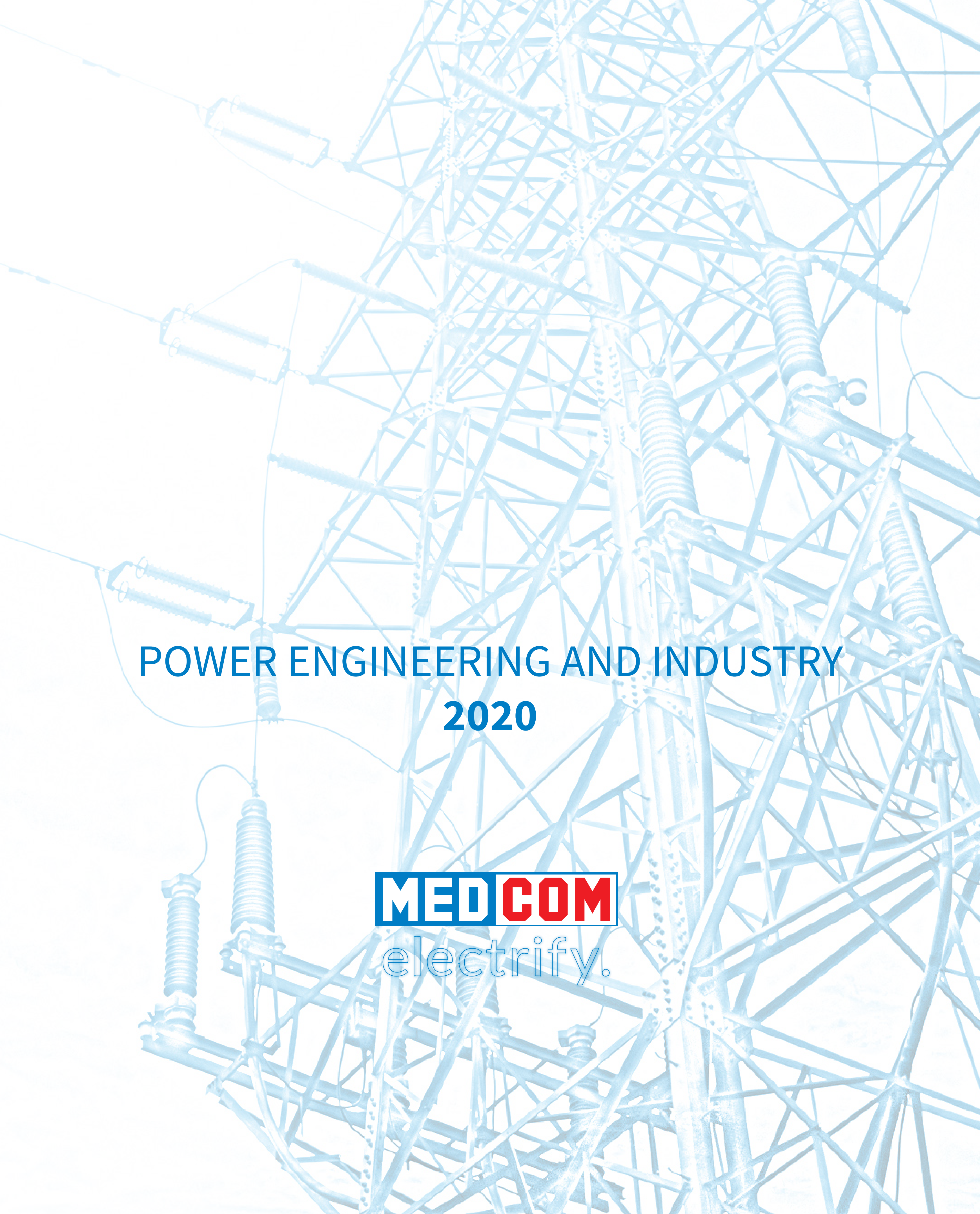

POWER ENGINEERING AND INDUSTRY

2020

MEDCOM

electrify.

The material presented in this catalogue is of informative nature. Due to the constant introduction of the latest technological accomplishments, our products may be subject to modifications. Therefore, some parts of presented description may no longer be valid.

POWER ENGINEERING AND INDUSTRY
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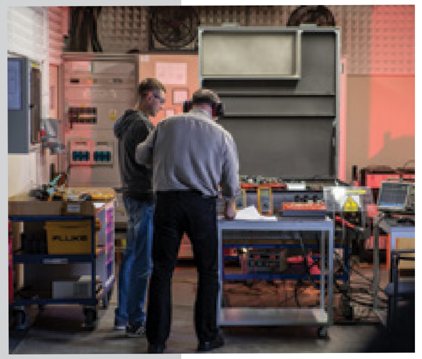
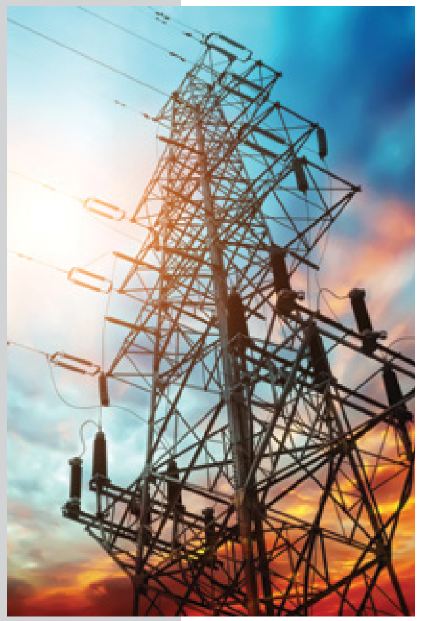

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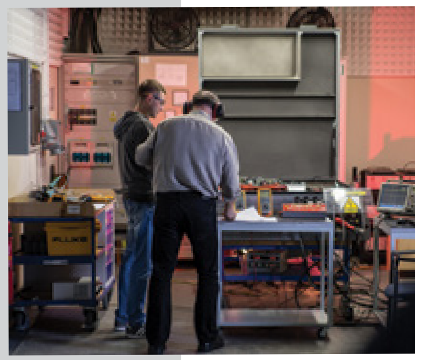
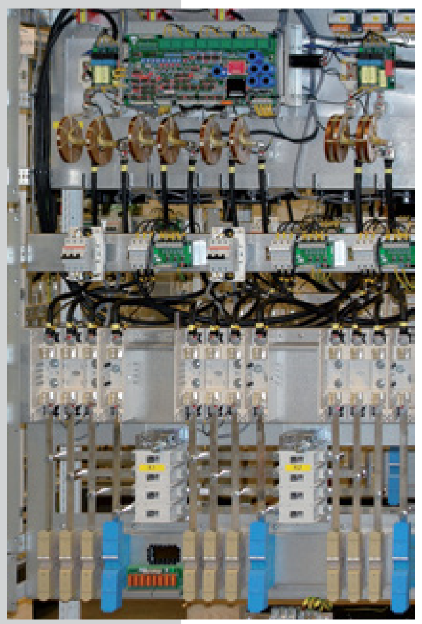




ABOUT US

MEDCOM is one of the most innovative manufacturers of power electronic devices in the world. For more than 30 years, we have been delivering solutions supporting advanced public transport systems and power supply systems for industrial installations and the power sector.

We specialize in the design, production, and integration of proprietary systems for railway vehicles (rail, metro, tramways), trolleybuses, electric buses, and other electric vehicles operating in all the traction power supply systems in the world. We offer a number of specialized solutions dedicated to specific types of vehicles – including comprehensive propulsion systems, power supply, control, and passenger information systems – as well as charging devices.

MEDCOM's AC & DC power supply systems work with systems responsible for the safety of key industrial installations, power systems, and telecommunications systems. The range of our products for the power sector and industry includes advanced DC power adapters and inverters for emergency power supply systems, supercapacitor-based energy recovery systems, active filters, and static transfer switches.

EXPERIENCE

We have developed and manufactured more than 28,000 devices dedicated to various applications and specific requirements of our customers.

Our products set in motion thousands of public transport vehicles worldwide and guarantee superior comfort of travel. Electric vehicles equipped with MEDCOM's solutions carry millions of passengers a week within the EU, as well as in the USA, Canada, Brazil, Russia, Turkey, Ukraine, and Belarus.

MEDCOM's products are used by the largest companies from the industrial, power, chemical, mining, and telecommunications sectors, including Tauron, EDF, PGE, RWE, Energa, NCBJ Świerk, PGNiG, PSE, Navy Ports of Gdynia and Świnoujście, Orlen, and ZA Puławy.

INNOVATION

We follow our own path of development and we are not afraid to look for innovative and groundbreaking solutions. Together with our customers, we want to create the technologies of tomorrow, while increasing the comfort of life of people all over the world.

All the devices manufactured by MEDCOM are proprietary designs created thanks to the knowledge and vision of our specialists.

Designers and engineers constitute as much as one fourth of the company's workforce of 250 employees. Our extensive Research and Development Department, modern production facilities, and proprietary know-how let us design and deploy new products in a record time – just a few months from the moment of beginning work on the design.

We have developed a whole range of innovative solutions for transport, the power sector, and industry. We were the first to introduce the E-recycler and products based on the SiC technology to the Polish market. In 2014, in cooperation with Siemens and Corvus, Medcom set a Guinness World Record for the longest distance covered by a tramway with a battery supply system. In August 2015, Impuls 45WE commissioned by Koleje Mazowieckie set a new speed record (226 km/h) on the test track and is the fastest passenger vehicle produced in Poland to date.

QUALITY

Our way of winning customers' trust is simple: proven components, proprietary engineering solutions, and reliable devices.

From the very beginning, we have been identified by solid solutions with the highest technical parameters, based on the best quality components available on the global market.

We comply with all the quality standards (IRIS rev. 2.0, ISO 9001, ISO 3834, PN-EN 15085, and ISO 14000). Before we introduce a product into our offer, we subject it to detailed, long-term tests with the use of strict procedures.

To us, high quality means more than just reliable products – it also includes comprehensive technical support, sales, and maintenance services. We offer our customers commissioning and service teams ready to help 24 hours a day. We also provide technical consulting and advisory services on an ongoing basis and organize regular training courses on service and operation, as well as seminars for the designers and users of guaranteed power supply systems.

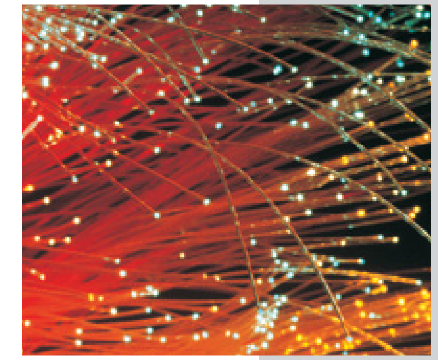
ECOLOGY

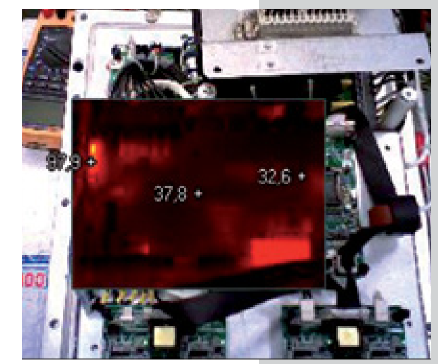
Following the concept of sustainable development, MEDCOM has been developing proprietary technologies which help protect the natural environment and minimize energy consumption.

We realize that the development of the contemporary industry, power industry, and public transport, is possible only thanks to the implementation of new solutions which help reduce energy consumption. And this is why in 2013 we developed the E-recycler – an innovative proprietary system for recovering energy generated during the breaking of traction vehicles.

Our company is also a leader in the dissemination of solutions based on the innovative silicone carbide (SiC) technology, which is likely to revolutionize the market in the coming years.

We manufacture our devices based on environmentally friendly components. We want our proprietary solutions to support the economy efficiently managing energy resources, help reduce air pollution and CO_2 emissions, and build a world based on electromobility.





MILESTONES

1988	MEDCOM is established in Warsaw
1989	A low-power emergency power supply unit for computers is designed
1990	Production of a 16 kVA offline emergency power supply unit for hospitals begins
1991	Production of an online emergency power supply unit begins
1992	First battery charger using the IGBT technology
1993	An emergency power supply unit in the fail-safe technology designed | First railway static converter in the IGBT technology
1994	First battery charger in the IGBT technology with power exceeding 100 kW
1995	First active filter designed
1996	Production of devices for the military begins
1997	Military certificate for battery chargers obtained
1998	The ISO 9001 certificate obtained
1999	A 30 kW AC/DC power supply module designed
2000	A 1,000 kVA inverter, operating in the active filter system, designed
2001	The Economic Award of the President of Poland for the Best Small Polish Enterprise
2002	Production of the SS/SSN/SST/SSTN series static transfer switches begins
2003	Production of high-power multi-system railway traction converters for UIC compliant voltage ranges begins
2004	Production of propulsion systems with power of up to 1,200 kW begins
2005	First 3 kV asynchronous DC propulsion system
2006	First 2 MW asynchronous propulsion system
2007	Train control and monitoring system designed
2008	Production of propulsion systems with power of up to 4000 kW begins
2009	Production of the train control and monitoring system (TCMS) for 3 kV asynchronous DC propulsion systems used in electric multiple units type EN57 AKM and EN71 AC SKM begins
2010	IRIS certification obtained | Opening of the new factory in Warsaw at ul. Jutrzenki 78A Opening of the MEDCOM BRASIL Business Office in São Paulo
2011	First 3.2 MW 3 kV asynchronous DC propulsion system for locomotives
2012	First 5,600 kW multi-system electric locomotive
2013	E-recycler – a supercapacitor-based energy recovery system
2014	Production of traction inverters for electric buses begins
2015	Static converter in the SiC technology
2016	Implementation of the full-SiC technology in new products | Production of a new range of chargers for electric buses begins
2017	Expansion of the factory and construction of a new training and lab center at ul. Jutrzenki 78A Construction of the world's first multi-system propulsion and power supply system for EMUs, with the use of SiC semiconducting elements, begins Inauguration of the Power Electronics postgraduate studies in the 2017/2018 academic year

AWARDS AND DISTINCTIONS

Over the years, MEDCOM has received numerous awards and distinctions. Below, we present some of them:

2001 **The Economic Award of the President of Poland for the Best Small Polish Enterprise**

2005 Honorable Mention in the Prof. Czesław Jaworski Competition at the TRAKO 2005 fair for the 2xFT-300-3000 asynchronous traction drive

2007 Honorable Mention in the Prof. Czesław Jaworski Competition at the TRAKO 2007 fair for the FT series traction inverters for 3 kV asynchronous drives. (The Polish Association of Engineers and Technicians of Transportation [SITK RP] Prof. Czesław Jaworski Competition for the best solutions in the technology and manufacture of devices for electrical traction)

Locomotive of the Railway Market 2007

1999 Medal of the ENERGETAB'99 International Trade Fair for the FA-2000 active filter

Medal of the ENEX'99 International Trade Fair for the SZPW auxiliaries power supply system

Award of the TRAKO'99 International Trade Fair for the PSM-25 static converter

Award of the Prime Minister of Poland – Polish Product of the Future 1999, for the FA-2000 active filter

2012 **The "New Impulse" title for 2012 awarded by Miesięcznik Gospodarczy Nowy Przemysł (New Industry Economic Monthly) and the wnp.pl web portal for effective operation on the market of modern electrotechnical equipment for industry and transport and one of the most dynamic examples of growth among medium-sized innovative Polish companies**

Forbes Diamonds 2012 (No. 126 nationwide, companies from PLN 50 to 250 million)

2014 **27th ENERGETAB 2014 International Power Industry Fair in Bielsko-Biała – Kazimierz Szpotański Lion Award for the E-recycler, a supercapacitor-based energy storage system**

2013 Forbes Diamonds 2013 (No. 14 nationwide, companies from PLN 50 to 250 million)

Grand Award in the Prof. Czesław Jaworski Competition (TRAKO'2013) for the 2xFT-500-3000 asynchronous traction drive

ZB and ZBDM series battery chargers for battery banks. The ZB and ZBDM series battery chargers are used to supply DC circuits, especially when operating with a buffer battery bank. They boast high reliability, very low output voltage ripple, and a vast range of options.

