, IP degree of protection, design of the bus bars, access to the cables from the top, coating colour, etc.;
	• measurements and communication: digital or analogue meters of appropriate class, indication of states, visualisation of operating modes, synoptic of connections, communication protocols, etc.

Parallel operation	The BFIz UPS systems may operate in parallel with the current equalisation and network synchronisation functions. Parallel operation of the inverters increases the power and reliability (system's redundancy (n+1)).
Active input filter (sinusoidal current draw from the mains):	To improve the THDi of the current drawn from the mains, you may use a bypass with an active filter. By using this solution, you achieve sinusoidal characteristics of drawing of current from the mains.
The bypass's transformer:	The SKB system reserve network voltage is fed through the isolating transformer (option).
Output circuits distribution board	In the BFIz UPS enclosure, you may separate a space and design a guaranteed AC voltages distribution panel equipped with protections of particular output circuits (option).
The SAN 5-1 autonomous battery module system	The device measures the battery's voltage and current, voltages at particular monoblocks, the battery's temperature, and the ambient temperature. Alarm states are indicated when the values of measurements exceed the threshold values.
ATSE system	The task of the automatics of the automatic reserve tripping (ATSE) is switching the basic power supply to the reserve power supply in the case of break or excessive drop of the voltage in the basic power supply circuit, maintaining full efficiency of the reserve power supply devices. The ATSE automatics is intended to improve the reliability of the ATSE system power supply.
Cable entry from the top	It is possible to design the enclosure in a way to allow cables entering from the top.

SERIES TYPE: 1-PHASE UPS SYSTEM CABINETS 1 ÷ 150kVA FOR AUTONOMOUS OPERATION

Rated output voltage 230 V AC*

Power, [kVA]	DC rated input voltage, [V]	AC rated input voltage, [V]	Example type	Min. dimensions of the enclosure [W×D×H**], [mm]
1 / 2 / 2.5 / 3 / 3.5 / 5	24 / 48 / 60	3×400 or 230	BFIz 1S 24/230 MS+SKB 1***+ PBI	600×800×2,000
7.5 / 10	60		BFIz 7.5S 60 / 230 MS+SKB 7.5***+ PBI	
1 / 2 / 2.5 / 3 / 3.5 / 5 / 7.5 / 10	110 / 220		BFIz 1S 110 / 230 MS+SKB 1***+ PBI	
12.5 / 15 / 20		3×400	BFIz 12.5S 110 / 230 MS+SKB 12.5***+ PBI	
25 / 30 / 40	110		BFIz 25S 110 / 230 MS+SKB 25***+ PBI	1,200×800×2,000
50 / 60			BFIz 50S 110 / 230 MS+SKB 50***+ PBI	1,800×800×2,000
25 / 30 / 40	220		BFIz 25S 220 / 230 MS+SKB 25***+ PBI	800×800×2,000
50 / 60 / 75			BFIz 50S 220 / 230 MS+SKB 50***+ PBI	1,400×800×2,000
100 / 120			BFIz 100S 220 / 230 MS+SKB 100***+ PBI	1,800×800×2,000
140 / 150			BFIz 140S 220 / 230 MS+SKB 140***+ PBI	2,400×800×2,000
50 / 60 / 75	400		BFIz 50S 400 / 230 MS+SKB 50***+ PBI	1,200×800×2,000
100 / 120			BFIz 100S 400 / 230 MS+SKB 100***+ PBI	1,400×800×2,000
140 / 150			BFIz 140S 400 / 230 MS+SKB 140***+ PBI	1,800×800×2,000

* – possible options: 220 / 230 / 240 V AC;

