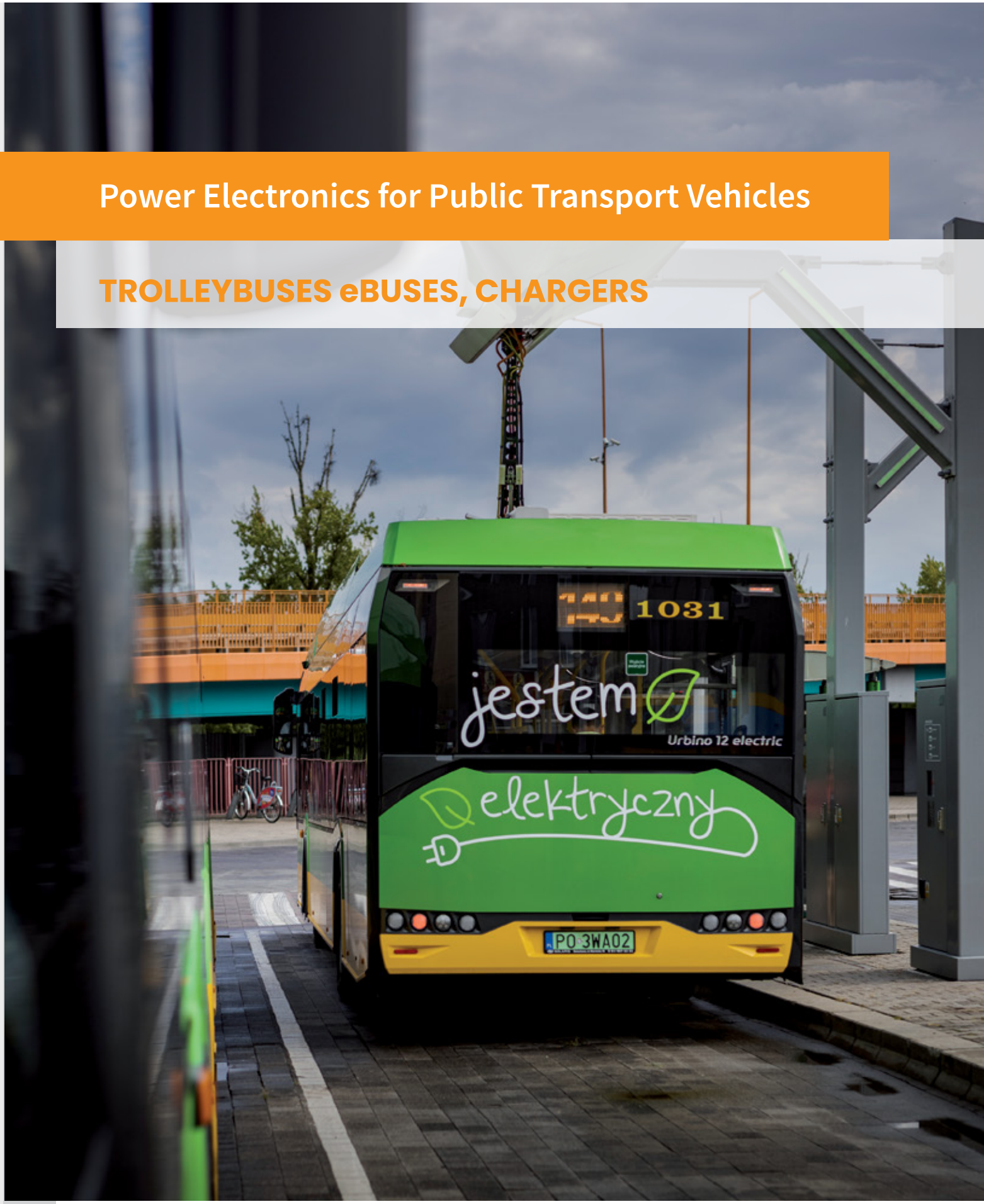
Power Electronics for Public Transport Vehicles

TROLLEYBUSES eBUSES, CHARGERS



TROLLEYBUSES eBUSES, CHARGERS

MEDCOM is a manufacturer of modern propulsion inverters for asynchronous or synchronous drives and auxiliary converters installed in vehicles powered by 600 VDC/ 750 VDC catenary system..

Propulsion inverters are based on the IGBT or SiC technology. Owing to the application of modern control systems, they ensure antislip control of the drive torque of the respective vehicle axles, effective electrodynamic braking within the whole speed range of the vehicle and a possibility of emergency braking in case of interruption of catenary line power supply.
Currently produced inverters with output power ranging from 50 kW to 450 kW ensure very good driving parameters of the vehicle. Their main advantages are a low level of noise emission and a high driving comfort.

Auxiliary converters with output power ranging from 5 kW to 500 kW ensure power supply for sub-assemblies of the propulsion system all other vehicle's loads (control, lighting, compressors, fans of the devices). Apart from that, the auxiliary converters may also supply heating, ventilation and air conditioning systems. Modern propulsion systems designed for electric and hydrogen buses are universal devices that can be used in all electric vehicles regardless of engine type, battery capacity and vehicle length. With the SiC technology used and the recuperation system, they are the most efficient devices on the market. Medcom bus equipment conforms to all European requirements and standards including cybersecurity.

Trolleybus propulsion systems are complex designs contained in a combo box. They have European trolleybus homologation allowing safe operation. They make it possible to charge traction batteries while the trolleybus is operating under the catenary. Due to its reliability and versatility, it can be used independently of the receiving and supplying equipment. All inverters and converters can be equipped with a diagnostic-control system based on Ethernet, MVB, CAN 2.0 B or RS232 interface.

Electric vehicle charging stations (EBC series) made by MEDCOM are scalable and customized. Every device, including the power module which is an integral part of the charging device, is manufactured in Poland, and has been fully designed and programmed by MEDCOM engineers. Through the use of the silicon carbide (SiC) technology in power modules, the User receives device with low level of interference introduced into the grid and high efficiency charger, which also results in a lower energy consumption. Having many years of experience in the energy and public transport sector, allows for a continuous development and modernization of MEDCOM’s proprietary design of the power supply module.

The range of EV charging products continues to expand. The EV chargers offer for electric vehicles includes:
- plug in chargers: mobile, stationary, cabinets with distribution points,
- pantograph chargers: integrated, separate cabinet and pantograph pillars,
- chargers with both pantograph and plug-in outputs.