Intended for charging and monitoring the battery, the new generation DC power supply units guarantee:

- Compliance with all battery types
- Operation in various configurations thanks to the adaptation to parallel and serial operation
- Current equalization can be used in parallel connection
- Extensive equipment in the standard version and a number of additional systems considerably increase charging quality and have a significant influence on battery life
- Very high resistance to network-based interference
- Compatibility with state-of-the-art remote monitoring and remote control systems
- Maintenance-free, easy servicing
- Much lower weight in comparison to conventional battery chargers with thyristor rectifiers

The standard version of the ZB series battery chargers guarantees:

- Compliance with 24, 48, 60, 110, 220, 400, and 440 V batteries
- Very high stability (<1%) and very low ripples (<0.5%) of output voltage
- High stability of output parameters regardless of load changes or voltage variations in the supply network
- The possibility of setting output voltage and – thanks to separate measurements of battery and load currents – setting battery current limitation
- Full galvanic isolation of DC and AC circuits
- Resistance to overload and short circuits (electronic safeguard)
- Information about output parameters and alarm operating states of the battery charger on the alphanumeric display
- Signaling that alarm parameters were exceeded
- Easy expansion of the power supply system thanks to compatibility with "plug & play" operation
- Systems incorporating an additional power supply unit for the so-called "booster battery" and the automatic circuit for connecting this battery if the primary battery is discharged can be set up

BATTERY CHARGERS
ZB series

Moreover, they can additionally be equipped with cutting edge auxiliary systems:

- The RS232, RS485, and Ethernet interfaces with software enabling complete remote control of the operation of the battery charger using a PC or a terminal
- A system and a probe for thermal correction (-10°C ÷ 40°C) of the battery end-of-charge voltage
- Operation in buffer, charging or boost charging mode
- Automatic battery circuit continuity control system
- Continuous measurement of the charge supplied to and drawn from the battery
- Digital battery operation monitor storing about 4000 previous alarm states or an RPB series monitor
- Battery circuit earth-fault measurement

Basic technical specifications		
Output power	**up to 2.4 kW**	**2.4 ÷ 264 kW**
Supply network voltage	**230 V**	**3×400 V**
Supply voltage variation range	**15% ÷ +10%**	
Output voltage stability	**< 1%**	
Output voltage ripple	**< 0.5%**	
Output voltage thermal correction	**10°C ÷ +40°C**	
Output current limitation threshold	**(1.02 ÷ 1.05) ln**	

Battery chargers are manufactured in W, S1, S2, R type housings and TS1, TS2, and TS3 type housings. R type housings are modules (5U) of the 19" rack system and are intended for mounting in TS type housings (or others compatible with the system).

Purpose

The ZBDM series high power battery chargers are intended for the uninterruptible (when working with the battery bank) power supply of 220 V, 125 V, 110 V or 24 V DC loads which are strictly required to operate continuously. Battery chargers also make it possible to charge individual batteries and supply DC loads in systems without batteries.

Battery charger basic module

The battery charger module is an autonomous unit that can operate separately or in systems comprising 1 ÷ 12 units (special versions may comprise up to 18 or up to 24 units).

The device features a three-stage energy processing technology. High frequency transformers with leading-edge nanocrystalline cores and IGBT transistors ensuring high efficiency and reliability of the battery charger are used for energy processing. As standard, the modules are supplied with 3 × 400 V – the 24 V (100 A) module is supplied with 230 V. In the export version (60 Hz), a 125 V (120 A) module with single-phase 480 V supply is also available – the input circuit includes a PFC system ensuring a sine waveform of current drawn from the network.

Module cooling is forced by two high efficiency fans supplied with direct current.

They feature a two-stage operation – up to about 60% of the rated module load, the fans operate at half of their performance. After reaching about 60% of power, the fans operate at full performance.

The modules are autonomous units, i.e. they can operate individually after a failure or tripping of the external control system.

Battery charger basic module

Properties:

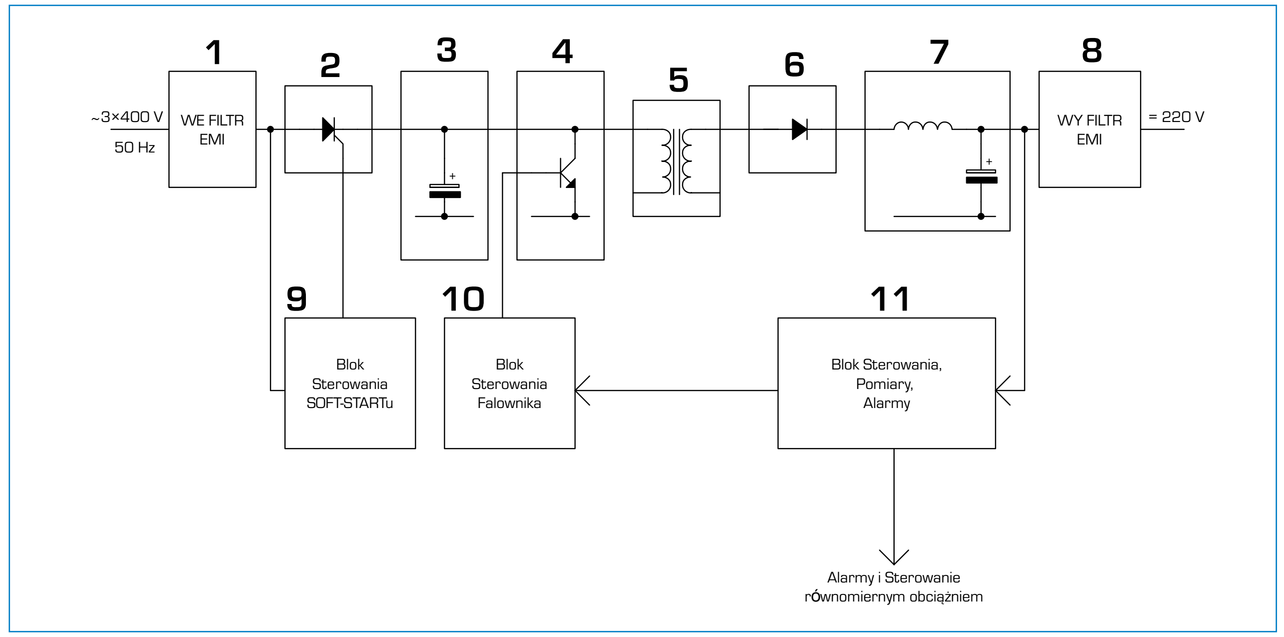
- Basic modules: 220 V (100 A), 110 V (150 A), 24 V (200 A), 24 V (100 A)
- 60 Hz version 125 V (120 A) module
- Parallel operation of modules with automatic current equalization
- Very high stability and exceptionally low voltage ripple
- Electronic overload and short circuit protection
- Very good dynamics with step load change
- Very high efficiency
- Battery charging voltage thermal correction
- Charging specification in compliance with PN-90/E-83007 and EUROBAT recommendations
- Several modes of operation: buffer, equalizing battery charging
- Very high reliability
- Electromagnetic compatibility (EMI filters)
- Battery circuit continuity control system
- Individual panels for monitoring modules and a general battery charger panel
- Passcode protected key panel connected to an LCD display (80 characters)
- Large set of alarm signals and 10 configurable alarm relays
- The RS232/485, LAN, CAN interfaces for remote monitoring and control of the battery charger operation
- Modules can be serviced individually without switching off the battery charger

HIGH POWER BATTERY CHARGERS
ZBDM series

Electrical and mechanical specification of an individual module

Technical data						
Rated input voltage	**220 V**	**110 V**	**125 V**	**24 V**	**24 V**	**other voltages available on request**
Rated output current	**100 A**	**150 A**	**120 A**	**200 A**	**100 A**	
Rated input voltage Uwe	**3×400 V**		**480 VAC**	**3×400 V**	**230 V**	
Permissible voltage variation Uwe	**-15% ÷ +10%**					
Input frequency	**50 Hz**		**60 Hz**	**50 Hz**		
Input current	**3×40 A**	**3×27 A**	**43 A**	**3×10 A**	**5 A**	
Rated power	**25 kW**	**23 kW**	**18 kW**	**6 kW**	**3 kW**	
Output voltage stability	**≤ 0.4%**					
Output voltage ripple	**≤ 0.4%**					
Efficiency	**ca. 95%**					
Ventilation	**internal inflow fans on the bottom, outflow fans on the top**					
Cable inputs	**from the bottom**					
Dimensions (height × depth × width)	**(600×550×170) mm**					
Weight	**65 kg**					
Protection rating	**IP20**					

Power module block diagram



Block diagram legend: 1. LC EMI filter, 2. Diode and thyristor rectifier, 3. Input smoothing filter, 4. Transistor inverter, 5. High frequency transformer, 6. Output rectifier, 7. LC output filter, 8. LC EMI filter, 9. Soft start control unit, 10. Transistor inverter power circuit controller, 11. Block of alarm and measuring systems

The basic configuration of the battery charger rack features the following:

- Battery charger modules (1 ÷ 12)
- A microprocessor-based control system
- Input and output module safeguards

The battery charger rack can optionally be equipped with the following elements:

- Actuating systems
- Battery and loads disconnectors
- Input ATS system
- Booster battery connection devices
- Load safeguards
- Measuring devices
- Earth-fault control system
- Converter systems for measuring voltage and current
- Battery diagnostics system(s)

Auxiliary elements

- Anti-condensation heater
- Air filters

Description of the control panel

The control panel is divided into three sections:

- Liquid-crystal display (LCD) with a key panel
- LEDs for local alarm signaling
- Battery charger design diagram

The "TEST LED" button monitors the working order of the LED signals and additionally switches off the acoustic signal during the alarm state.

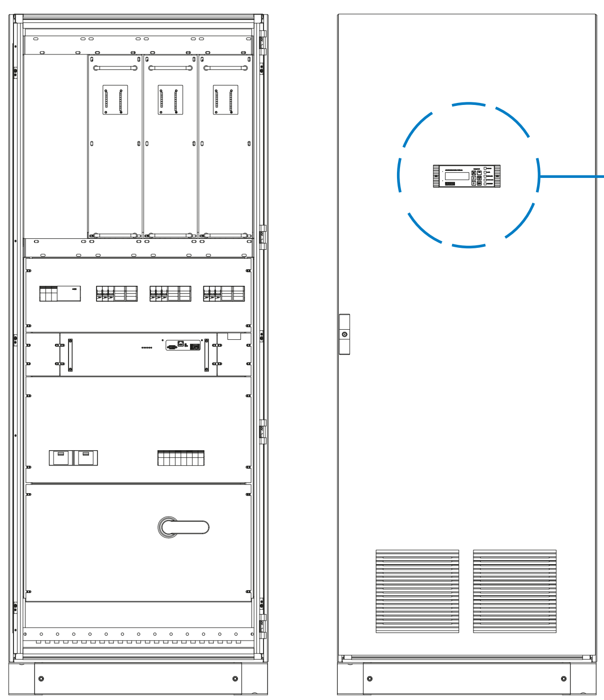
The "RESET ALARM" button resets the registered alarm states.

Display

Each battery charger features a monitoring panel with an easy to read alphanumeric display, key panel and LEDs.

The display provides the following data:

- Output voltage and current
- Battery ambient temperature
- Charge supplied to and drawn from the battery
- Messages on alarm states:
  - OVERLOAD
  - SHORT CIRCUIT
  - NO CHARGING
  - NO NETWORK
  - BATTERY LOW
  - NO PHASE
- And with additional options:
  - BATTERIES OPEN CIRCUIT
  - TEMPERATURE (>Tmax)
  - SENSOR FAILURE (temperature)
- Recording alarm states by the monitor: year–month–day–hour–minute–U–I–alarm state code



Battery charger design

Technical specification

Supply parameters				
"Rated" input voltage	3×400 V	230 V	480 V	other voltages available on request
Frequency	50 Hz		60 Hz	
Input current	depends on the number of modules			
Permissible voltage variation range (output rated parameters)	-15% ÷ +10%			
Permissible voltage variation range (operation)	-15% ÷ +20%			
Power factor cos (f)	ca. 0.92			
Overvoltage resistance	category I			PN-93/E-05009/443
Insulation strength	DC 2.8 kV 60 s			
Output parameters				
Rated output voltage	220 V, 110 V, 24 V	24 V	125 V	other voltages available on request
Rated output current In	depends on the number of modules			
Output current limitation	1.02 ÷ 1.05 In			stabilization of the output current at the limit level
Battery current limitation adjustment	0.1 ÷ 1.0 In			stabilization of the battery current at the limit level
Performance characteristics	IU			
Rated power	depends on the number of modules			
Efficiency	ca. 95%			
Output voltage stability	≤ 0.4%			typically 0.2%
Output voltage ripple	≤ 0.4% pp			rms 0.1%
Voltage thermal correction range	-10 ÷ +40°C			
Measurements				
Output voltage – accuracy	0.5%			
Output current – accuracy	1%			internal LEM sensor
Alarms				
ALARM 1 *)	low battery voltage, no battery charging, no input voltage			
ALARM 2 *)	open battery circuit			
ALARM 3 *)	battery circuit earth-fault (option)			
ALARM 4 *)	output voltage low or high			
ALARM 5 *)	overload, overheat, equalizing charging, overvoltage protector failure, malfunction of one of the modules, backup line operation (option), thermal probe failure (option), temperature outside compensation range (option)			

* a different configuration for the activation of alarm relays can be specified in the order

Purpose

DC/DC converters are intended for converting supply source voltage into voltage required by current-using equipment. Converters change the output voltage and simultaneously stabilize it and eliminate interference.

By ensuring galvanic isolation between the input and output circuits of the DC/DC converter, it can be used in battery bank and load systems whose poles are earthed in reverse or it can be used to connect an earthed system to an unearthed system.

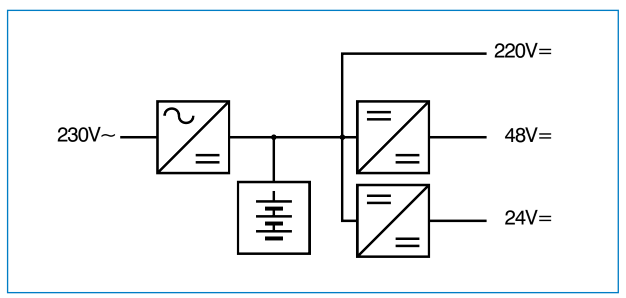
DC/DC converters are used in 220 V (110 V) battery supply systems to obtain low voltages (24 V or 48 V). The redundancy used in the DC/DC converter ensures the high supply reliability of low voltage loads. Consequently, an additional battery bank system (24 V or 48 V) does not have to be used. The continuity of supply for low voltage loads is provided by the 220 V (110 V) battery bank and the DC/DC converter.

Similarly, low voltage DC/DC converters make it possible to supply high voltage loads (220 V or 110 V) from the 24 V or 48 V battery supply system. In this case, the use of a 220 V or 110 V battery bank becomes unnecessary.

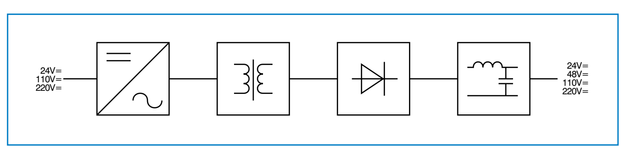
The major advantage of using DC/DC converters consists in limiting the number of battery supply systems with various rated voltages, which eliminates the costs of installation and maintenance of additional battery banks. The same backup time is maintained for all loads.