** – add the height of the pedestal to the height of the device: by standard, 100 mm;

*** – a cabinet without the SKB bypass is available as an option;

SERIES TYPE: 3-PHASE UPS SYSTEM CABINETS 1 ÷ 500kVA FOR AUTONOMOUS OPERATION

Rated output voltage 3×400 V AC*

Power, [kVA]	DC rated input voltage, [V]	AC rated input voltage, [V]	Example type	Min. dimensions of the enclosure [W×D×H**], [mm]
1 / 2 / 2.5 / 3 / 3.5 / 5	24 / 48 / 60	3×400 or 230	BFIz 1T 24/400 MS+SKB 1***+ PBI	600×800×2,000
7.5 / 10	60		BFIz 7.5T 60 / 400 MS+SKB 7.5***+ PBI	
1 / 2 / 2.5 / 3 / 3.5 / 5 / 7.5 / 10	110 / 220		BFIz 1T 110 / 400 MS+SKB 1***+ PBI	
12.5 / 15 / 20		3×400	BFIz 12.5T 110 / 400 MS+SKB 12.5***+ PBI	
25 / 30 / 35 / 40			BFIz 25T 110 / 400 MS+SKB 25***+ PBI	800×800×2,000
50 / 60 / 75	110		BFIz 50T 110 / 400 MS+SKB 50***+ PBI	1,400×800×2,000
50	220		BFIz 50T 220 / 400 MS+SKB 50***+ PBI	800×800×2,000
60 / 75			BFIz 60T 220 / 400 MS+SKB 60***+ PBI	1,400×800×2,000
100 / 120			BFIz 100T 220 / 400 MS+SKB 100***+ PBI	1,600×800×2,000
140 / 150 / 160			BFIz 140T 220 / 400 MS+SKB 140***+ PBI	2,000×800×2,000
180 / 200 / 220 / 250			BFIz 180T 220 / 400 MS+SKB 180***+ PBI	3,000×800×2,000
300			BFIz 300T 220 / 400 MS+SKB 300***+ PBI	3,600×800×2,000
60 / 75	400		BFIz 60T 400 / 400 MS+SKB 60***+ PBI	1,200×800×2,000
100 / 120 / 140			BFIz 100T 400 / 400 MS+SKB 100***+ PBI	1,400×800×2,000
150 / 160 / 180 / 200			BFIz 150T 400 / 400 MS+SKB 150***+ PBI	1,800×800×2,000
220 / 250 / 300 / 350			BFIz 220T 400 / 400 MS+SKB 220***+ PBI	2,400×800×2,000
400 / 450 / 500	700		BFIz 400T 700 / 400 MS+SKB 400***+ PBI	4,200×800×2,000

* – possible options: 3×380 / 3×400 / 3×415 V AC;