Medcom also carries out comprehensive projects for power supply infrastructure for electric vehicles, i.e. the execution of the detailed design together with cable and construction work, including the supply and commissioning of MV/LV transformer stations.

FT-160-600(750)/PSM-42T/ZBBT-13

Propulsion Inverter integrated with Auxiliary Converter and Traction Battery Charger

The traction drive used in a trolleybus consists of a propulsion inverter, a traction motor, high voltage switchgear and a braking resistor. The integrated system circuit also consists of an auxiliary converter PSM. The propulsion inverter and auxiliary converter placed in one box are cooled by forced air circulation. The use of air cooling enables reliable operation over a wide range of outdoor temperatures. The operation of the fans in the unit is controlled by an inverter's control system. The inverter is made with HV IGBT technology. The control of the inverter is performed in DSP (Digital Signal Processing) technology with the use of FOC SVPWM (Field Oriented Control Space Vector Pulse Width Modulation) control. The control system provides constant torque starting and low loss power. The used busbar system in conjunction with the IGBT driver guarantees failure-free operation at short-circuits, additionally eliminating the possibility of secondary damage in the event of a transistor failure. The capacitors used ensure high durability and protect the circuit due to voltage changes in the catenary system. The inverter complies with UN regulations and EN standard for safety and electromagnetic compatibility. The system has very low levels of low-frequency interferencess. Diagnostics and control of the inverters is carried out via the CAN-Bus interface. The system is adapted to cooperate with an event recorder of traction parameters and inverter parameters, which allows to replay power supply conditions in the event of malfunctions in operation or in the event of failure of the propulsion system.
The ZBBT-13 placed inside the box enables charging of the traction batteries from the catenary line even while vehicle is in motion.

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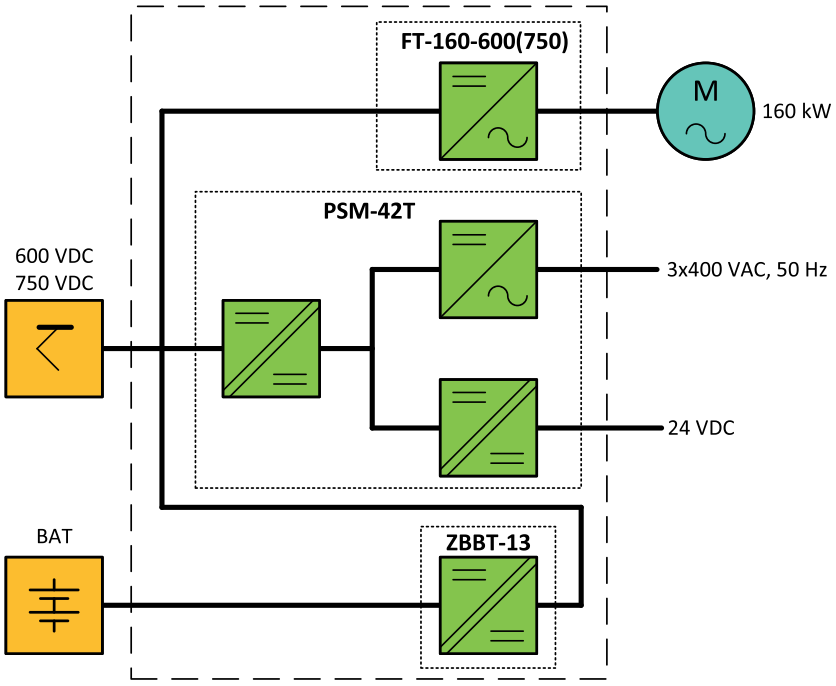
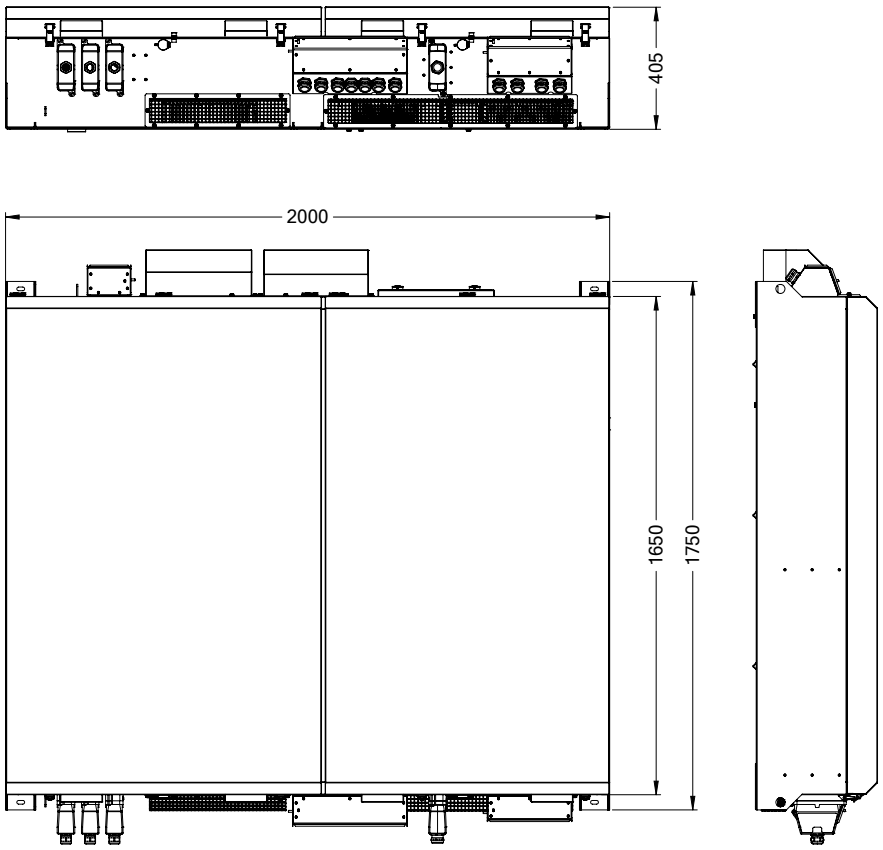


FT-160-600(750)/PSM-42T/ZBBT-13

Propulsion Inverter integrated with Auxiliary Converter and Traction Battery Charger