19” subrack with DC/DC converters

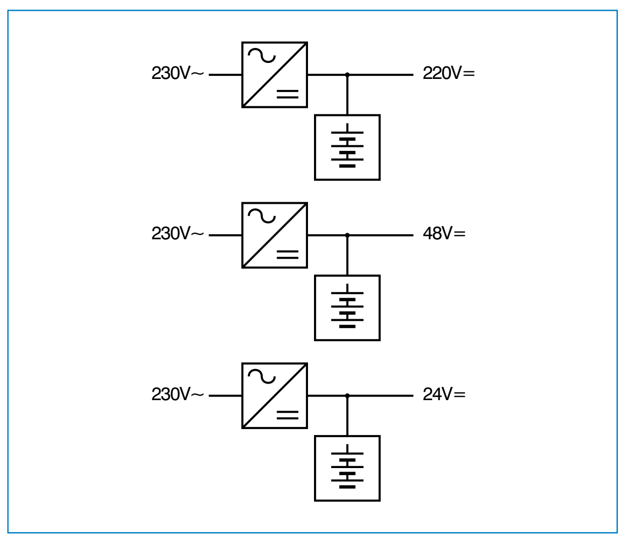
DC/DC converters for mounting in a 19” rack



Single-battery system with converters



DC/DC converter block diagram



Classic multi-battery system

MODULAR DIRECT CURRENT CONVERTERS

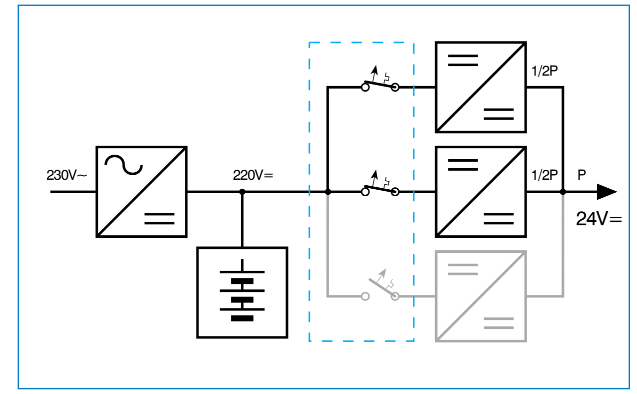
DC/DC Converters

Principle of operation

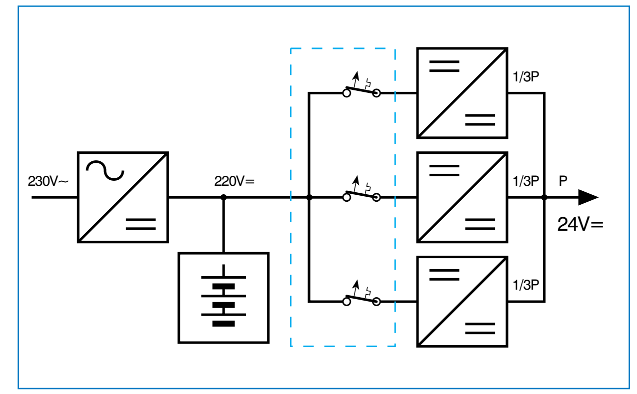
The DC/DC converter comprises a voltage inverter with IGBT or MOSFET transistors, a high frequency transformer, and an output rectifier with a filter. Input direct voltage is continuously changed by the inverter into a high frequency alternating voltage wave. Next, the transformer matches the voltage amplitude as required by the output and provides galvanic isolation between the input and output circuit. The voltage from the transformer is rectified and after ripples are filtered out, it is supplied to the converter output. The adjustment and stabilization of the output voltage of the DC/DC converter is performed via voltage inverter transistor pulse-width modulation.

To increase the reliability of supplying current-using equipment, DC/DC converters are manufactured as redundant systems, e.g. featuring 2-of-3 redundancy. This means that three DC/DC converters adapted to parallel operation are mounted in one power supply subrack. The output power of any two converters is sufficient to properly supply the loads. During normal operation, converters operate with a common load and each one provides 1/3rd of the output power. If any converter fails, the remaining two take over the supply of loads. During this time, the damaged converter can be replaced (without switching off the power system).

The supply subrack is fitted with a set of fuses protecting circuits of individual DC/DC converters. Configurations with various redundancy versions (1-of-2, 2-of-3) and various numbers of converters connected for parallel operation can be ordered.



2-of-3 redundant system during emergency operation



2-of-3 redundant system during normal operation

DC/DC converters basic technical specifications

Parameter	Value				
DC input voltage	220 V			110 V	
Permissible input voltage variation range	+15%, -15%				
DC output voltage	24	48 V	110 V	24 V	48 V
Rated output current [A]	15, 50, 100	10, 75	50	50	50
Output voltage stability	≤ 1%				
Efficiency	≥ 90%				
Output voltage ripple	≤ 0.5%				
Overload capacity	1.02In*				
Operating temperature	0 ÷ 40°C				
Storage temperature	5 ÷ 40°C				

* Overload capacity of 2In can be arranged with the manufacturer

The FM, FPM, and FPTM series inverters make it possible to supply single-phase or three-phase AC loads with a stabilized voltage free from interference. They can be supplied from a direct or alternating voltage network or both at the same time.

The special version of inverters (the so-called "Z" series) boasts higher short-circuit current which, in the case of multiple supplied circuits, enables quick operation of the fuse and selective disconnection of the circuit where the short circuit occurred.

Single-phase inverters are manufactured as standard in power ranges from 1 kVA to 60 kVA, whereas three-phase inverters are in the 3 kVA to 250 kVA power range.

Purpose

Cutting edge industrial and power engineering inverters work with an external 220 V (340 V) battery ensuring continuous operation of 230 V and 3×400 V (50 Hz) loads in the case of voltage loss in the supply network.

Inverters:

- Can operate in various configurations, including redundancy
- Current equalization can be used in parallel connection
- Are characterized by higher interference resistance (from network and load end)
- Are resistant to overloads and short circuits
- Supply stabilized voltage with low harmonics
- Are compatible with static switches
- Are compatible with state-of-the-art remote monitoring and control systems
- Operate in a fully automatic mode and are easy to operate
- Devices are with a proven track record in industry and the power engineering sector

Inverter features:

- High reliability
- Small size and weight
- Easy installation and operation
- Sine output voltage waveform
- Parallel operation
- Microprocessor control (high voltage stability, high frequency stability, low harmonics level)

Supply parameters	
Voltage	**230 V single-phase devices 10%** [1)] **3×400 V three-phase devices 10%** [1)]
Frequency	**50 Hz ±2 Hz** [1)]
Output parameters	
Voltage	**230 V single-phase devices** [1)] **3×400 V three-phase devices** [1)]
Frequency	**50 Hz ±0,2 Hz 1)**
Voltage stability	**3%**
Impulse response	**±10% within 60 ms**
Power factor cos (f)	**0.7 ÷1.0**
Efficiency	**88 ÷ 95%**
Crest factor	**3:1 (6:1)**
Output voltage overload capacity	**125% In / 10 s**
Harmonics content in output voltage	**<3%**
Safeguards	
Overvoltage	**switching off or switching over to bypass** [2)]
Undervoltage	**switching off or switching over to bypass** [2)]
Short circuit	**switching off after 10 s or switching over to bypass** [2)]
Operating conditions	
Acoustic noise level	**53 dB ÷ 66 dB**
Operating temperature	**0 ÷ 40°C** [1) 3)]
Storage temperature	**5 ÷ 40°C**
Humidity	**98% without condensation**
Cooling	**forced**
Housings [4)]	
Protection rating	**IP20**
Material	**1 mm, 1.5 mm, 2 mm steel sheet**
Finish	**powder coating RAL 7035** [1)]
Access	**from the front**
Cable input	**through rack bottom** [1)]

[1)] it is also possible to order battery chargers with customised specifications
[2)] depending on the system configuration
[3)] this does not apply to the battery working with the battery charger
[4)] housings with the dimensions provided herein do not include the BYPASS circuit transformer

Purpose

Static transfer switches (STS) are intended for contactless transfer of single-phase or three-phase alternating voltage circuits. In contrast to the classic automatic transfer switching (ATS) device, the transfer is about 20 times faster (typically 1/4 of a period), which allows to maintain the continuity of operation of loads which are particularly sensitive to supply interruptions. The return transfer of the load to the preferred line occurs practically without interruption (typically 3 ms). STSs are generally used in control and power engineering circuits, power systems in the petrochemical industry, computer and telecommunication centers, operating theaters and intensive care units, smart building automation and protection installations, and other loads sensitive to instantaneous supply voltage loss.

The high overload capacity of static transfer switches and the algorithm for transfer to the source with higher current efficiency enables quick isolation (disconnection) of short-circuited network fragments and provides the proper supply of other loads. Implemented thyristor switch overvoltage protection systems constitute an additional protection of the loads against damage.

Characteristics:

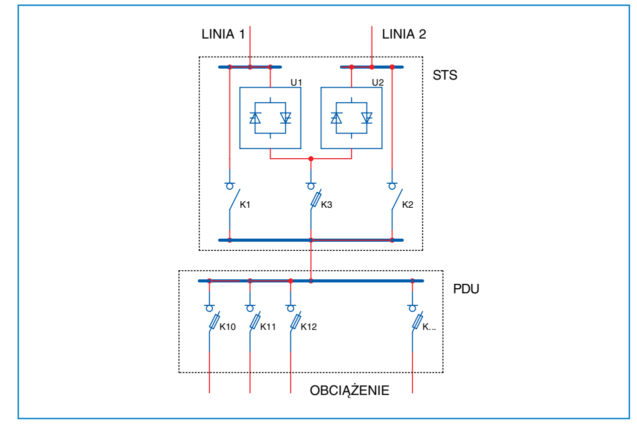
- Possible to create systems with redundancy (transfer between independent electric lines, various UPSs and power generators)
- Short disconnect time (typically 3 ms) from the damaged line
- Elimination of voltage dips, surges, and interruptions on the load (transfer)
- Controlling switches using the FAIL-SAFE CMOS technology to provide quick transfer and low sensibility to interference
- Internal redundancy of power systems, measuring systems, and thyristor switch controllers (elimination of points that could put the system out of order)
- Easy operation
- Simple installation
- Short mean time to repair time (MTTR)
- Low installation and operation costs in comparison to UPS systems
- Bypass switch system making it possible to service the STS without interrupting supply
- Remote transfer of the supply source
- Signaling device and supply line operating condition, optionally:
- Communication interface:
  - MODBUS RTU
  - SNMP Server, MODBUS TCP, WEB

STATIC TRANSFER SWITCHES
SSN, SST, SSTN series

Configurations

STS SYSTEM FOR THE POWER DISTRIBUTION UNIT

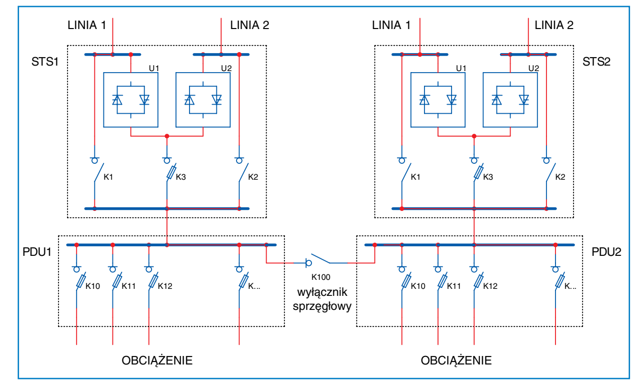
THE STS SYSTEM FOR THE POWER DISTRIBUTION UNIT (PDU) is a set manufactured by leading international companies. Simple implementation of the PDU based on the static switch control system is possible at the manufacturing stage. Transfer to the backup input occurs when the preferred input voltage exceeds the permissible tolerance. The STS input supply from the UPS system makes it possible to transfer the supply on the UPS request caused e.g. by a discharged battery. Transfer occurs without interruption even before the loss of voltage in the UPS connected to the preferred line.



Operation of the STS with a power distribution unit

TWO-STS SET FOR THE TWO-SECTION POWER DISTRIBUTION UNIT WITH A TIEBREAKER

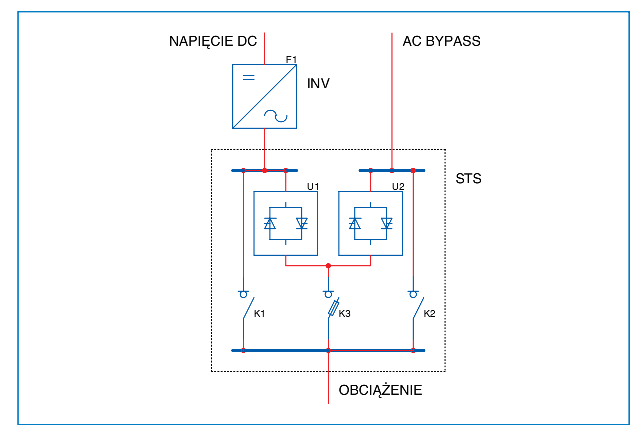
The two-STS set for the two-section PDU with a tiebreaker enables the independent operation of both STS–PDU section sets. Both PDU sections can be transferred to a single STS. The tiebreaker is triggered after both STSs are service transferred to a single supply line. After one STS is disconnected, the other one can operate individually with both PDU sections.



Operation of two STSs with a two-section power distribution unit with a tiebreaker

STS SET ON THE NETWORK VOLTAGE INVERTER OUTPUT

An individual voltage inverter with a limited output current is susceptible to short circuits and overloads which result in output voltage drops and dips. Voltage dips are eliminated by adding a network bypass circuit via the STS on the inverter output. Transfer to the backup line occurs if the inverter output voltage exceeds the permissible tolerance or if the maximum current is exceeded (the shortening of fuse blow times in supplied circuits).



Operation of the STS with an inverter

Technical specification Other voltage versions can be requested, please contact the commercial department at info@medcom.com.pl

Supply parameters			
Rated input voltage	120 V 3×208 V 3×480 V	230 V, 240 V 3×400 V, 3×415 V	TN-C, TN-S network model
Permissible voltage range	-25% ÷ +20%		operation
Frequency	60 Hz	50 Hz	
Frequency tolerance	-9% ÷ +6%		
Overvoltage resistance (overvoltage limitation)	<1.5 kV		for Iimp 15 kA 8/20us
	<1.0 kV		for Iimp 5 kA 8/20us
Insulation strength	AC 2 kV 60 s		
Efficiency	>98%	>99%	for cos(Φ) > 0.8
Output parameters			
Rated output current	63 A, 100 A 150 A, 250 A 400 A, 630 A 1,000 A		available versions: • 1-phase 2-pole (neutral transferred) • 3-phase 3-pole • 3-phase 4-pole (neutral transferred)
Maximum crest factor	3.5		
Power factor cos (f)	0.5÷1		inductive, capacitive
Overvoltage resistance (overvoltage limitation)	<1.5 kV		for Iimp 15 kA 8/20us
	<1.0 kV		for Iimp 5 kA 8/20us
Overload capacity	125% 400% 800% 1,000% 1,500%		t = 1 h t = 5 s t = 0.4 s t = 0.2 s t = 20 ms
Short-circuit strength of thyristor switches	3 kA / 20 ms 8 kA / 20 ms 15 kA / 20 ms 28 kA / 20 ms 55 kA / 20 ms		In= 63 A In=100, 150 A In=250, 400 A In=630 A In=1,000 A
Breaking capacity of fuses	50 kA		

Transfer parameters		
Preferred input selection	L1 / L2	with retransfer or without retransfer after the disturbance in the preferred input line disappears
Remote preferred line selection	L1 / L2	Two-state input for the L1 / L2 line
Input voltage upper limit setting range	+6% ÷ +20% in 3% increments	transfer when the limit is exceeded and the second line is operational
Input voltage lower limit setting range	-8% ÷ -24% in 4% increments	programmed with a DIP switch
Synchronized line phase error limit setting range	±8° ÷ ±24° in 4° increments	
Transfer interlock after exceeding output current	3 In 6 In 9 In no interlock	programmed with a DIP switch
Manual transfer time of synchronized lines with phase error below the limit	< 0.6 ms	
Automatic transfer time of synchronized lines with phase error below the limit	< 6 ms	
Manual or automatic transfer time of unsynchronized line	12 ms 17 ms 25 ms 50 ms	programmed with a DIP switch
Time of retransfer to preferred line	1 s 8 s 25 s	programmed with a DIP switch (both lines operational)

ACTIVE FILTERS

Series: FA, FA-3, FAW-3

Purpose

Active filters are intended to compensate passive distortion power and passive displacement power or, after appropriate switching, only passive distortion power. In both cases, the active filter decreases the higher harmonics content in the current drawn from the network supplying non-linear loads.

Three-phase active filters have an additional advantage, i.e. balancing the supply network three phase load. In the case of an installation fitted with a neutral conductor, this ensures current compensation in that conductor.