** – add the height of the pedestal to the height of the device: by standard, 100 mm;

*** – a cabinet without the SKB bypass is available as an option;

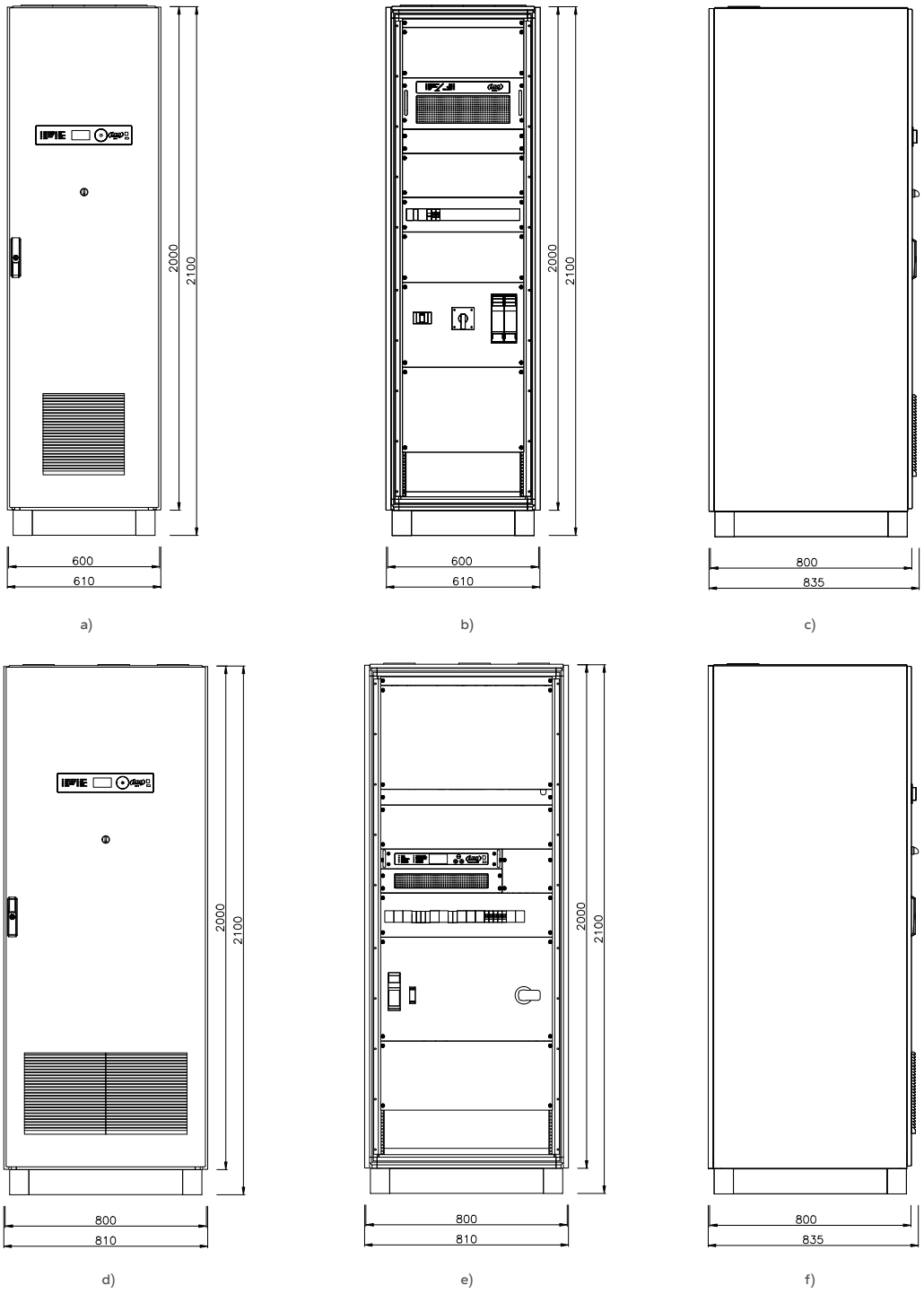


Fig. 89. Views with dimensions of the UPS system cabinet:

a) 600×800×2,000 cabinet – front view, closed door; b) 600×800×2,000 cabinet – front view, open door; c) 600×800×2000 cabinet – left-side view; d) 800×800×2,000 cabinet – front view, closed door; e) 800×800×2,000 cabinet – front view, open door; f) 800×800×2000 cabinet – left-side view.

NON-TRANSFORMER UPS SYSTEMS

UPS MODULA – a modular industrial UPS of sinusoidal current consumption has been constructed on the basis of over twenty years of experience in designing and production of devices for energetics and the industry.

MODULA is intended, among others, for the following types of facilities:

- Data Center,
- Industrial control systems (DCS/PLC),
- Intelligent building systems (IBS).

In economy sectors such as:

- Industry,
- Finances and banking,
- Telecommunications,
- Medicine.

THE CHARACTERISTICS OF THE UPS MODULA:

- the "n+1" redundant configuration is possible by use of a single redundant module;
- high stability of voltage and output frequency, both in steady and dynamic state;
- high efficiency thanks to the capacitive technology;
- data archiving and events buffer on SD card;
- UPS MODULA is equipped in a manual (maintenance) bypass switch. Switching to operation on the bypass line is done in an uninterrupted manner – on/off switch;
- sinusoidal current draw from the mains;
- module design: Hot-Plug;
- RS485, USB and Ethernet integrated communication interfaces;
- high efficiency;
- wide selection of data transmission protocols: Modbus RTU, IEC 60870-5-103, IEC 61850, SNMP; APS6000; other
- SAN 8 microprocessor monitoring of the entire system.