Specification		
Input voltage		**600 VDC / 750 VDC**
Auxiliary voltage		**24 VDC (+25% ÷ –30%)**
FT-160-600(750)		
Nominal power		**160 kW**
Nominal current		**240 A**
PSM-42T		
DC output		**24 VDC / 10.8 kW**
AC output		**3x400 VAC, 50 Hz / 30 kVA**
ZBBT-13		
Rated battery voltage		**662 VDC**
Charging power		**53 kW**
Housing		
Cooling		**Forced air**
Weight		**630 kg**
Dimensions		**2000 x 1750 x 405 mm**
Protection degree	Clean section	**IP55**
	Dirty section	**IP20**

HOUSING



FT-175-600/PSM-30TE

Propulsion Inverter integrated
with Auxiliary Converter

The traction inverter and auxiliary converter are cooled by forced air circulation. The use of air cooling enables reliable operation over a wide range of outdoor temperatures. The operation of the fans in the unit is controlled by an inverter's control system.
The inverter is made with HV IGBT technology. The control of the converter is performed in DSP (Digital Signal Processing) technology with the use of FOC SVPWM (Field Oriented Control Space Vector Pulse Width Modulation) control. The control system provides constant torque starting and low loss power. The used busbar system in conjunction with the IGBT driver guarantees failure-free operation at short-circuits, additionally eliminating the possibility of secondary damage in the event of a transistor failure. The capacitors used ensure high durability and protect the circuit due to voltage changes in the catenary system.
The inverter complies with UN and EN standards for safety and electromagnetic compatibility. The system has very low levels of low-frequency interference.
Diagnostics and control of the inverters is carried out via the CAN-Bus interface. The system is adapted to cooperate with an event recorder of traction parameters and inverter parameters, which allows to replay power supply conditions in the event of malfunctions in operation or in the event of failure of the propulsion system.

Specification	
Input voltage	**600 VDC (+50% ÷ -30%)**
Auxiliary voltage	**24 VDC (+25% ÷ –30%)**
FT-175-600	
Nominal current	**312 Arms**
Nominal power	**175 kW**
PSM-30TE	
DC output	**24 VDC / 10.8 kW**
AC output 1	**3x400 VAC, 50 Hz / 18 kVA**
AC output 2	**1x230 VAC, 50 Hz / 2.5 kVA**
AC Overcurrent	**2 x In / 5 s**
Housing	
Weight	**630 kg**
Dimensions	**2000 x 1750 x 405 mm**
Cooling	**Forced air**
Ambient temperature	**-30°C ÷ +40°C**

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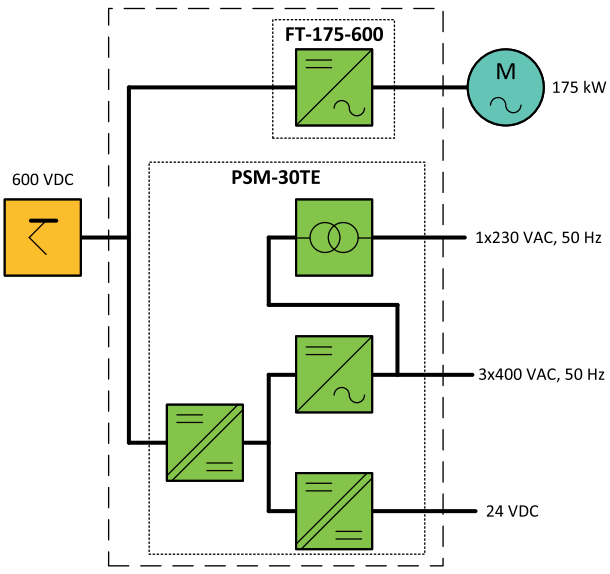

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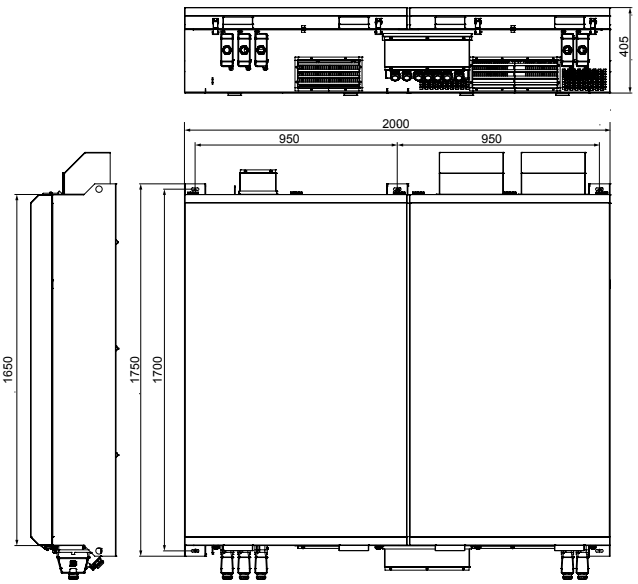

FT-250-600T/PSM-44T

Propulsion Inverter integrated with Auxiliary Converter

The FT-250-600T propulsion inverter is designed to supply the traction motor, which drives the wheel axle of the trolleybus. The container that houses the FT-250-600T propulsion inverter with a HV switchgear and PSM-44T auxiliary converter is to be mounted on the roof of the vehicle. The propulsion inverter is designed for the traction power supply of 600 VDC.
The propulsion system ensures the vehicle start-up, driving at a set torque, coasting and braking of the vehicle. It also enables start-up, driving and braking after setting driving in the reverse direction.
The propulsion inverter transforms the input voltage of 600 VDC into an adjustable output voltage in the range from 0 to the rated voltage of the traction motor, maintaining a constant ratio between the output voltage and voltage frequency (U/f).

The FT-250-600T inverter is made with HV IGBT technology. Control of the inverter is provided by the DSP (Digital Signal Processor), which uses FOC SVPWM (Field Orientation Control Space Vector Pulse Width Modulation). In the range of high speeds, the system operates with synchronized Bus Clamping Pulse Width Modulation (BCPWM), which reduces the losses and noise emissions. The control system provides the start-up with a constant torque and low power loss. The system of bus bars combined with the IGBT driver guarantee a failure-free operation during short-circuits and eliminates the risk of secondary damage during transistor failure. The polypropylene capacitors ensure high durability and resistance of the system to voltage changes in the overhead line. The inverter meets UN regulations and EN standards for safety and electromagnetic compatibility. The system has very low levels of low-frequency interferences generated in the catenary line. The diagnostics and inverter control is provided via the CANBus interface. The system is adapted to cooperate with a device that records traction and inverter parameters, which allows the user to review the conditions of power supply in case of malfunctions or failures in the propulsion system.