Three-phase filters are manufactured in a version for a 3-wire network or in a universal version (3- or 4-wire network).

The filter ensures:

- Decreased harmonics content in the current drawn from the network
- Decreased peak value of the current drawn from the network
- Decreased effective value of the current drawn from the network
- Decreased starting current when switching on loads
- Decreased network interference hazardous to loads

The advantages of using the filter include:

- Decreased supply cable diameter
- Decreased rated values of supply network fuses
- Decreased power of the electric power generator or the inverter supplying the loads

The advantages of multi-level filters include:

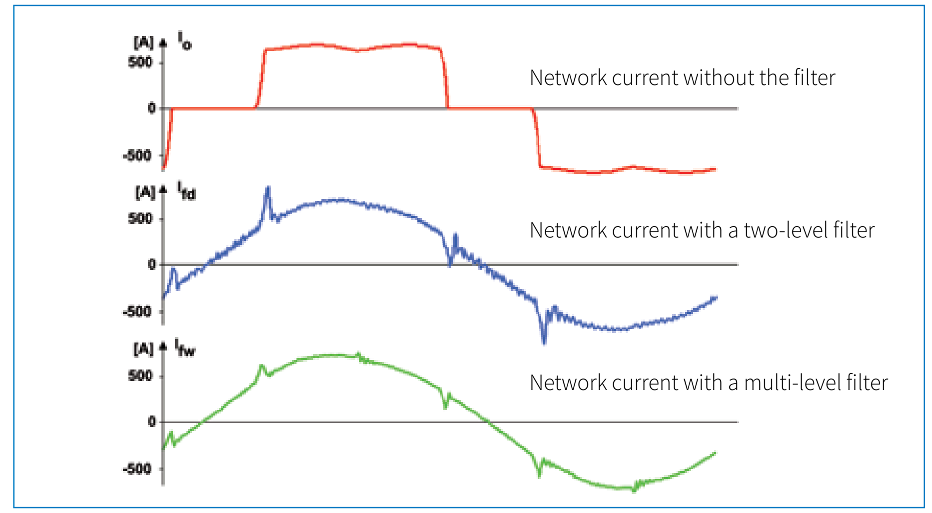
- Very high slew rate of compensation current (2,000 A/ms for the 200 kVA filter) ensuring effective correction of current distortions generated by non-linear loads
- Can work with loads up to 3×600 V
- High efficiency
- Low content of high frequencies in the filter output current

Principle of operation

The principle of operation of the filter is illustrated in the block diagram provided in Fig. 1.

The diagram identifies: input fuses, an overvoltage protection system, passive LC filter, transistor inverter (IGBT), Cf capacitor bank connected to the direct voltage circuit, and the control block. Based on the comparison of load current with the reference sine wave, the control block determines the form of the current generated by the inverter. After this current is added to the load current, it gives the network current a sine waveform. Operation of the active filter is possible thanks to the bidirectional energy flow in the inverter-capacitor Cf system.

ACTIVE FILTERS
Series: FA, FA-3, FAW-3



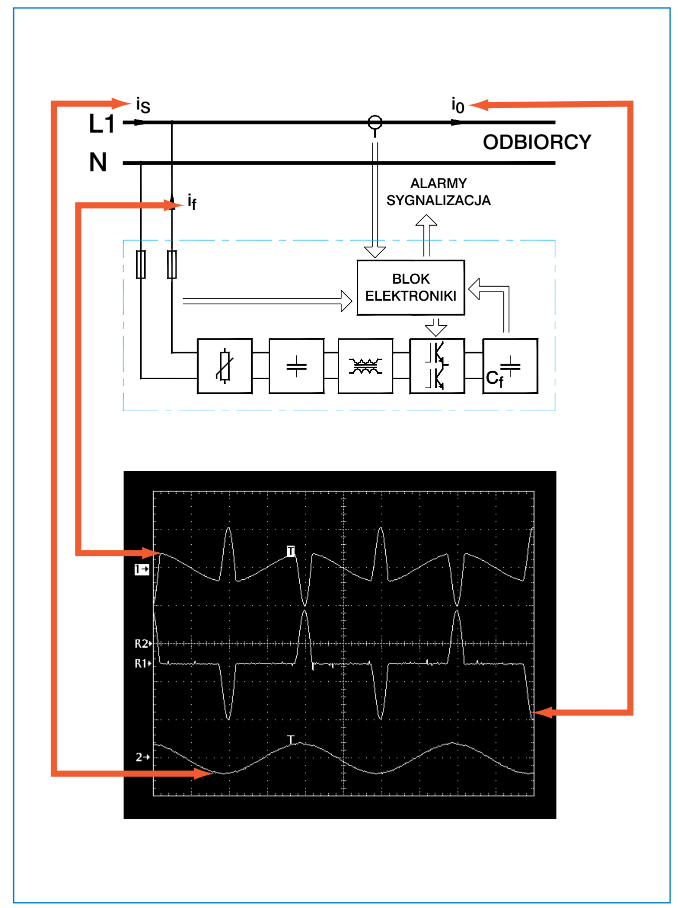


Fig. 1. Filter block diagram and current waveforms in the system

AUXILIARIES POWER SUPPLY SYSTEM

Purpose

Instantaneous supply interruptions or other disturbances resulting in device failure can frequently cause high financial losses and even pose a serious health hazard. To prevent the consequences mentioned above, guaranteed power supply systems, ensuring continuous operation of devices in case of electric network based disturbances can be installed. The relevance of the power supply continuity issue is confirmed by spectacular failures frequently encompassing large areas and population centers.

The most frequently used guaranteed power supply solutions include:

- A rectifier-battery set for supplying DC loads
- A UPS, for supplying AC loads (1- and 3-phase)
- An auxiliaries power supply system for the comprehensive power supply of AC and DC loads
- A distributed power supply system

Rectifier-battery set

The rectifier-battery set constitutes a basic DC load guaranteed power supply system. The ZB series battery charger – specially adapted to battery operation – is fitted with a number of extra options increasing the reliability of the set. These include battery circuit automatic continuity control, battery charging voltage thermal compensation, battery boost charging, a battery operation monitor, a battery earth-fault control system, etc.

Using diode sensors or DCDC separators, rectifier-battery sets can be connected to form larger systems. The separators (provided with galvanic isolation) enable reciprocal backup of connected charger-battery sets, considerably increasing the reliability of the load supply.

AUXILIARIES POWER SUPPLY SYSTEM

Auxiliaries power supply systems

Auxiliaries power supply systems are intended for comprehensive guaranteed power supply of DC and AC loads.

The systems include:

- ZB series battery chargers
- Direct voltage DC/DC converters
- FM, FPM, FPTM series inverters
- SS/SSN/SST/SSTN series static transfer switches
- Auxiliary devices and measurement and monitoring equipment
- Battery banks

System configuration is determined based on the individual requirements of each installation. The system can operate with an existing battery or can be delivered as a complete set. The system is delivered with an appropriate number of output circuit breakers with arranged output parameters, as requested by the Customer.

Central and distributed power supply systems

AC load guaranteed power supply systems can be implemented using one of two possible topologies:

- A central system with a single UPS and an extensive network, connected to each load comprising the system
- A distributed system with individual UPSs dedicated to each load (or a small group of loads)

Both topologies have their advantages and disadvantages.

Advantages and disadvantages of the distributed power supply system

	Central system	Distributed system
Advantages	1. One battery charger and one battery are easy to maintain	1. Low cost
	2. Long backup time with a high capacity battery and a program disconnecting minor loads during autonomous operation	2. Easy to expand
	3. The battery charger and battery room can be fitted with an AC unit to extend the system lifetime	3. Standard supply network can be used
Disadvantages	1. High cost	1. Low backup time of the supplied devices
	2. An additional guaranteed voltage installation has to be provided	2. Low lifetime of the batteries in battery chargers

STATIONARY SUPERCAPACITOR-BASED ENERGY STORAGE SYSTEM FOR ACCUMULATING ENERGY

UCER-01

Principle of operation

The energy storage system is connected to the traction network by the substation's DC distribution board. The storage system circuit is protected with DC fuses. The disconnector on the input breaks the circuit and allows the converter circuit to remain dead. After supplying voltage to the 600VDC input, the soft start system charges internal capacities and limits the starting current of the device..

The closing of the K_UCM/TR disconnector also connects the supercapacitor modules to the converter output. The circuit output is equipped with a soft start system if there is no voltage in the capacities in the intermediate circuit. The soft start system on the supercapacitor end limits the current impulse from the charged supercapacitors to the converter.

An additional IGBT module enables controlled supercapacitor discharging to the discharge resistor. The resistor is connected with SG5 and SG4 contactors. The SG3 and SG4 contactors are switched on in the case of an emergency device shut-off and directly connect supercapacitor modules with the discharge resistor.

The opening of the K_UCM/TR („OFF") disconnector interrupts the supply circuit on the traction end and on the supercapacitor battery end. Switching on of the UZ1 disconnector causes the internal capacities to discharge and the converter remains dead. The ground contact can be connected only if the green signal lamp "OK TO GROUND" is lit. The signal lamp signalizes open main contactors in the supercapacitor and traction battery supply circuit.

The mechanical interlock prevents the simultaneous connection of the K_UCM/TR and UZ1 disconnectors.

The input and output systems are fitted with overvoltage and overcurrent safeguards.

The guaranteed 24VDC supply is provided by a buffer rectifier connected to a chemical battery.

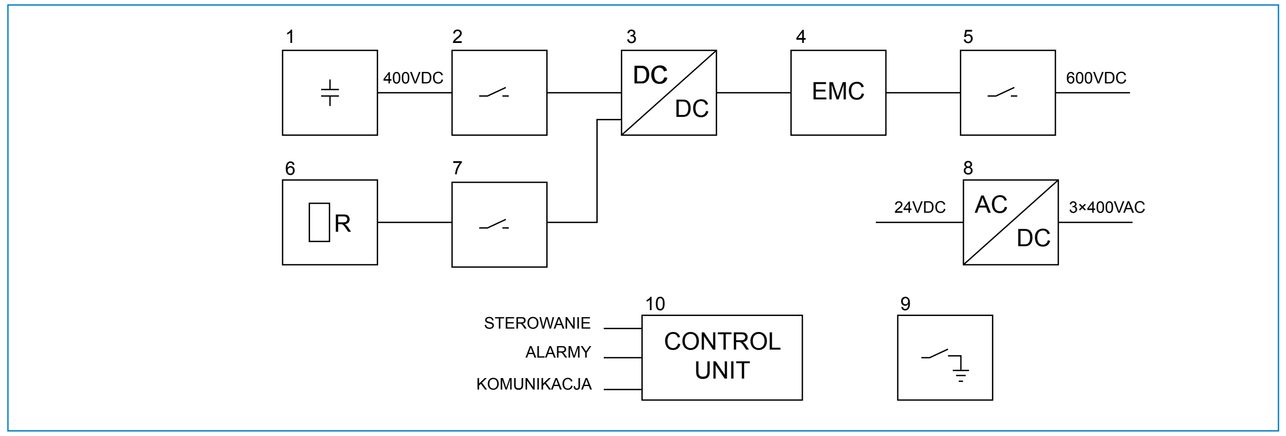
When voltage drops to the <Ud1 ; Ud2> range on busbars, supercapacitor discharging and energy transfer to the traction network begins. When voltage increases to the <Uc1 ; Uc2> range on busbars, supercapacitor charging and transfer of the braking energy to the storage system begins. At the same time, the diode rectifier current is controlled so that charging does not use the substation supply network. When voltage exceeds Uri on busbars, interventional energy dissipation in the discharge resistor begins.

System control is performed locally from the cam-switch and the HMI touch panel. The system can be remotely disconnected from the traction network by controlling the high speed current breaker in battery charger field no. 2.

The UCER-01 assembly can also be shut off remotely without disconnecting it from the traction network.

recycler

UCER-01 block diagram



Electrical parameters

Parameter/feature	Value	Remarks
Input voltage	**600 VDC**	
Input current	**500 A**	
Input voltage variation range	**400 ÷ 900 VDC**	
Input protection	**internal protection**	fuses + electronic safeguards
Output EMC filter	**yes**	
Overvoltage protection	**Class OV3**	varistor protection
Operating temperature	**0°C to +45°C**	
Input power	**400 kW / 20 s**	

Input parameters – supercapacitor

Parameter/feature	Value	Remarks
Output voltage	**375 VDC**	
Max. output voltage	**388.8 VDC**	
Output current	**1,000 A**	
Output voltage variation range	**187 ÷ 375 VDC**	
Battery capacity	**104.15 F**	
Energy capacity	**1.56 kWh**	
Output protection	**internal protection**	fuses + electronic safeguards
Output power	**400 kW / 20 s**	
Short-circuit protection	**yes**	

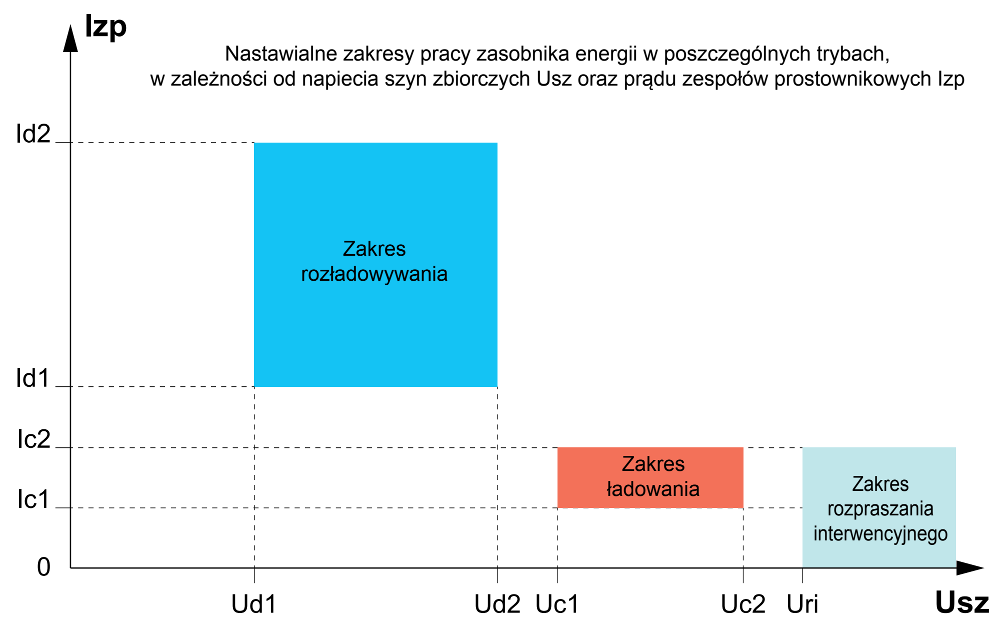
Mechanical parameters – converter cabinet

Parameter/feature	Value	Remarks
Dimensions	2,000 / 800 / 800	height / width / depth
Weight	850 kg	
Operating temperature	0°C ÷ 45°C	
Humidity	<98%	
Housing protection rating	IP21	

Mechanical parameters – supercapacitor module container

Parameter/feature	Value	Remarks
Dimensions	2,056 / 1,917 / 1,170	height / width / depth
Weight	1,245 kg	
Operating temperature	-25°C ÷ 45°C	
Humidity	<98%	
Housing protection rating	IP55	

Energy storage system operating ranges



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STATIONARY SUPERCAPACITOR-BASED ENERGY STORAGE SYSTEM FOR ACCUMULATING ENERGY
UCER-01

HMI computer main screen

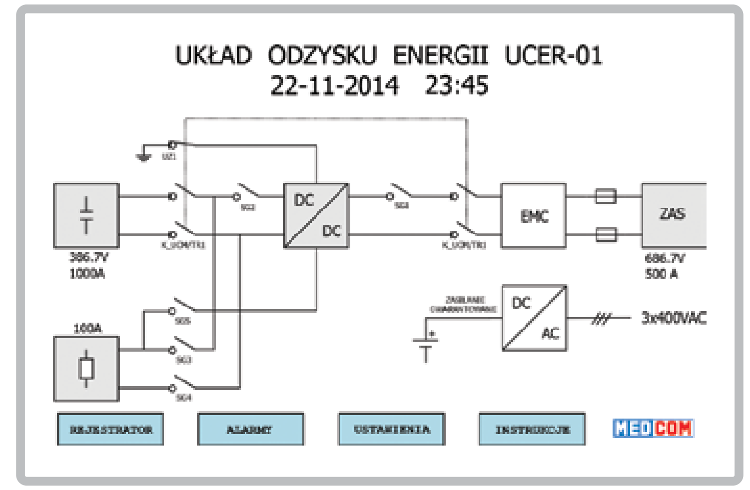
Keys for accessing the monitoring device, viewing current alarms setting system parameters, and viewing the system instruction manual are located in the bottom section of the screen.