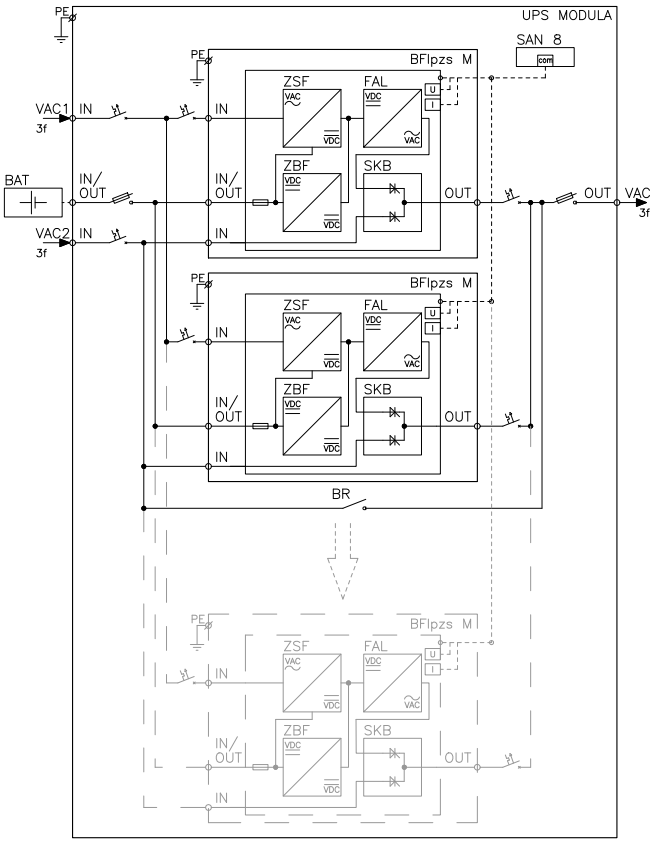


Fig. 90. Block diagram of the UPS MODULA cabinet.

View of the non-transformer UPS cabinet

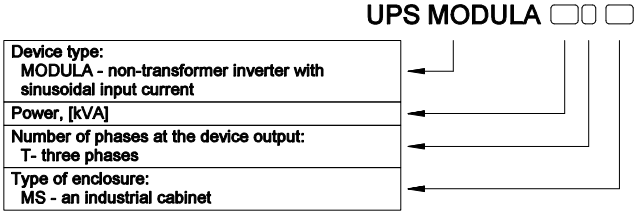
Due to application of active IGBT rectifier, it is possible to draw sinusoidal current from the mains and achieve a high input power factor of 0.99 at rated load. Modular design allows for power configuration from 20 to 120kVA. This functionality allows for expansion of a power supply by further modules without the need to change dimensions of the cabinet infrastructure.

Correct operation is controlled by an automatic monitoring system of the latest generation, designed on the basis of DSP (Digital Signal Processor) microprocessor. Operation of the power supply may be monitored remotely using a delivered software or via communication interfaces in an SCADA type master system.

Each UPS MODULA module constitutes an independent inverter of double AC/DC/AC conversion (as per EN IEC 62040 – 3 VFI) equipped with an automatic bypass (Static Switch) and a battery rectifier.

The module is equipped with short-circuit, over-voltage and temperature protection. Installation of the module in the cabinet does not need screw connectors – it is possible to replace a unit during operation of the entire system (Hot Swap).