Specification		
Input voltage		**600 VDC (+25% ÷ -30%)**
Auxiliary voltage		**24 VDC (+25% ÷ –30%)**
FT-250-600T		
Rated power		**250 kW**
Rated current		**430 Arms**
PSM-44T		
DC Output		**24 VDC / 12 kW**
AC Output		**3×400 VAC, 50 Hz / 32 kVA**
Housing		
Cooling		**Forced air**
Weight		**700 kg**
Dimensions		**2000 × 1750 × 405 mm**
Protection degree	Clean section	**IP55**
	Dirty section	**IP20**

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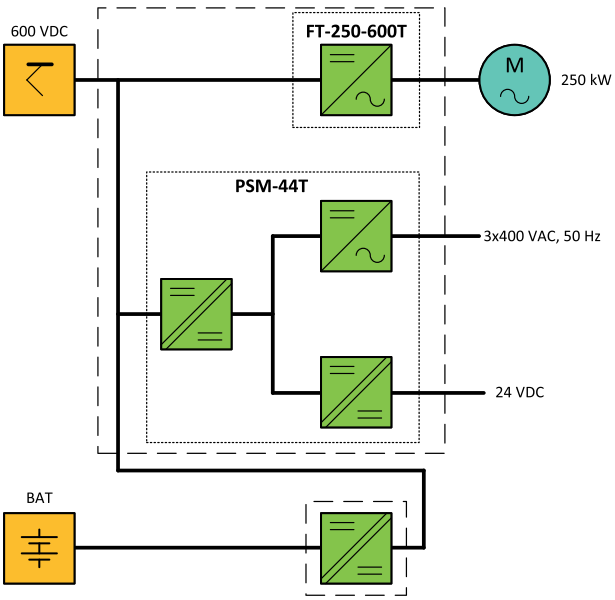

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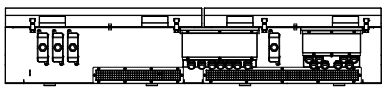

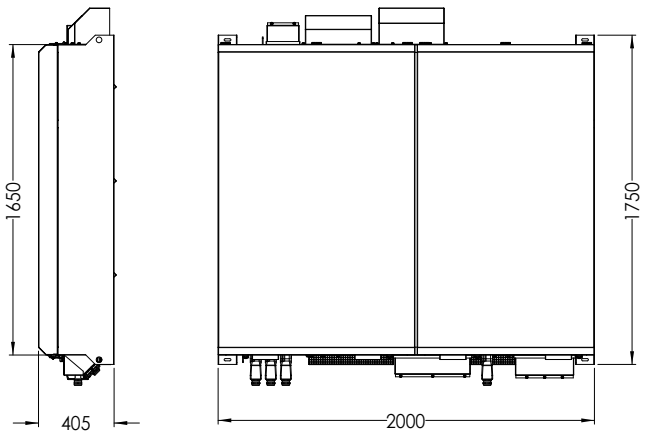

FT-250-600(750)/PSM-52T/FCEC-85

Propulsion Inverter integrated with Auxiliary Converter and Fuel Cell Energy Converter

The FT-250-600(750) propulsion inverter is designed to supply the traction motor, which drives the wheel axle of the trolleybus. The container that houses the FT-250-600(750) propulsion inverter together with the HV switchgear, PSM-52T auxiliary converter and FCEC-85 fuel cell energy converter is to be mounted on the roof of the vehicle. The propulsion inverter is used for the traction power supply of 600(750) VDC.

The drive assembly ensures the vehicle start-up, driving at a set torque, coasting and braking of the vehicle. It also enables start-up, driving and braking after setting driving in the reverse direction. The propulsion inverter transforms the input voltage of 600(750) VDC into an adjustable output voltage in the range from 0 to the rated voltage of the traction motor, maintaining a constant ratio between the output voltage and voltage frequency (U/f).

The transistor converters, line choke and inverters are cooled by forced air circulation. The use of air cooling ensures reliable operation over a wide range of outdoor temperatures. The fans installed in the housing of the drive assemble are controlled by inverter's control system.

The FT-250-600(750) inverter is made with HV IGBT technology. Control of the converter is provided by the DSP (Digital Signal Processor), which uses FOC SVPWM control (Field Orientation Control Space Vector Pulse Width Modulation). In the range of high speeds, the system operates with synchronized Bus Clamping Pulse Width Modulation (BCPWM), which reduces the losses and noise emissions. The control system provides the start-up with a constant torque and low power loss. The system of bus bars combined with the IGBT driver guarantee a failure-free operation during short-circuits and eliminates the risk of secondary damage during transistor failure. The polypropylene capacitors ensure high durability and resistance of the system to voltage changes in the catenary line. The inverter meets UN regulations and EN standards for safety and electromagnetic compatibility. The system has very low levels of low-frequency interferences generated in the overhead line.

Diagnostics and inverter control is provided via the CANBus interface. The system is adapted to cooperate with a device that records the traction and inverter parameters, which allows the user to review the conditions of power supply in case of malfunctions or failures in the propulsion system.

The PSM-52T auxiliary converter is design to convert the 600 (750) VDC catenary line voltage into 24 VDC and 3x400 VAC, 50 Hz voltage of the traction battery or fuel cell and for supplying the auxiliary circuits of the vehicle.

The fuel cell energy converter is designed for transforming the fuel cell voltage to the voltage required to power the propulsion inverter over the sections without access to the catenary line.