Pressing individual UCER-01 system blocks lets the user view individual system parameters:

- Supercapacitor container (UCER-01 STORAGE SYSTEM)
- DC/DC converter (UCER-01 DC/DC)
- System power supply

If the AC/DC block is lit in red, this signalizes an alarm generated by the battery rectifier supplying the 24 V battery – guaranteed voltage.

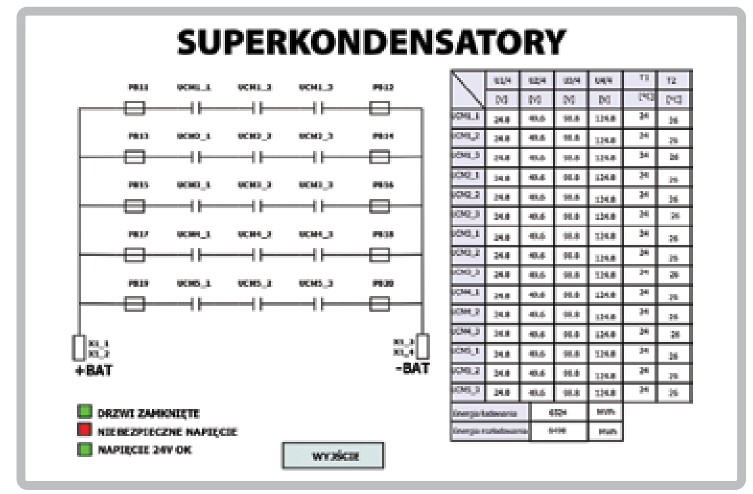
If an alarm is generated, a red “Alarms” message is displayed on the screen.



HMI computer screen – supercapacitor view

The supercapacitor view screen displays the following readouts:

- Supercapacitor module voltage
- Supercapacitor module temperature
- Supercapacitor module charging level
- Charging energy, i.e. energy supplied to the storage system
- Discharge energy, i.e. energy drawn from the storage system
- Container door closing signal (UCER-01 STORAGE SYSTEM)
- >60 VDC battery voltage signal
- 24 VDC supply voltage in the container signal



E-BUS CHARGERS

EBC series

EBC (E-Bus Charger) is a family of chargers for electric vehicles including devices with output power from 30 kW up to 950 kW. Thanks to such a power range, the devices can be used for fast charging via the CCS Type 2 and/or CHAdeMO interface and ultra fast charging via a pantograph.

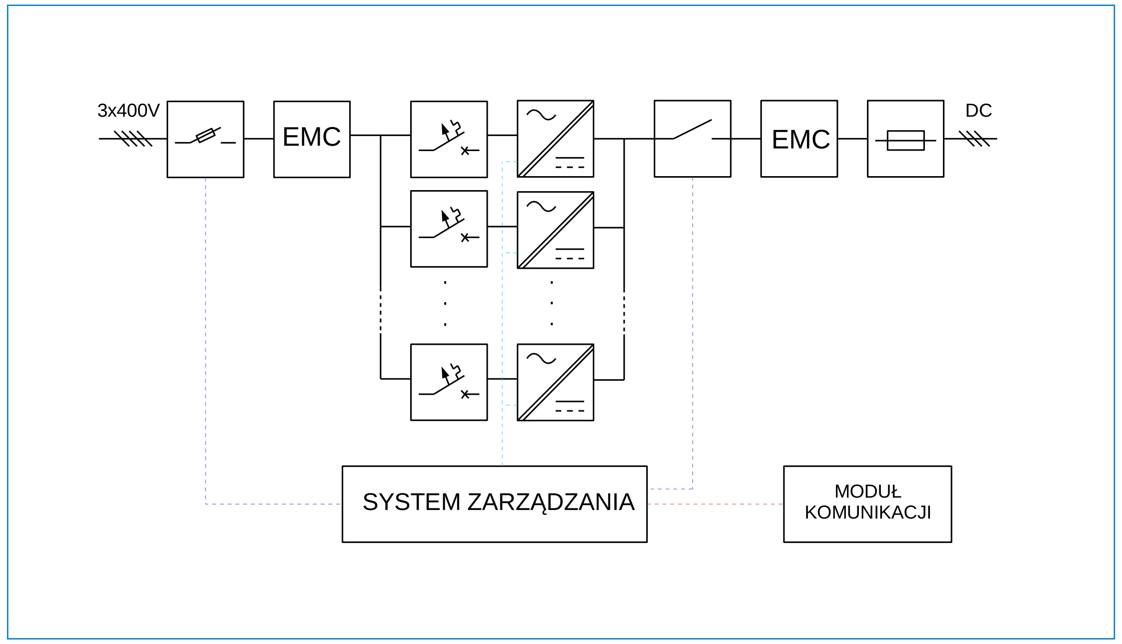
The supply equipment complies with the latest standards for charging and communication with electric vehicles, including e-buses, adjusting the charging parameters to the requirements of the vehicle. It also provides high efficiency of voltage conversion and a low level of interference generated into the network.

The chargers are characterized by their incorporation of a redundant design feature. If one module becomes damaged, the remaining modules ensure operation with rated or lowered power.

EBC devices are available in two power supply variants: 1 – from the network (e.g. 3×400 VAC 50Hz); 2 – from the traction (e.g. 600 VDC).

Innovative electric bus charging systems:

- Plug-in service chargers
- Stationary plug-in chargers
- Stationary pantograph chargers



Simplified diagram of the EBC charger

E-BUS CHARGERS

EBC series

SERVICE/MOBILE CHARGERS

Mobile devices with power up to 100 kW. They are characterized by comfort of use and small dimensions. The mobile equipment is fitted with wheels. Charging takes place via the CCS Type 2 or CHAdeMO interface. The device has a communication interface for remote dispatcher monitoring.

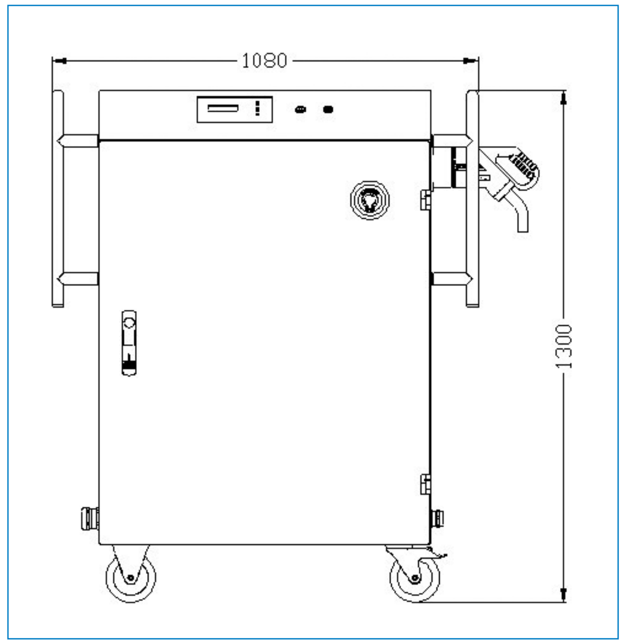
The devices are equipped with:

- LED signals informing about the charger status
- OLED operator panel
- Acoustic signal informing about end of operation
- Emergency button
- Visual error signalling
- Battery charge status signalling
- Operation authorization key switch
- Limiting of output power possible

OCPP 1.6 communication interface available as an option.

Service/mobile charger	
Catalog designation	**EBC**
Charging type	**DC**
Station rated power [kW]	**40-100**
Maximum charging current [A]	**60-200**
Charging rated voltage [V]	**300-800 VDC**
Efficiency [%]	**≥95**
THDi [%]	**≤5**
Active power factor cos (Φ)	**≥0.99**
Operating temperature [°C]	**-30°C to +45°C**
Interface type	**CCS type 2, CHAdeMO**
Degree of protection provided by the housing (IP code)	**IP 54**

MEDCOM service chargers



Dimensions of an example plug-in service charger with power of 50 kW

E-BUS CHARGERS

EBC series

STATIONARY PLUG-IN CHARGERS

A free-standing device used to charge one or two electric vehicles at the same time. Designed for fast charging with direct current. Wireless communication via Wi-Fi, LTE possible. The possibility of monitoring via mobile applications with the option of saving data in the cloud, reporting, data archiving, using the OCPP 1.6 or MODBUS TCP protocol.

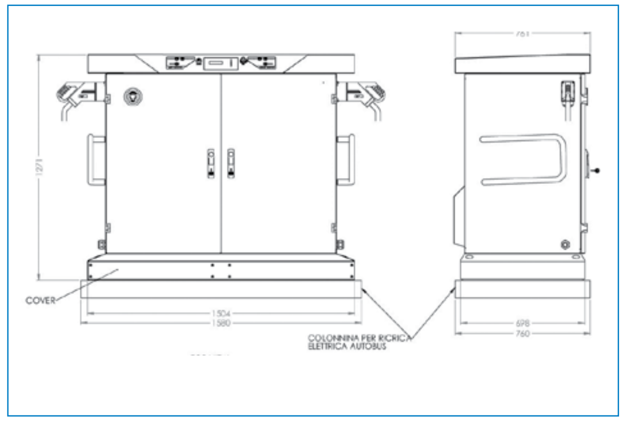
Just like service chargers, the devices are equipped with:

- LED signals informing about the charger status
- OLED operator panel
- Acoustic signal informing about end of operation
- Emergency button
- Operation clearance station
- Visual error signalling
- Battery charge status signalling
- Operation authorization key switch
- Limiting of output power possible

OCPP 1.6 communication interface available as an option.

Stationary plug-in charger	
Catalog designation	**EBC**
Charging type	**DC**
Station rated power [kW]	**40-150**
Maximum charging current [A]	**80-250**
Charging rated voltage [V]	**300-800 VDC**
Efficiency [%]	**≥95**
THDi [%]	**≤5**
Active power factor cos (Φ)	**≥0.99**
Operating temperature [°C]	**-30°C to +45°C**
Interface type	**CCS type 2, CHAdeMO**
Degree of protection provided by the housing (IP code)	**IP 54**

Example stationary plug-in charger



Dimensions of an example stationary plug-in charger

E-BUS CHARGERS
EBC series

PANTOGRAPH CHARGERS

Fast modular chargers with a pantograph interface. Fully individual design with no standardized dimensions. The station makes it possible to charge electric vehicles via a pantograph interface with power from 150 up to 950 kW. It is also equipped with an emergency plug-in interface up to 200 A. Wireless communication via Wi-Fi, LTE is possible. In the case of chargers of this type, there is also the possibility of monitoring via mobile applications with the option of saving data in the cloud, reporting, data archiving, using the OCPP 1.6 and MODBUS TCP protocol. Furthermore, MEDCOM's pantograph chargers can be fitted with the OppCharge system with the use of the MKZ-1 module.

The devices are equipped with:

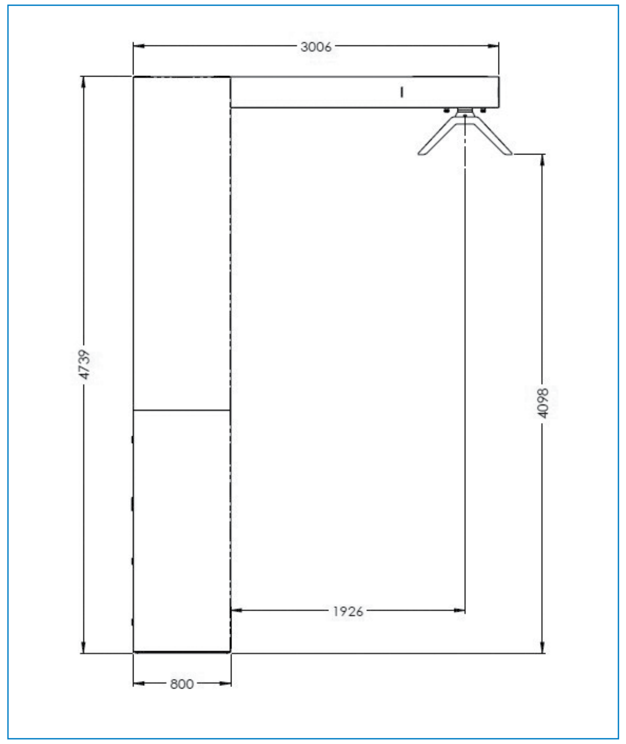
- Charger operation light signaling
- Battery charge level signaling
- A communication interface for remote dispatcher monitoring

The OppCharge system is available as an option.

Battery charge level signaling is located on the vehicle.

Fast charging station with a pantograph interface	
Catalog designation	**EBC**
Charging type	**DC**
Station rated power [kW]	**150-950 kW**
Maximum charging current [A]	**1,200**
Charging rated voltage [V]	**200-800 VDC**
Efficiency [%]	**≥95**
THDi [%]	**≤5**
Active power factor cos (Φ)	**≥0.99**
Operating temperature [°C]	**-30°C to +45°C**
Interface type	**pantograph interface, emergency plug-in interface as an option**
Degree of protection provided by the housing (IP code)	**IP 54**

Example pantograph charging station



Dimensions of an example pantograph charging station

CHARGER SERIES OF TYPES (E-bus)

Type		Maximum battery charging current	Maximum charging power
MOBILE CHARGERS	EBC-40M	80 A	40 kW
	EBC-50M	100 A	50 kW
	EBC-100M	200 A	100 kW
STATIONARY CHARGERS	EBC-40S	80 A	40 kW
	EBC-50S	100 A	50 kW
	EBC-100S	200 A	100 kW
	EBC-150S	250 A	150 kW
PANTOGRAPH CHARGERS	EBC-150	300 A	150 kW
	EBC-200	460 A	200 kW
	EBC-250	500 A	250 kW
	EBC-350	700 A	350 kW
	EBC-500	1000 A	500 kW
	EBC-650	1200 A	650 kW

CAR CHARGERS

An electric car charging station comprising a charger and a distribution post. The charger supplies the distribution post, from which vehicles may be charged via three types of interface: CHAdeMO, CCS Type 2, CCS AC. The charger makes it possible to charge from one of the DC interfaces (CHAdeMO, CCS Type 2) and the CCS AC interface at the same time. The device must be located at a distance of up to 200 m from the distribution post and may work with two distribution posts at a time. Wireless communication via Wi-Fi, LTE is possible. The possibility of monitoring via mobile applications with the option of saving data in the cloud, reporting, data archiving, using the OCPP 1.6 or MODBUS TCP protocol.

The distribution post is equipped with:

- A screen visualizing the charger's operation
- Three types of interfaces
- Operation buttons for each of the interfaces separately
- Emergency button

Car charger – charger parameters	
Catalog designation	EBC
Charging type	DC
Station rated power [kW]	2×40 kW/1×80 kW
Maximum charging current [A]	2×80A/1×160 A
Charging rated voltage [V]	50-500 VDC
Efficiency [%]	≥94
THDi [%]	≤5
Active power factor cos (Φ)	≥0.99
Operating temperature [°C]	-25°C to +45°C

Car charger – distribution post parameters	
Catalog designation	EBC-SC
Rated power CCS Type 2 output [kW]	80
Rated power CHAdeMO output [kW]	62.5
Rated power CCS AC output [kW]	22 or 44
Maximum charging current CCS Type 2 output [A]	160
Maximum charging current CHAdeMO output [A]	125
Maximum charging current CCS AC output [A]	3×32 or 3×63
Rated voltage, CCS Type 2 and CHAdeMO output [V]	50-500 VDC
Rated voltage CCS AC output [kW]	3×400 VAC
Operating temperature [°C]	-25°C to +45°C
Interface type	CCS type 2, CHAdeMO, CCS AC
Degree of protection provided by the housing (IP code)	IP 54

DEDICATED CHARGERS FOR THE V2G SYSTEM

Devices are designed using a future-proof approach for the V2G (Vehicle to Grid) system. The system ensures a bidirectional power flow between the electric vehicle and the grid. The vehicle not only draws power, but also constitutes an element of the grid, and so it does not just increase load on the grid, but, as a mobile energy storage, it provides the opportunity to support and enhance its operation.