METHOD OF DESIGNATION OF THE UPS MODULA SYSTEM:



KEY OF THE ABBREVIATIONS USED IN THE DIAGRAMS IN THE CHAPTER

BAT – battery	SAN 8 – console
INV – inverter	SKB – automatic bypass
I – current measurement	VAC – alternating current (AC)
IN – power supply	U – voltage measurement
com – communication	ZBF – inverter's battery power supply
OUT – output	ZSF – inverter's power supply

UPS MODULA – TECHNICAL CHARACTERISTIC – STANDARD PARAMETERS

PARAMETER		VALUE
POWER SUPPLY UNIT		
The maximum power drawn from the AC network at cos φ = 1 (in the battery charging mode)		20kW (the charging current lowers in a way to not exceed 20kW)
The rated power drawn from the AC network at cos φ = 1 (without battery charging)		17 kW
Rated AC input current at φ = 1 (without battery charging)		3×25 A
The maximum current drawn from the AC network at cos φ = 1 (when charging the battery with the maximum current)		3×29 A
Power factor (PF)		0.99 (at load lower than 25 %, PF = 0.97)
AC rated input voltage		3×400 V
AC input voltage tolerance		+10 % to -15 %
AC input voltage rated frequency		50 Hz
AC input voltage frequency tolerance		±5 %
THDi current distortions		<6 % (at load >75 %)
Battery charging current pulsation		<5 A/100 Ah
INVERTER		
Rated output power at cos φ = 0.8		20 kVA / 16 kW
Rated output current at cos φ = 0.8		3×29 A
DC input voltage range		454 to 605 (for 2×126 cells) 475 to 633 (for 2×132 cells)
DC rated current at the input		33.5 A (for 2×126 cells) 32 A (for 2×132 cells) (it also depends on the active power of the inverter)
Rated output AC voltage		3×400 V (with a neutral cable)
AC output voltage rated frequency		50 Hz
Output voltage stability: symmetric load		±1 %
	50 % asymmetrical load	±1 %
	100 % asymmetrical load	±2 %
	dynamic load (step-load up to 100 %)	≤5 %
Adjustment time		20 ms
Change of the electric angle:	symmetric load	<1°
	50 % asymmetrical load	<2°
	100 % asymmetrical load	<3°
Output disruptions (THDu):	linear load	≤2 %
	non-linear load	≤5 %
Crest factor		2:1
Output protection against short-circuit		2×In for 100 ms (without voltage in the bypass circuit) 2×In for 20 ms (with voltage in the bypass circuit)
Inverter overload capability		<101 % constant, 101 to 109% 10 min, 110 to 125 % 1 min
Overheating protection (temperature at the heat sink)		70 °C

UPS MODULA – TECHNICAL CHARACTERISTIC – STANDARD PARAMETERS – CONTINUED

PARAMETER		VALUE
ELECTRONIC BYPASS		
AC rated input voltage		3×400 V (with a neutral cable)
AC input voltage tolerance		+10 % to -15 %
AC input voltage rated frequency		50 Hz
AC input voltage frequency tolerance		±5 %
Rated consumption of current from the mains		3×29 A
Bypass overloading capability		<125 % constant, 125 to 150 % 10 min, 150 to 175 % 1 min
Output protection against short-circuit		3×In for 400 ms
Time of switching from an inverter to bypass		<10 ms
Time of switching from a bypass to inverter		<10 ms
Overheating protection (temperature at the heat sink)		70 °C
BATTERY		
Number of battery elements		2×126 to 2×132
Maximum battery charging current		5 A*
Battery charging current characteristics		IC10
Battery charging voltage in the buffer mode		2.20 to 2.70 V/cell**
Battery voltage temperature compensation		0 to 0.01V/cell/ °C**
Discharged battery minimum voltage		1.50 to 2.30 V/cell**
Voltage stability		±1 %
Voltage pulsation		≤1 %
Charging characteristics		IU as per DIN 41773
GENERAL PARAMETERS		
Efficiency without battery charging:	100 % load	95 %
	75 % load	95 %
	50 % load	95 %
	25 % load	90 %
Cabinet noise level		<74dB (A)
Operating temperature (EN 50178 class 3k3)		+5 to +40 °C***
Storage temperature (EN 50178 class 1k4)		-25 to +55 °C***
Humidity (EN 50178 class 3k3)		5 to 85 % (non-condensing)***
Access to the device		Operation and maintenance from the front***
Cable entry		From the bottom / from the top****
Maximum height above the sea level without change of the rated parameters		1,000 m ASL