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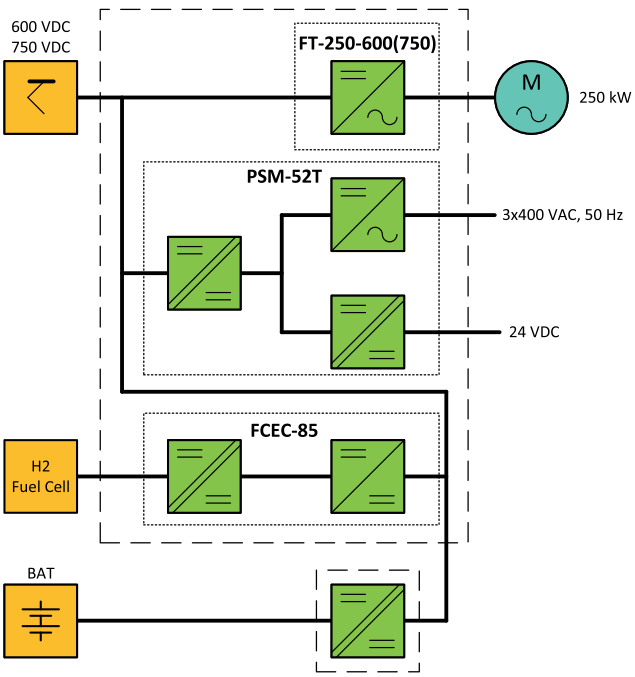
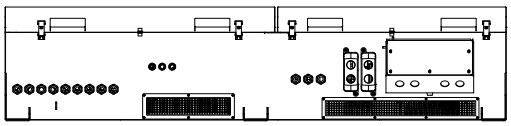


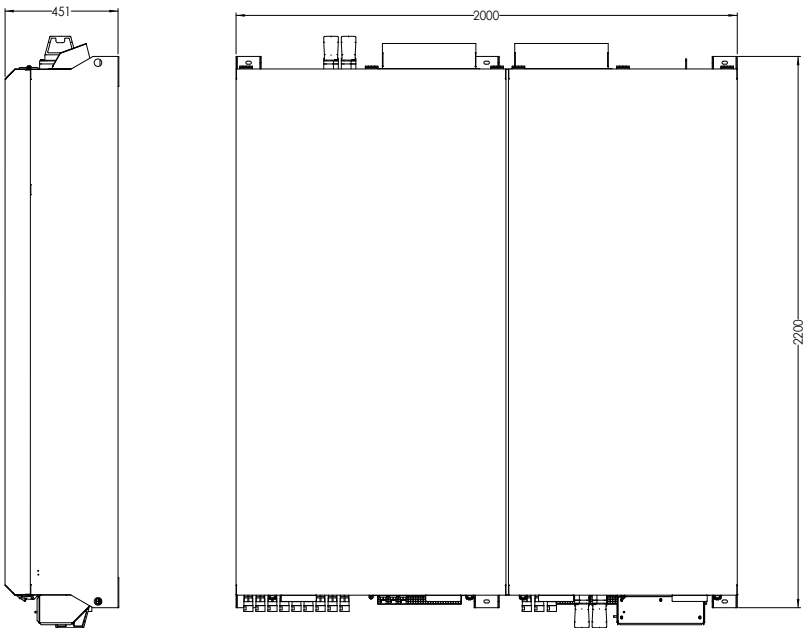
FT-250-600(750)/PSM-52T/FCEC-85

Propulsion Inverter integrated with Auxiliary Converter and Fuel Cell Energy Converter

Specification		
Input voltage		**600 VDC (750 VDC)**
Auxiliary voltage		**24 VDC (+25% ÷ –30%)**
FT-250-600/750		
Rated power		**250 kW**
Rated current		**430 Arms**
PSM-52T		
DC Output		**24 VDC / 19 kW**
AC Output		**3×400 VAC, 50 Hz / 30 kVA**
FCEC-85		
Input voltage		**280 ÷ 420 VDC**
Input power		**85 kW**
Rated current		**288 ADC**
Housing		
Cooling		**Forced air**
Weight		**945 kg**
Dimensions		**2200 × 2000 × 450 mm**
Protection degree	Clean section	**IP55**
	Dirty section	**IP20**

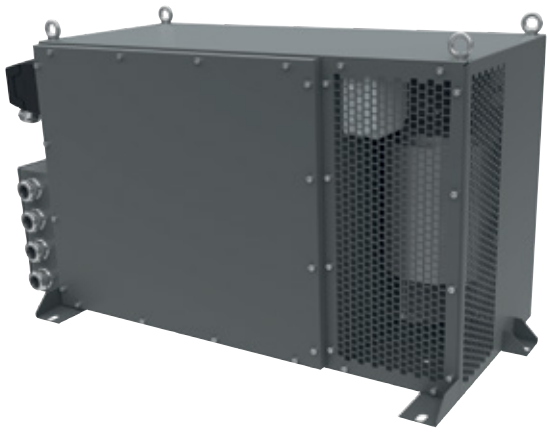
HOUSING





ZBBT200-DC40-AU250

Battery Power Supply



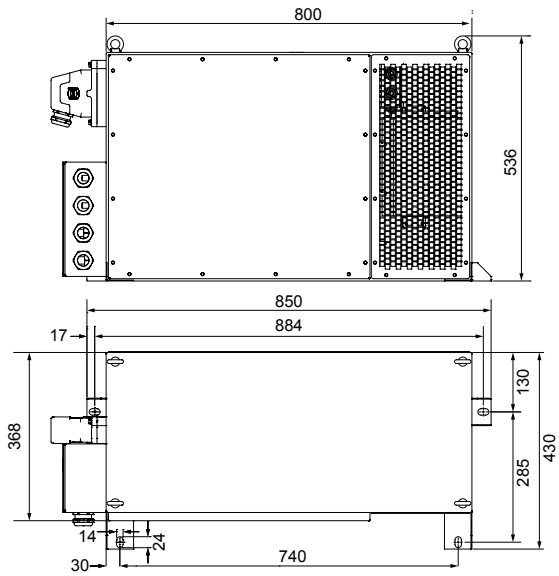
The battery power supply for propulsion drives is used for:

- powering traction and auxiliary converters from the battery; if no grid power is available on current collectors,
- charging the traction battery from the catenary including the re-generated energy,
- charging the traction battery from the 3×400 V, 50 Hz depot supply isolated from power supply by a separating transformer.

The advantage of the solution is that the trolleybus can drive even if no supply voltage is available or if it has to pass a section of the route with no catenary line, e.g. a historical district of a town.
During its normal operation the power supply charges the trolleybus traction battery by converting the supply power. The power converter is controlled via a microprocessor controller, which monitors the supply voltage and the battery's charging current, protecting it against damage. During the stop time at the depot the traction battery may be charged with 3×400 VAC supply voltage from external grid. The pantograph must be lowered when the battery is being charged from a 3×400 VAC source. If there is no supply voltage in catenary line, the propulsion inverter is supplied by the power supply with traction battery voltage. This allows the vehicle to return to the depot in emergency mode (with the battery discharged in various profiles).