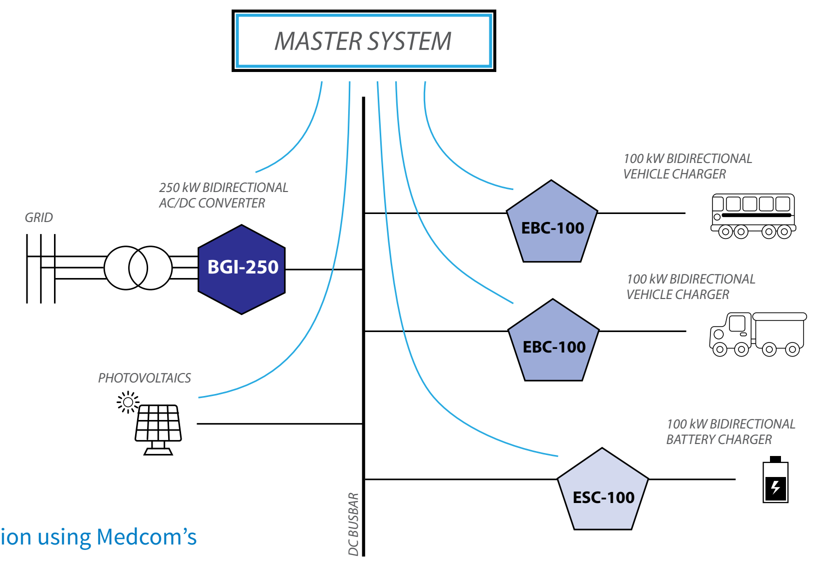
MEDCOM manufactured the following dedicated devices for the V2G technology:

- **BGI-250**

  250 kW bidirectional, three-phase AC/DC converter. A device capable of controlling the direction and amount of power in order to maintain the DC busbar. Reactive input power control possible in the master system. Communication: Modbus/TCP via Ethernet.
- **EBC-100**

  100 kW bidirectional DC/DC converter with modular design (2x50 kW). Device fitted with the CHAdeMO connector capable of charging and discharging electric vehicles. Communication: Modbus/TCP, communication with the vehicle: CHAdeMO protocol.
- **ESC-100**

  100 kW bidirectional DC/DC converter with modular design (2x50 kW). Device capable of charging and discharging the batteries of the energy storage device. Communication: Modbus/TCP.



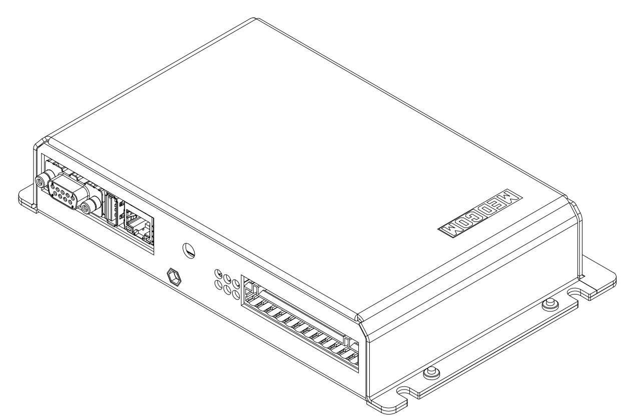
Example system configuration using Medcom's devices described above

BASIC DEVICE SPECIFICATIONS	BGI-250	EBC-100	ESC-100
Rated power	250 kW	100 kW	100 kW
Input voltage	400 V AC /±10%	660-780 V DC	660-780 V DC
Frequency	50/60 Hz	-	-
Output voltage	660-780 V DC	50-500 V DC	50-500 V DC
THDi	≤5%	-	-
Efficiency	≥98%	97,5%	97,5%
Operating temperature	-25 ÷ 40°C	-25 ÷ 40°C	-25 ÷ 40°C
Housing protection rating	IP23	IP54/IP23 (cooling system)	IP54/IP23 (cooling system)
Active power factor with the reactive power compensation function switched off	≥0,99	-	-

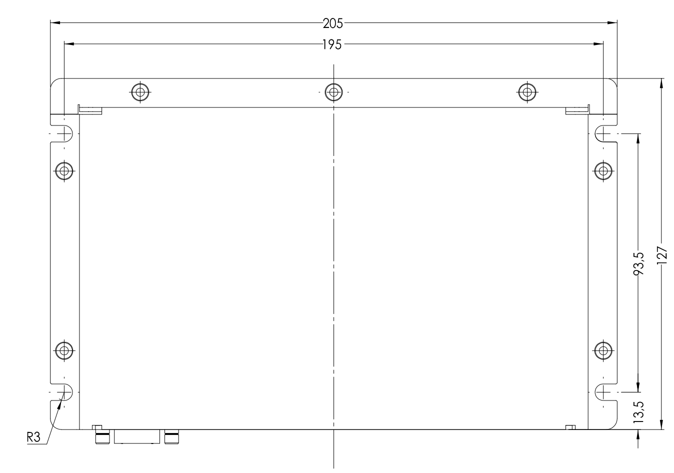
MKZ-1 MODULE FOR THE OPPCHARGE STANDARD

MKZ-1 is an electric vehicle communication controller (EVCC) compliant with the ISO 15118 standard. The device is used for OppCharge applications. The module can communicate via the Control Pilot line (basic PWM signals and high level PLC communication) or wirelessly in the inverted pantograph application.

Basic information about the MKZ-1 module		
1	Power supply range	9 – 36 VDC (24 VDC rated voltage)
2	Power consumption	4 W
3	WLAN	IEEE 802.11 a/b/g/n 2.4 GHZ and 5 GHz (compliance with ISO 15118-8)
4	CAN bus	250 kBps, extended (internal protocol)
5	Control Pilot	-12V - +12V, 1 kHz HomePlug Green PHY (compliance with PN-EN 61851-24 and ISO 15118-3)
6	Operating temperature range	-25 °C - +45 °C
7	Dimensions	203 mm x 127 mm x 39,2 mm
8	Weight	ca. 0,6 kg
9	Standards	ISO 15118-1: 2019 ISO 15118-2: 2016 ISO 15118-3: 2016 ISO 15118-8: 2018 PN-EN 61851-1 PN-EN 61851-23 PN-EN 61851-24



General view



Dimensions

MASTER SYSTEM

The MODBUS TCP type of monitoring system is an advanced application intended for comprehensive management of fast charging stations. It enables remote control, as well as monitoring and logging the operating status. We use the latest version of the OCPP 1.6 protocol for communication between the systems and the charging station. The protocol makes it possible to establish an encrypted connection with the charging station and to obtain charging process parameters and diagnostics.

The charging station sends its status in real time: available, charging, paused, unavailable, failure. In the case of failure, detailed information about the cause is sent out. The start and finish of the charging process are signaled by a message including the date and time and the current status of the power meter.

Data available in the monitoring system:

a) Real-time access to current demand for input power of the charger, output power of the charger, output voltage, charging current, set power limit

b) Data transfer in order to prepare historical analyses (demand for power, energy consumption, energy consumption per vehicle, currents, voltages, failures, charger operating hours, charging parameters including as expected by the vehicle and actual ones, etc.)

c) Information about the charger's operating status

d) The possibility of remote power management, e.g. in the case of energy supply limitations

e) The possibility of dynamic power management, depending on unused power, taking into consideration charger priority

f) The possibility of sending alerts, among others concerning failures or lack of connection with the charger, to an e-mail address or via text messages

g) The possibility of e-mail notifications about completed charging

h) The possibility of remotely introducing charger software updates and remote device diagnostics

i) Measuring and recording at least the following data during the charging process: current voltage and strength for the given vehicle, vehicle identification, start, finish, and duration of the charging process with reference to the car's identification number, through the recording of the start and finish date and time, power meter status – energy input, vehicle energy input, current charging power, voltage of the supply network, charging station temperatures (in places significant for the continuity of the charging process, e.g.: transformer, power modules, interfaces)

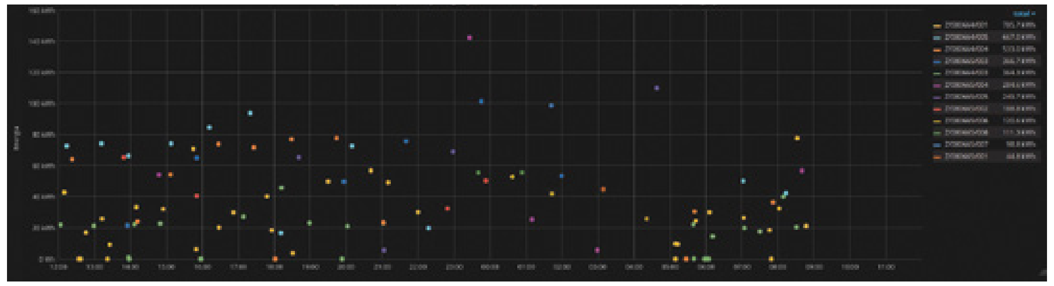
j) Charging start/stop/pause, charger reset, disabling the visibility (availability) of the charger in the system

The systems of communication between the charger and the bus have to be integrated and compliant with the following standards:

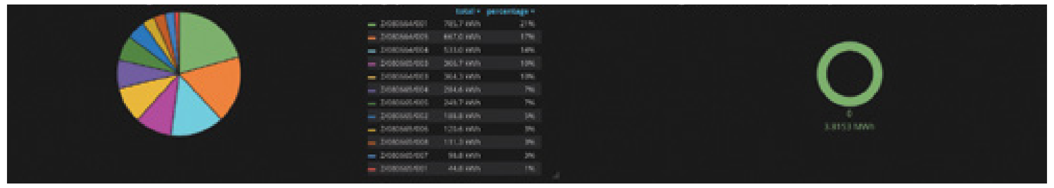
- **DIN70121** – Vehicle to charger communication interface
- **PN-EN 61851-1** – Electric vehicle conductive charging system – Part 1: General requirements
- **PN-EN 61851-23** – Electric vehicle conductive charging system – Part 23: DC electric vehicle charging station
- **PN-EN 61851-24** – Electric vehicle conductive charging system – Part 24: Digital communication between a DC EV charging station and an electric vehicle for control of DC charging
- **PN-EN ISO 15118-1** – Road vehicles – Vehicle to grid communication interface – Part 1: General information and use-case definition
- **PN-EN ISO 15118-2** – Road vehicles – Vehicle to grid communication interface – Part 2: Network and application protocol requirements
- **PN-EN ISO 15118-3** – Road vehicles – Vehicle to grid communication interface – Part 3: Physical and data link layer requirements
- **ISO 15118-8** – Road vehicles – Vehicle to grid communication interface – Part 8: Physical layer and data link layer requirements for wireless communication

MASTER SYSTEM

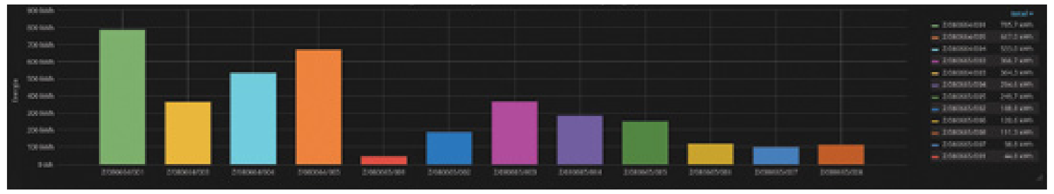
The master system helps obtain detailed data about the devices, which makes it possible to control both individual chargers and the entire group of chargers. Thanks to the analysis of the available information and proper management of the knowledge gained, it is possible to examine the needs and in consequence, optimize and manage the whole infrastructure and vehicle fleet in terms of energy management. Example information provided by the master system is presented below. The information is collected within the time specified by the administrator.



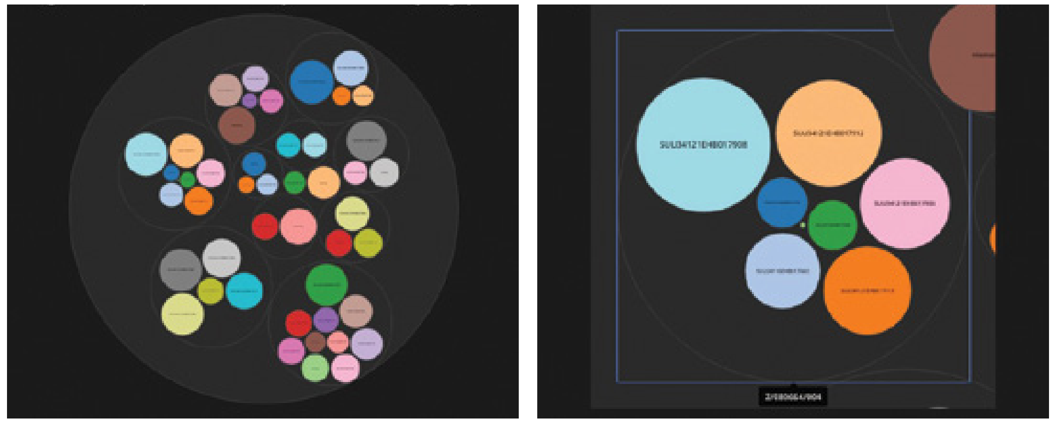
Charging energy during a single cycle, according to charger number



Energy supplied by the chargers | Total energy supplied by all of the chargers

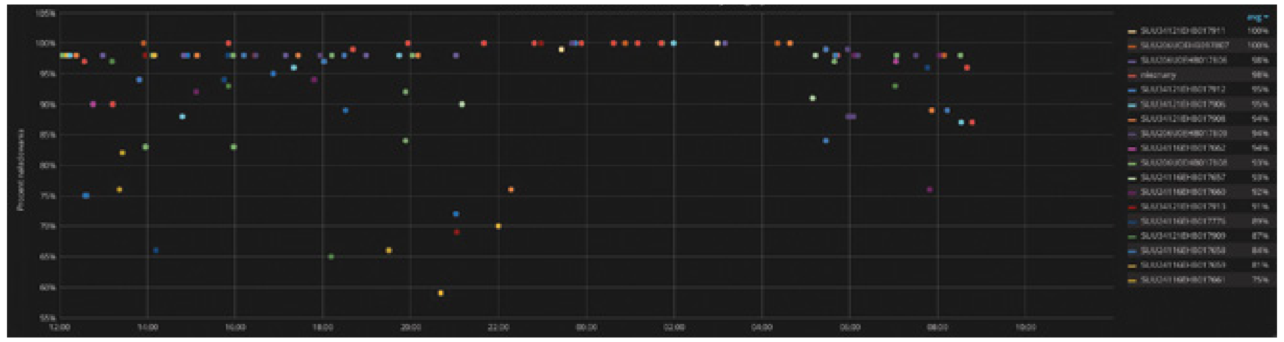


A graph illustrating the supplied energy, according to VIN number

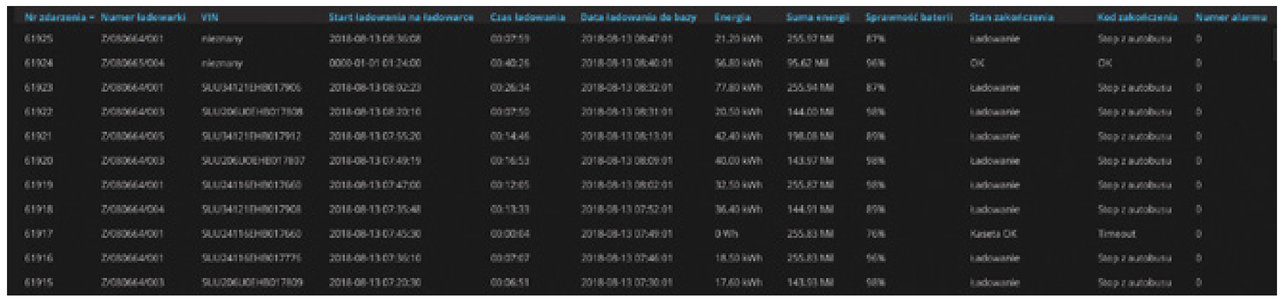


The size of the circle symbolizes the amount of supplied energy, after clicking on the circle, bus numbers are zoomed in (the size of the circle with the bus number symbolizes the size of energy input)
Energy supplied by the chargers and VIN numbers

MASTER SYSTEM



Battery percentage



Logs

Sectors for another implementation, the OCPP 1.6 system, are presented above (one rhombus denotes one charger)

AUTOMATIC TRANSFER SWITCHING MODULE MSZR

Measurement and monitoring equipment

Purpose

By controlling the contactor operation in the primary line (PL) and the backup line (BL), the device automatically transfers supply to the backup line if voltage drops in any of the primary line phases.