* – for the amount of modules n=1, in other cases: I_{MAX}=n×5 A;
** – set by the user;
*** – it is possible to design different parameters upon agreement with the manufacturer;
**** – only for installation in the industrial cabinet (MS enclosure type);

SERIES TYPE: 3-PHASE UPS MODULA CABINETS

Power, [kVA]	Number of modules	Example type	Min. dimensions of the enclosure [W×D×H*], [mm]
10 / 20	1	UPS MODULA 10T MS	600×800×2,000
40 / 60	2 / 3	UPS MODULA 40T MS	600×800×2,000
80 / 100 / 120	4 / 5 / 6	UPS MODULA 80T MS	1,200×800×2,000

* – add the height of the pedestal to the height of the device: by standard, 100 mm.

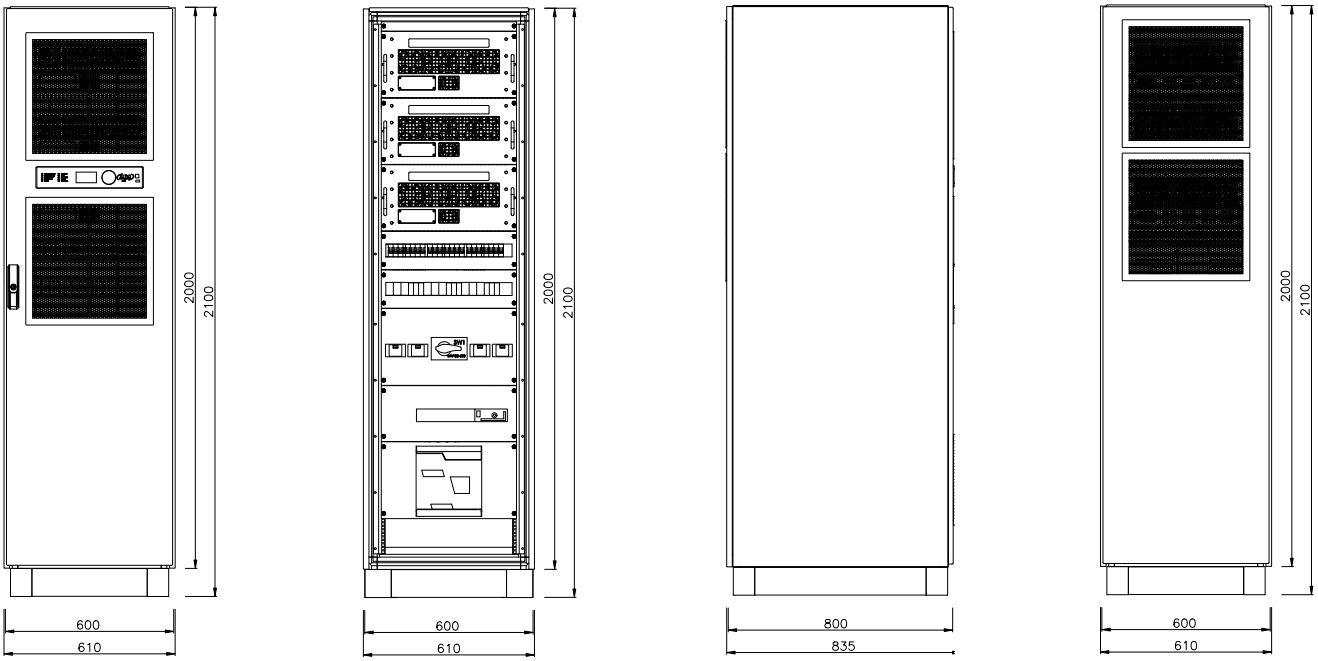


Fig. 91. Views with dimensions of the UPS MODULA cabinet:

a) 600×800×2,000 cabinet – front view, closed door; b) 600×800×2,000 cabinet – front view, open door;
c) 600×800×2,000 cabinet – left-side view; d) 600×800×2,000 cabinet – back view.