Specification	
Nominal traction supply voltage	**600 VDC (+30% ÷ –30%)**
Nominal battery supply voltage	**200 VDC (+40% ÷ –30%)**
Depot supply voltage	**3x400 VAC, 50 Hz**
Auxiliary voltage 1	**24 VDC (+25% ÷ –30%)**
Auxiliary voltage 2	**230 VAC 50, Hz (+10% ÷ –10%)**
Battery current	**16 A (float charging)**
	40 A (boost charging)
Current from the traction	**7 A (float charging)**
	18 A (boost charging)
Nominal power	**50 kW**
Housing	
Cooling	**Forced air**
Weight	**130 kg**
Dimensions	**800 × 430 × 500 mm**

HOUSING



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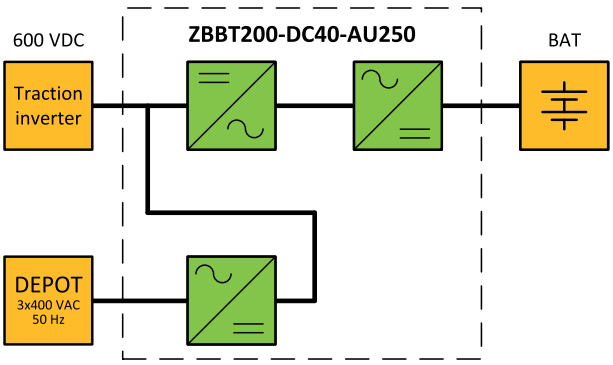


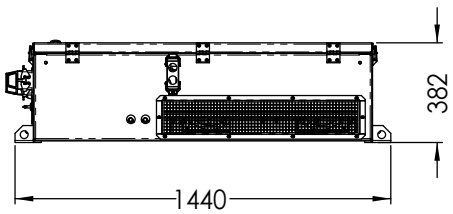
FT-80-600D/PSM-42
FT-120-600D/PSM-42

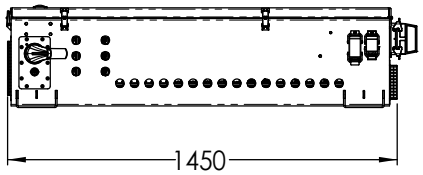
Propulsion Inverter integrated with Auxiliary Converter

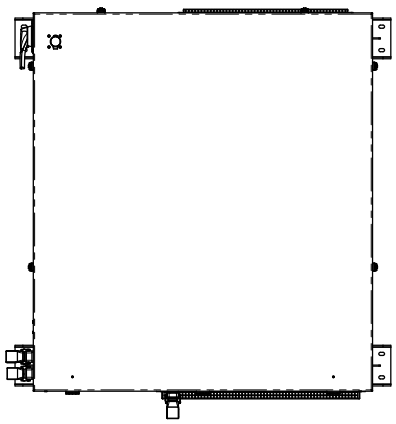
Propulsion inverter is intended to supply traction motor which drive the bus wheels. The inverter container with the RWN switchgear and PSM auxiliary converter is intended for installation on the vehicle roof.
The propulsion inverter is intended for power supply from a traction battery.
The propulsion system enables accelerating, driving with a set torque, coasting and regenerative braking. It also enables accelerating, driving and braking when travelling in a reverse direction.
The propulsion inverter enables conversion of the input voltage to regulated output variable voltage within a range of 0 to the rated traction motor voltage, while maintaining a constant relationship between the output voltage and voltage frequency (U/f).
The traction drive used in the electric bus is composed of the propulsion inverter, traction motor and braking resistor. The high voltage circuit is additionally composed of the PSM auxiliary converter.

Propulsion inverter and auxiliary converter are cooled by forced air circulation. The use of air cooling enables reliable operation in a wide range of external temperatures. The supply of the fan in the drive box is provided by a 3x400 V, 50 Hz inverter in the auxiliary converter.
The inverter is manufactured in the HV IGBT technology. The inverter control is provided by DSP (Digital Signal Processing), using FOC SVPWM (Field Oriented Control Space Vector Pulse Width Modulation). The control system ensures constant torque acceleration and low power losses.
The inverter meets the UN and EN standards on safety and electromagnetic compatibility. Inverter diagnostics and control is provided using the CAN-Bus interface. The system is adopted to operate with a recorder of traction parameters and inverter parameters, which enables the reconstruction of power supply conditions in case of interferences in the operation or in case of failure of the propulsion system.

HOUSING







FT-80-600D/PSM-42
FT-120-600D/PSM-42

Propulsion Inverter integrated with Auxiliary Converter

Specification		
Input voltage		**600 VDC**
Auxiliary voltage		**24 VDC (+25% ÷ –30%)**
FT-80-600D		
Rated power		**2 × 80 kW**
Rated current		**2 x 185 A**
PSM-42		
DC Output		**24 VDC / 12 kW**
AC Output		**3×400 V, 50 Hz / 30 kVA**
Housing		
Cooling		**Forced air**
Weight		**310 kg**
Dimensions		**1440 × 1450 × 382 mm**
Protection degree	Clean section	**IP55**
	Dirty section	**IP20**

Specification		
Input voltage		**600 VDC**
Auxiliary voltage		**24 VDC (+25% ÷ –30%)**
FT-120-600D		
Rated power		**2 × 120 kW**
Rated current		**2 x 185 A**
PSM-42		
DC Output		**24 VDC / 12 kW**
AC Output		**3×400 V, 50 Hz / 30 kVA**
Housing		
Cooling		**Forced air**
Weight		**310 kg**
Dimensions		**1440 x 1450 x 382 mm**
Protection degree	Clean section	**IP55**
	Dirty section	**IP20**

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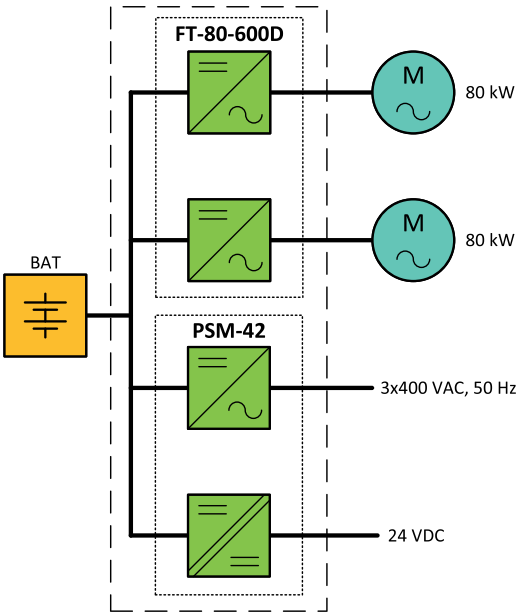