Principle of operation

The device is supplied with voltage from the measured PL1 (PL) phase.

The following operating parameters can be set using the adjusters available on the device's face panel:

- Up transfer voltage to backup line (PL/BL transfer)
- Interlock time τ between disconnecting the PL primary line contactor and connecting the BL backup line contactor (during PL/BL transfer) and between disconnecting the BL backup line contactor and connecting the PL primary line contactor (during BL/PL transfer)

Voltage thresholds depending on the value set on the "MIN. VOLTAGE" adjuster. Threshold voltage setting accuracy: ±2 V.

AUTOMATIC TRANSFER SWITCHING MODULE MSZR

Measurement and monitoring equipment

Technical specification of the device

Supply parameters	
Rated voltage	**3×400 V / 230 V, 50 Hz**
Rated current *)	**20 ÷ 400 A**
Measurement parameters	
Transfer voltage (Up) PL/BL	**set within range: 170 ÷ 216 V**
Transfer voltage Up setting accuracy	**± 2 V**
BL/PL transfer voltage	**Up+Uh**
Hysteresis voltage (Uh)	**10 V ± 2 V**
PL primary line disconnect time	**≤ 100 ms**
PL primary line connect time	**10 s ± 2 s**
Interlock time (τ) with PL/BL and BL/PL transfer	**set within range: 20 ms ÷ 420 ms**
Parameters of circuits controlling actuating contactors	
Type of relays controlling the primary and backup line actuating contactors	**RM96**
Control relay maximum operating voltage	**250 V~**
Control relay maximum contact load current	**4 A**
Suppressing circuit parameters RC	**R=100Ω, C=100nF on control relays contacts**
Alarms	
Primary line phase voltage lower than Up	**“PRIMARY LINE” LED switches off Activation of the “Backup line operation” relay**
“Backup line operation” relay electrical parameters	**300 V–/0.3 A– 250 V~/4 A~**
Operating conditions	
Ambient temperature during operation	**0°C ÷ 40°C**
Storage temperature	**-40°C ÷ 40°C**
Humidity (no condensation)	**max. 98%**
Cooling	**natural**
Level of interference	**class N**
Housing	
Protection rating	**IP22**
Housing dimensions (height × width × depth)	**90 mm × 60 mm × 73 mm**
Installation	**on 35 mm rail**

*) Depends on the contactors working with the module; contactors do not constitute an integral part of the module

THERMAL PROBE ST-01

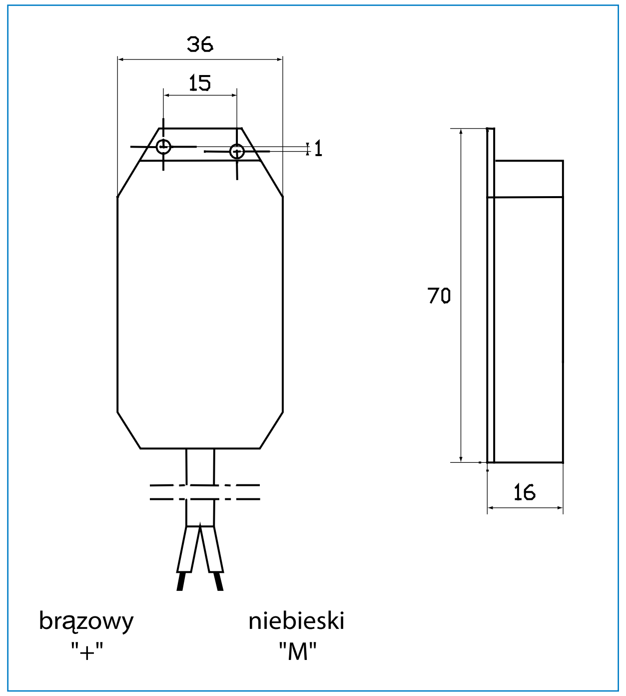
Measurement and monitoring equipment

Purpose

The thermal probe is intended for measuring the cell housing temperature or battery ambient temperature. The device includes a special electronic integrated element sensitive to temperature variations.

The probe should constitute optional equipment of the ZB series battery chargers which can use the measuring signal to correct the battery end-of-charge voltage versus temperature variations.

Parameters	
Measuring range	**-20°C÷+60°C**
Output signal	**4÷20 mA**
Sensitivity	**0.2 mA/°C**
Accuracy	**± 2°C**



VOLTAGE MEASUREMENT MODULE MPN-1

Measurement and monitoring equipment

Device description

The device is supplied with a measured voltage of 110V or 220V. Depending on the value of the measured voltage, the measuring circuit is connected to appropriate module terminals.

Each measurement threshold is specified with two decimal adjusters placed on the face panel of the module.

Changing the position of the adjuster specifying the successive decimal numbers following the number provided on the housing changes the alarm level. Example overvoltage (ALARM 4) and undervoltage (ALARM 1) alarm settings are provided in the drawing and are 1.15Un and 0.85Un, respectively.

Purpose

The device is intended for measuring and signaling exceeded voltage levels in 110 V and 220 V DC power installations.

The MPN-01 module is used in particular for:

- signaling when voltage drops below the alarm value (two defined values)
- signaling when voltage increases over the alarm value (two defined values)
- implementing ATS systems in direct voltage circuits
- implementing stabilizing systems with a booster battery
- implementing stabilizing systems with a "countercell"

The system includes four programmable voltage comparators with trigger thresholds that are set independently. The comparators feature actuating relays for controlling contactors or for transmitting information about exceeded alarm levels to other devices. The MPN-1 module is characterized by high reliability and external interference resistance. The housing can be installed on a typical 35 mm rail.

Parameters	
Input voltage	110 V/220 V=
Measuring range	Un ± 20%
Rated voltage	110 V, 220 V
Voltage variation measurement range	Un ± 20%
Undervoltage comparator setpoint range	(0.80 ÷ 0.99) Un *)
Overvoltage comparator setpoint range	(1.01÷1.20) Un *)
Alarm level setpoint resolution	0.01 Un
Alarm level setpoint accuracy	±0.6%
Measuring system hysteresis	2.5 V ± 0.5 (110 V) 5V ± 1 V (220 V)
Activation time constant	2 s ± 0.5 s *)
Power consumption	10W
Alarm relay breaking capacity	250 V AC 8 A 300 V DC 0.3 A
Dimensions width × height × depth	70×90×73 mm

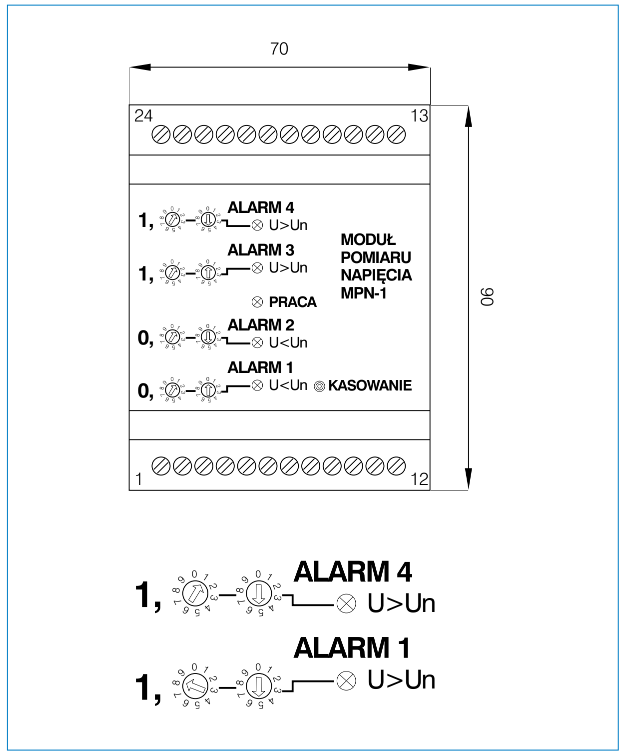
*) other values can be arranged with the manufacturer in special versions

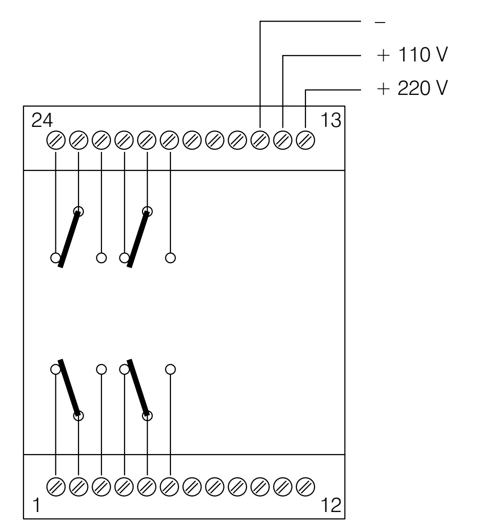
VOLTAGE MEASUREMENT MODULE MPN-1

Measurement and monitoring equipment

Parameters	
Input voltage	110 V/220 V=
Measuring range	Un ± 20%
Rated voltage	110 V, 220 V
Voltage variation measurement range	Un ±20%
Undervoltage comparator setpoint range	(0.80÷0.99) Un *)
Overvoltage comparator setpoint range	(1.01÷1.20) Un *)
Alarm level setpoint resolution	0.01 Un
Alarm level setpoint accuracy	±0.6%
Measuring system hysteresis	2.5 ± 0.5 (110 V); 5 V ± 1V (220 V)
Activation time constant	2 s ± 0.5 s *)
Power consumption	10 W
Alarm relay breaking capacity	250 V AC 8 A; 300 V DC 0.3 A
Dimensions width × height × depth	70×90×73 mm

*) other values can be arranged with the manufacturer in special versions



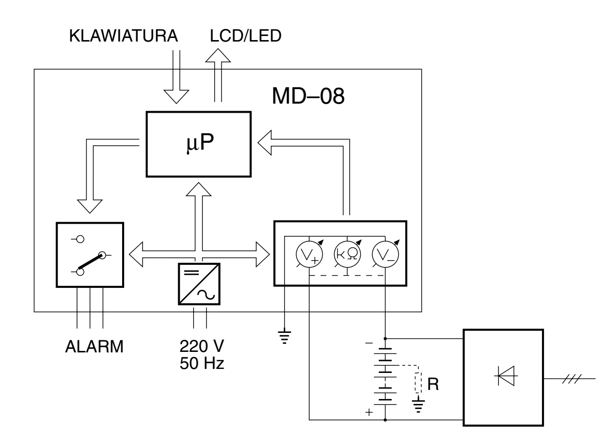


Purpose

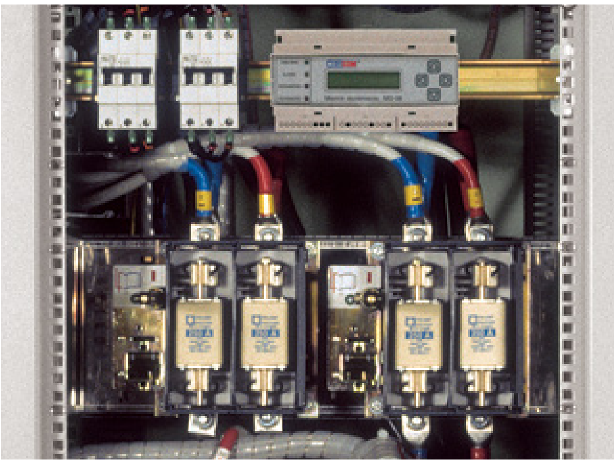
The MD-08 device is intended for measuring insulation resistance in DC installation circuits. If the resistance decreases below a set level, the alarm relay is activated. The device can work in 220 V=, 110 V=, 48 V=, and 24 V= installations. The system detects asymmetric (only the positive or negative pole in relation to the earth or 220 V / 380 V electric network) and symmetric (simultaneous resistance drop of both poles) resistance drops. Additionally, the voltage of both battery poles is measured, and the minimum and maximum permissible battery voltage alarm thresholds can be set.

Main features:

- Easy operation
- Stable parameters
- Simple installation
- Small size
- Low installation and operation costs
- High interference resistance
- Low measuring signal (5 V)
- High resistance measurement range
- High alarm level setpoint range
- Can work in 220 V=, 110 V=, 48 V=, 24 V= installations
- "+" and "–" voltage measurement in relation to PE



Earth-fault meter functional diagram



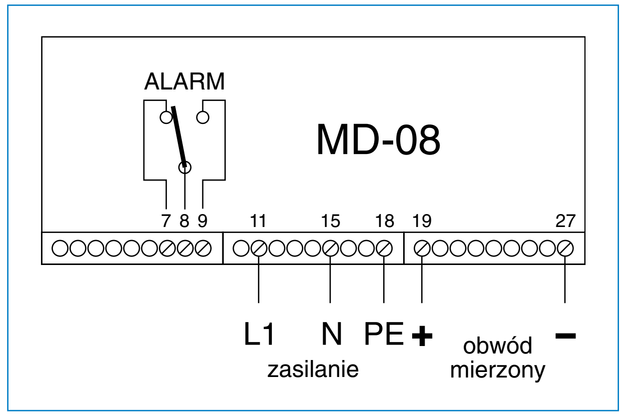
Fragment

Installation

Three sections with terminals are located in the bottom section of the housing.

The following should be properly connected to the meter:

- Terminals 7, 8, 9 – alarm circuit
- Terminals 11, 15 – 220 V (50 Hz) power supply
- Terminal 18 – PE circuit
- Terminals 19, 27 – battery poles



Technical specification

Supply parameters		
Supply voltage	220 V +15% ÷ –15% (–25%)	
Frequency	50 Hz	
Insulation withstand voltage	2.8 kV 60 s	
Measuring system parameters		
Rated battery voltage	220 V= (110 V=)	48 V= (24 V=)
Battery voltage variation range	+15% –25%	
"+" and "–" voltage measurement in relation to PE	0÷250 V	0÷99.9 V
Symmetrical resistance measurement range	1÷500 kΩ	
Resistance measurement error	10% (±2 div.)	
Alarm threshold setting range	5÷500 kΩ	
Internal resistance	ca. 0.5 MΩ	
Max. capacity of the measured circuit	25 µF (50 µF for R<50 kΩ)	
Resistance measurement settling time	ca. 5 min.	
Voltage measurement settling time	ca. 5 s	ca. 30 s
Alarm contact parameters		
Max. operating voltage	300 V= or 250 V~	
Max. contact current-carrying capacity	220 V~ 4 A 220 V= 0.3 A	
Operating conditions		
Ambient temperature	0÷40°C	
Storage temperature	-40÷65°C	
Humidity (no condensation)	max. 98%	
Housing		
Protection rating	IP20	
Material	self-extinguishing plastic NORYL UL 94 V-O	
Housing mounting	snap fastening on 35 mm rail	
Dimensions (width × depth × height)	158 mm × 73 mm × 90 mm	

Purpose

The RPB-2 microprocessor-controlled battery monitoring system is intended for measuring electrical parameters of stationary battery banks working in guaranteed voltage circuits.

The device controls the battery condition in accordance with the set parameters recommended by the manufacturer (the database covers nearly all batteries used in Poland).