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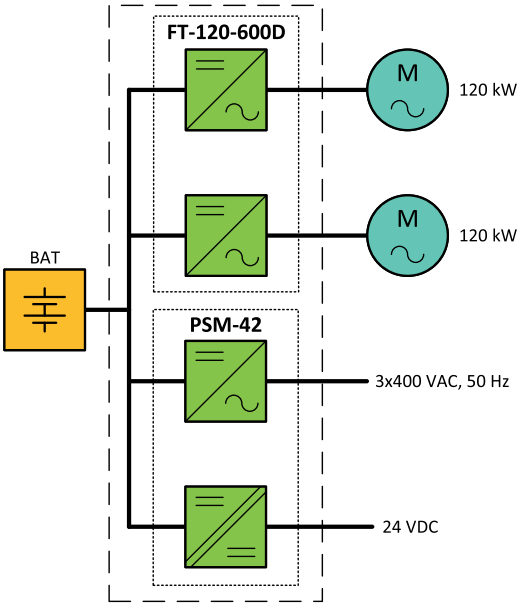


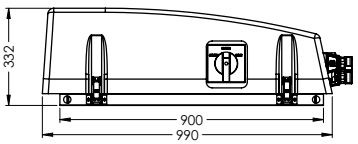
FT-160-600 SiC/PSM-42 SiC

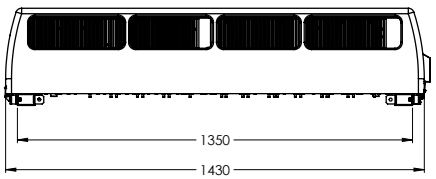
Propulsion Inverter integrated with Auxiliary Converter

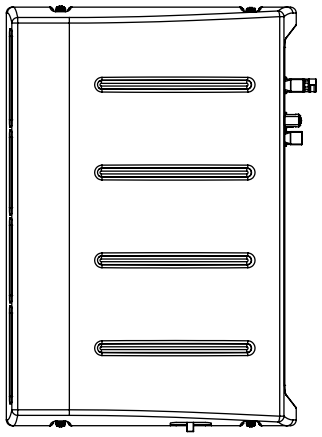
The FT-160-600 SiC propulsion inverter is designed to supply motors of eBus. The inverter is based on the full-SiC technology. It is controlled by means of the DSP (Digital Signal Processor) technology, applying the FOC SVPWM (Field Oriented Control Space Vector Pulse Width Modulation) algorithm. The controller guarantees optimum control of the asynchronous motor's performance, achieving very good traction parameters and a high level of driving comfort. The inverter has been equipped with a natural air-cooling system. The system meets all European standards and Regulation no. 100 with regard to safety and radio interferencess. The system is installed on the roof. The system has been equipped with an integrated high voltage switchgear to connect traction battery, battery chargers and precharge system. The latest generation components and an extensive diagnostic system guarantee a high level of reliability and low operating costs. The propulsion inverter is integrated with auxiliary converter (based on SiC technology).
By incorporating the newest silicon carbide (SiC) technology in our traction converters, power losses can be reduced up to 30% of conventional devices along with significant noise reduction. Utilizing SiC enables reduction of size and weight even by 40%.

Specification	
Input voltage	**520 ÷ 750 VDC**
Auxiliary voltage	**24 VDC (+30% ÷ –40%)**
FT-160-600 SiC	
Rated current	**300 Arms**
Rated power	**160 kW**
PSM-42 SiC	
DC output	**24 VDC / 12 kW**
AC output	**3x400 VAC, 50 Hz / 30 kVA**
AC Overcurrent	**1,5 In / 30 s**
Housing	
Cooling	**Natural**
Dimensions	**1430 × 990 × 332 mm**
Weight	**165 kg**

HOUSING







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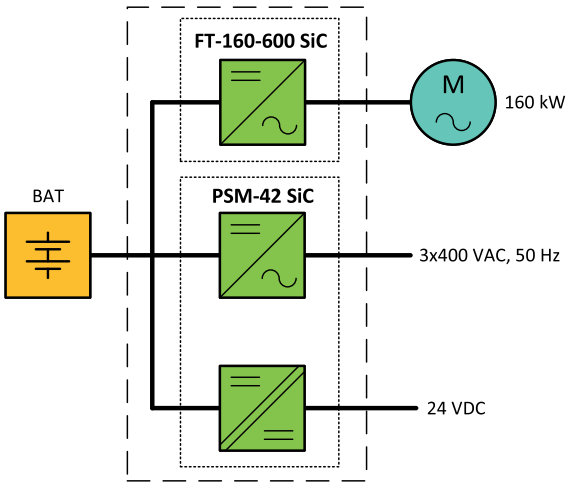
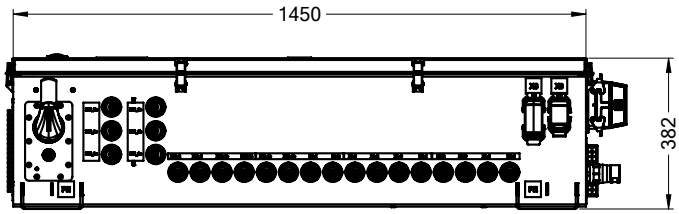