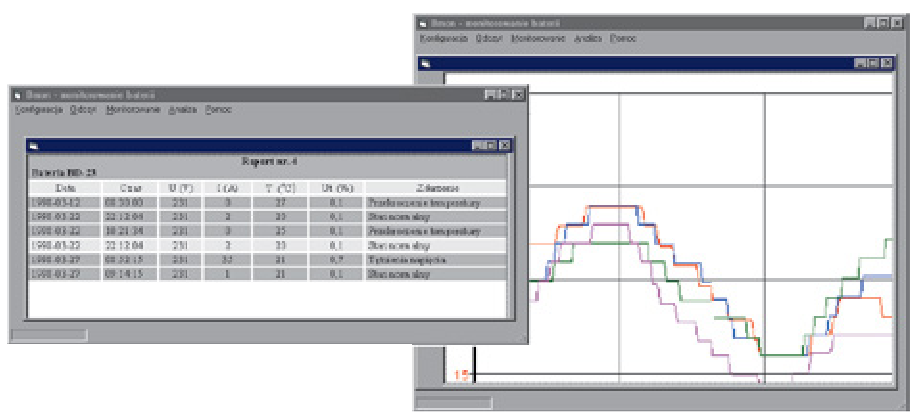
The algorithms for analyzing battery operation take into account the Eurobat recommendations.

If a parameter exceeds the characteristics recommended by the battery manufacturer, an alarm triggering contact outputs is generated. Each alarm is saved in an internal monitor.

Battery Monitoring System RPB-2

Main features:

- Measurement of voltage, current, voltage ripple, electric charge, and ambient temperature
- Ability to record 6,000 alarm events (exceeding predefined levels) in internal memory
- Communication with computer monitoring systems via RS-232 or remote systems via a modem
- Device supply directly from the monitored battery
- Galvanic isolation between all the measurement inputs (2kV) and additional isolation of the serial interface
- Device configuration via PC software
- Alarm state signaling in accordance with preset battery characteristics



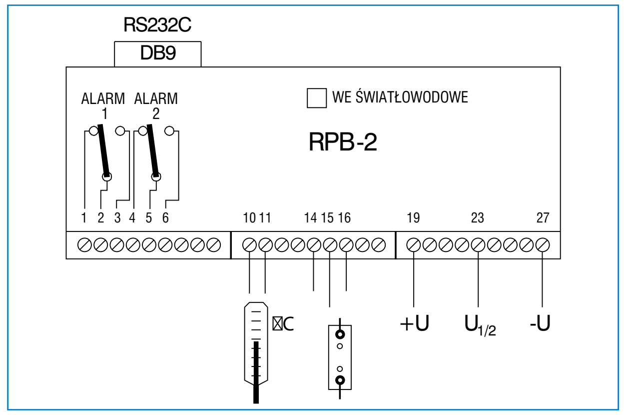
Data analysis

The data collected by RPB-2 can be analyzed based on text reports describing the occurrence of an alarm state and the return to the normal state. B-mon software can also draw graphs of the battery parameters (voltage, current, temperature, voltage ripple, collected charge).

RPB-2 TERMINAL BLOCK

The following should be properly connected to the monitor:

Terminals 1, 2, 3	alarm circuit 1
Terminals 4, 5, 6	alarm circuit 2
Terminals 10, 11	temperature measuring sensor
Terminals 17, 18	measuring shunt
Terminals 16, 17, 18	current measuring sensor
Terminals 19, 27	battery poles
Terminal 23	battery mid-point
DB9 connector	RS232C circuits



Technical specification

Supply parameters			
Input voltages	**220 V=**	**48 V=**	**other voltages available on request**
Permissible voltage variation range	**±40%**		
Power consumption	**ca. 2 W**		
Insulation strength	**2.8 kV= 60 s**		
Measuring system parameters			
Battery voltage	**140÷300 V**	**18÷80 V**	**other voltages available on request**
Voltage measurement accuracy	**±0.2%**		
Mid-point voltage	**70÷150 V**	**9÷40 V**	**other voltages available on request**
Mid-point voltage measurement accuracy	**±0.2%**	**stability 10 years 0.5%**	
Battery current measurement	**0.1÷600 A**		
Battery current measurement accuracy	**1.5%**		
Battery temperature measurement	**-20÷50°C**		**thermal probe 4÷20 mA**
Battery temperature measurement accuracy	**±2°C**		
Voltage ripple measurement	**0.2÷5%pp**		**50÷600Hz**
Charge measurement	**32,000 Ah**		
Charge measurement accuracy	**±2%**		
Alarm contact parameters			
Max. operating voltage	**300 V= or 250V~**		
Max. contact current-carrying capacity	**4 A for 220 V~; 0.3 A for 220 V=**		
Operating conditions			
Ambient temperature	**0÷40°C**		
Storage temperature	**-40÷65°C**		
Humidity (no condensation)	**max. 98%**		
Level of interference	**class N**		
Housing			
Protection rating	**IP20**		**self-extinguishing plastic NORYL UL 94 V-O**
Housing mounting	**on 35 mm rail**		

COMPUTER COMMUNICATION MODULE MKK

Measurement and monitoring equipment

Purpose

The MKK computer communication module is intended for connecting a MEDCOM device (e.g. a battery charger or an inverter) with an external master system using a specified communication protocol. It makes it possible to adapt the device to operation in distributed environments and in SCADA systems used by the user.

Parameters

Type	MKK-5	MKK-6	MKK-7	MKK-8	MKK-9
Data transmission channel	RS232, RS485	RS232, RS 485, 2×Can 2.0	Ethernet	2×Ethernet RS232, RS 485, Can 2.0	Ethernet 2×RS232, RS 485, 2×Can 2.0
Protocol	ModbusRTU, IEC60870-5-103	CANBus CAN Open ModbusRTU, IEC60870-5-103	Modbus TCP/IP, SNMP, IEC 61850	Modbus TCP/IP, SNMP, IEC61850, CANBus CAN Open ModbusRTU, IEC60870-5-103	Modbus TCP/IP, SNMP, IEC61850, ModbusRTU, IEC60870-5-103 CANBus CAN Open
Number of inputs for checking the state of dry contacts	4	6	4	8	4
Other	-	-	-	-	USB, microSD

DISCHARGE METER RESISTORS RV50/100/200

Measurement and monitoring equipment

The RV meter resistor is a device for automatic maintenance-related battery bank discharge making it possible to determine the actual battery capacity.

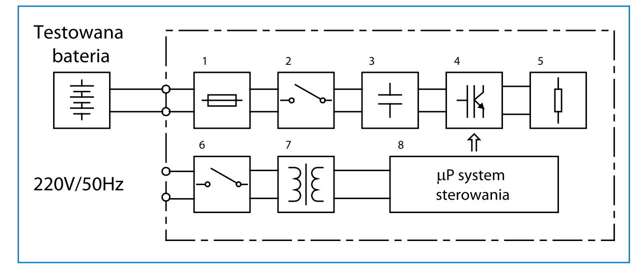
Device description

The device discharges the battery with direct current (in accordance with the battery manufacturer's recommendations) with a specified end-of-discharge voltage.

The key panel and the LCD display located on the front panel are used for determining the discharging current and end-of-charge voltage. Battery voltage and current, as well as the charge received from the battery are shown on the LCD display during the test.

Once the battery discharges to the preset voltage, the load is automatically disconnected and the display provides the current battery capacity. Once the discharging is complete, it is recommended that the voltage of individual battery cells should be measured to eliminate potentially damaged cells.

The device is protected against improper connection of the battery and against exceeding the permissible load resistor heat dissipation.



Block diagram

Technical specification

	R25V3	R50V1	R50V2	R100V1	R100V3	R200V1	R200V3
Rated input voltage (Un)	220 V/400 V	220 V	24/48/110/220 V	110 V	48/60 V	48 V	48/60 V
Maximum voltage (Umax)	270/470 V	250 V	*)	120 V	*)	54.5 V	*)
Minimum voltage (Umin)	170/270 V	170 V	*)	85 V	*)	37 V	*)
Maximum current (Imax)	25 A/400 V; 50 A/220 V	50 A	50 A	100 A	100 A	200 A **)	200 A **)
Current setpoint range	0 ÷ Imax						
Current setpoint resolution	0.1 A			1 A			
Current measurement accuracy	±0.2 A			±1 A			
Current stabilization	≤1%						
Current ripple (at Imax)	0.5%						
Charge measurement accuracy	≤1%						
Auxiliary voltage	230 V (50 Hz)						
Dimensions (width × depth × height)	(425×355×500) mm						
Weight	20 kg						

*) Depends on the specified rated voltage

**) For Un=60 V current Imax=180 A

BATTERY RECONDITIONING UNIT BATGO

Measurement and monitoring equipment

Purpose

The device is intended for service-related controlled charging and discharging of individual 2 V cells and 4 V, 6 V, 12 V monoblocks enabling quick regeneration.

Device description

The assembly is placed in an airtight plastic housing case, resistant to mechanical shocks and weather.

The device comprises an electronic module, microprocessor controller, and a monitoring panel including an LCD display, key panel, and LEDs.

Discharging current is limited by the maximum heat dissipation, which is 400 W.

The voltage and the charging or discharging current can be set with the key panel.

A report on the performed process can be printed or transferred to a PC.

As standard, the device is supplied with a set of cables (silicone insulation, length 1.5 m) mounted outside the housing.

Technical specification	
Charge mode	I=0 ÷ 150 A, at U ≤ 2.7 V I=0 ÷ 100 A, at U ≤ 5.4 V I=0 ÷ 60 A, at U ≤ 8.1 V I=0 ÷ 30 A, at U ≤ 16.2V
Discharge mode	I=0 ÷ 150 A, at U ≤ 2.0 V I=0 ÷ 60 A, at U ≤ 4.0 V I=0 ÷ 40 A, at U ≤ 6.0 V I=0 ÷ 20 A, at U ≤ 12.0 V
Voltage ripples	≤ 1%
Voltage measurement	1 ÷ 17V
Charge measurement	0 ÷ 1500 Ah ±1%
Dimensions	340 × 300 × 150 mm
Weight	10 kg

DISCHARGE METER RESISTOR R200V5

Measurement and monitoring equipment

Purpose

The R200V5 discharge meter resistor provides a stabilized, direct current load in a broad range of input voltage variations. It should be used for controlled discharging of battery banks or as a continuous load in research laboratories.

Main features:

- One device for all battery types: 24 V, 48 V, 110 V, and 220 V
- The new microprocessor system detects battery type and its proper connection to input terminals
- Batteries can be discharged with a direct current with constant power or constant resistance
- High stability of discharging parameters
- Very low ripple of discharging current
- Automatic termination of the discharging process
- Accurate charge measurement
- PC communication via USB
- Battery discharging process graphs
- Lighter than the previous versions

Technical specification

R200V5				
Rated voltage (Un)	24 V	48 V	110 V	220 V
Max. voltage (Umax)	30 V	60 V	130 V	260 V
Max. current (Imax)	200 A	200 A	100 A	50 A
Current setpoint range	0 ÷ Imax			
Current setpoint increment	0.1 A (Imin = 1 A)			
Current measurement accuracy	± 0.2 A			
Current stability (rms)	≤ 1%			
Current ripple (at Imax)	≤ 2%			
Charge measurement accuracy	≤ 1%			
Auxiliary voltage	230 V, 50 Hz			
Dimensions (width × depth × height)	230 mm × 545 mm × 438 mm			
Weight	approx. 20 kg			

Device description

The device discharges the battery with a direct current, the current whose value results from the condition of maintaining constant power or constant load resistance.

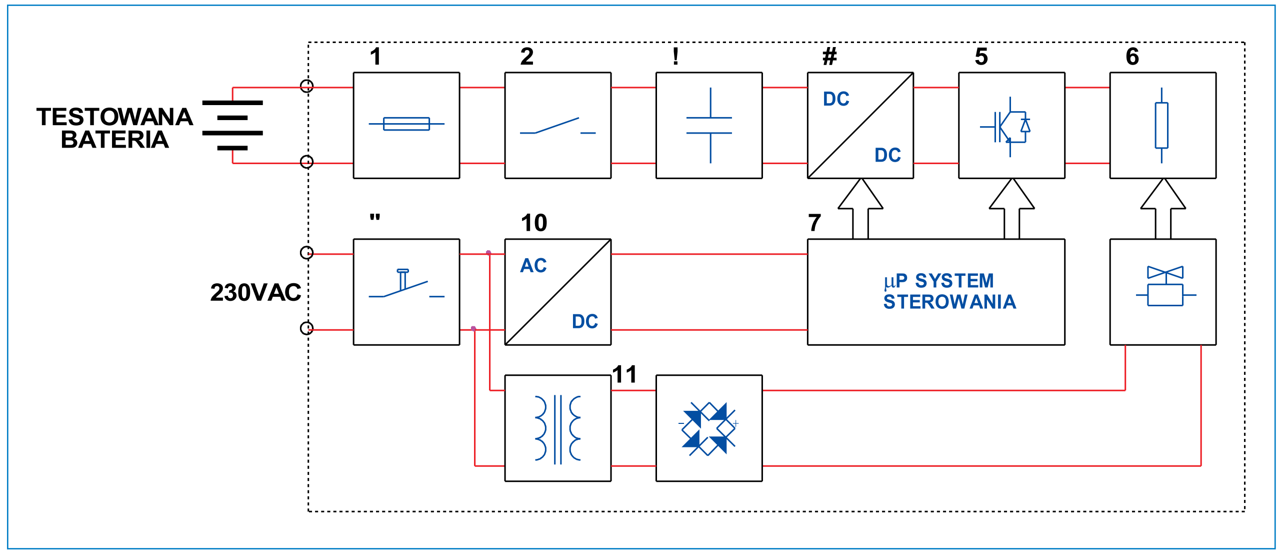
Thanks to the use of the DC/DC converter connected with the internal resistor block transistor switch, the R200V5 resistor replaces a whole range of discharge resistors. 24V, 48V, 110V and 220V rated voltage battery banks can be connected to the device. The discharging current is determined by a digital controller. The system controlling the operation of the entire device is implemented using a new microprocessor system. The discharging process lasts until the battery voltage decreases to the set value; the battery is then disconnected and the LCD display shows the current battery capacity.

DISCHARGE METER RESISTOR R200V5

Measurement and monitoring equipment

Aside from the LCD display, a key panel and the main switch of the device are located on the front panel.

The energy drawn from the battery is lost in the internal resistor block (maximum power: 12 kW), which is provided with forced cooling via a fan assembly.



The device block diagram is presented in the drawing, the elements are designated as follows:
1. Input fuse, 2. Contactor system, 3. Low-pass filter, 4. DC/DC converter,
5. Transistor controller [IGBT], 6. Resistor block, 7. Microprocessor control system,
8. Fan assembly, 9. Mains switch, 10. Power supply unit, 11. Fan assembly power supply units

EXAMPLES OF COMPLETED PROJECTS

EBC type charging stations

Bergamo

80 kW stationary charger with the possibility of charging 2×40 kW, type EBC-80S/2x40SB

Brussels

75 kW stationary chargers, type EBC-75SB

PKM Jaworzno

85 kW plug-in chargers, type EBC(ZBBT)-85S2 with power supply infrastructure

EXAMPLES OF COMPLETED PROJECTS
EBC type charging stations

PKM Jaworzno

Fast charging stations with their power supply infrastructure, type EBC(ZBBT)-180 with power supply infrastructure

Bolzano

80 kW stationary chargers, type EBC-80S (5x).

25 kW mobile charger, type EBC-25M (5x).

300 kW fast charging station, type EBC-300SP with Schunk's system.

Bolzano

300 kW integrated charger..

EXAMPLES OF COMPLETED PROJECTS
EBC type charging stations

MPK Rzeszów

35 kW stationary chargers, type EBC-35S (10x).

300 kW fast charging stations, type EBC-300SP with an inverted pantograph (2).

MPK Kraków

40 kW mobile chargers, type EBC-40M2, and 60 kW mobile chargers, type EBC-60M1 with power supply infrastructure

Kraków

Fast charging station, type EBC-250K with power supply infrastructure (design, medium-voltage connection, transformer station).

EXAMPLES OF COMPLETED PROJECTS
EBC type charging stations

MZA Warsaw

Fast charging station design with output power of 200 kW, type EBC-200 W, and with output power of 400 kW, type EBC-400 W with power supply infrastructure

Oslo

Stationary chargers with the total power of 300 kW, with distribution heads suspended on the truss. 1x300 kW or 6x50 kW charging.

Świdnica

250 kW fast charging station with an inverted pantograph, according to the OppCharge standard.

NOTES

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