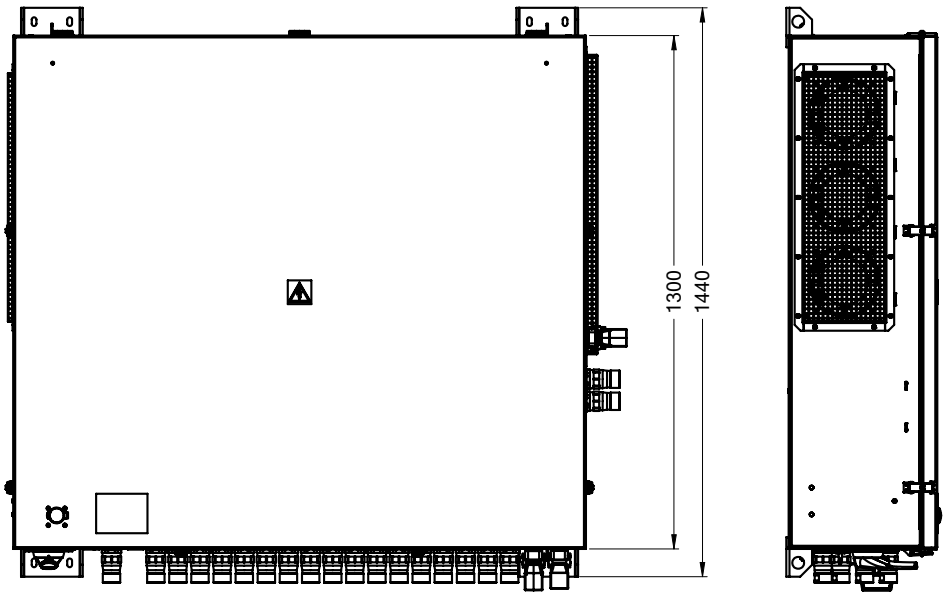
FT-160-600 SiC/PSM-42
FT-240-600 SiC/PSM-42

Propulsion Inverter integrated with Auxiliary Converter

Propulsion inverter is designed to supply the motor or motors in an electric bus. Container of the inverter with HV switchgear and PSM auxiliary converter is designed for installation on the roof of the vehicle. Propulsion inverter is supplied from the traction battery.
The propulsion system in the vehicle enables starting, driving at a given torque, running out and braking the vehicle with regeneration. It also enables starting, driving and braking in backward direction. The propulsion inverter makes it possible to convert the input voltage into a regulated alternating output voltage in the range from 0 to the nominal traction motor voltage, while maintaining a constant relation between the output voltage and voltage frequency (U/f). The propulsion inverter and auxiliary converter are cooled by forced air circulation. The use of air cooling enables reliable operation over a wide range of outdoor temperatures. The power supply of fans is 24 VDC.
Power supply while driving is provided by a set of batteries grouped in packages (Battery Pack). The inverter is made in silicon carbide (SiC) technology. The control of the converter is performed in DSP (Digital Signal Processing) technology with the use of FOC SVPWM (Field Oriented Control Space Vector Pulse Width Modulation) control. The control system provides constant torque starting and low loss power. The inverter complies with UN regulations and EN standards for safety and electromagnetic compatibility. The system has very low levels of low-frequency interferencess.
Diagnostics and control of the inverters is carried out via the CAN interface. The system is adapted to cooperate with a recorder of traction parameters and inverter parameters, which allows to replay power supply conditions in the event of malfunctions in operation or in the event of failure of the propulsion system.

HOUSING





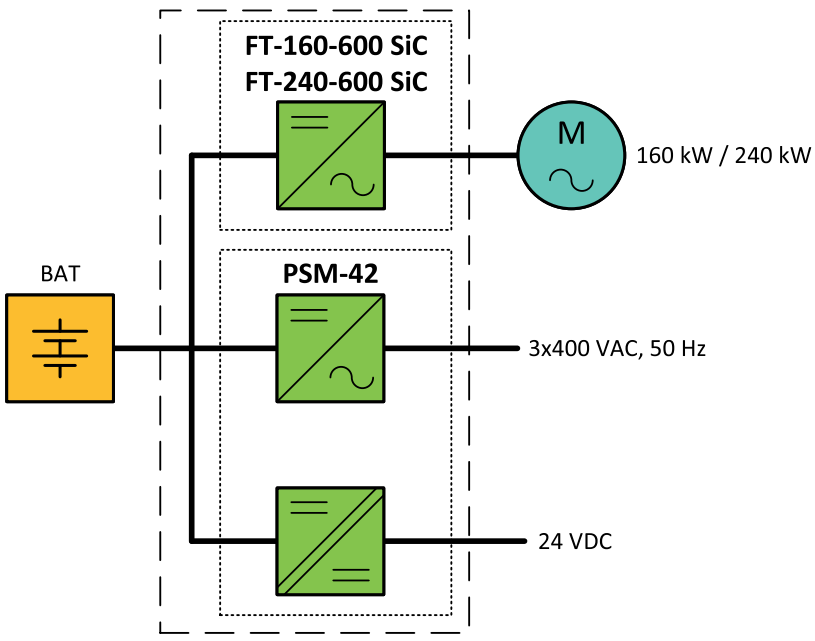
FT-160-600 SiC/PSM-42
FT-240-600 SiC/PSM-42

Propulsion Inverter integrated
with Auxiliary Converter

Specification		
Input voltage		**510 ÷ 750 VDC**
Auxiliary voltage		**24 VDC (+25% ÷ –30%)**
FT-160-600 SiC		
Rated current		**185 Arms**
Rated power		**160 kW**
PSM-42		
DC output		**24 VDC / 12 kW**
AC output		**3x400 VAC, 50 Hz / 30 kVA**
AC Overcurrent		**1,5 In / 5 s**
Housing		
Weight		**310 kg**
Dimensions		**1450 x 1440 x 382 mm**
Cooling		**Forced air**
Protection degree	Clean section	**IP54**
	Dirty section	**IP20**

Specification		
Input voltage		**510 ÷ 750 VDC**
Auxiliary voltage		**24 VDC (+25% ÷ –30%)**
FT-240-600 SiC		
Rated current		**278 Arms**
Rated power		**240 kW**
PSM-42		
DC output		**24 VDC / 12 kW**
AC output		**3x400 VAC, 50 Hz / 30 kVA**
AC Overcurrent		**1,5 In / 5 s**
Housing		
Weight		**310 kg**
Dimensions		**1450 x 1440 x 382 mm**
Cooling		**Forced air**
Protection degree	Clean section	**IP54**
	Dirty section	**IP20**

BLOCK DIAGRAM



FT-250-600D SiC + FCEC-125 + ZB24DC800 + RWN-630-600

Modular Power Converters Set for Hydrogen Buses

The Modular Power Converters Set is designed for vehicles with traction battery packs and hydrogen fuel cells. The units are made using the latest SiC technology, which results in high electrical performance values and low power losses. The use of SiC technology transistors in the converters and the liquid cooling system have helped to reduce the weight and dimensions of the devices. Each component is mounted in a separate housing, allowing any arrangement of equipment on the vehicle and enables improved maintenance indicators in terms of time and cost effectiveness.

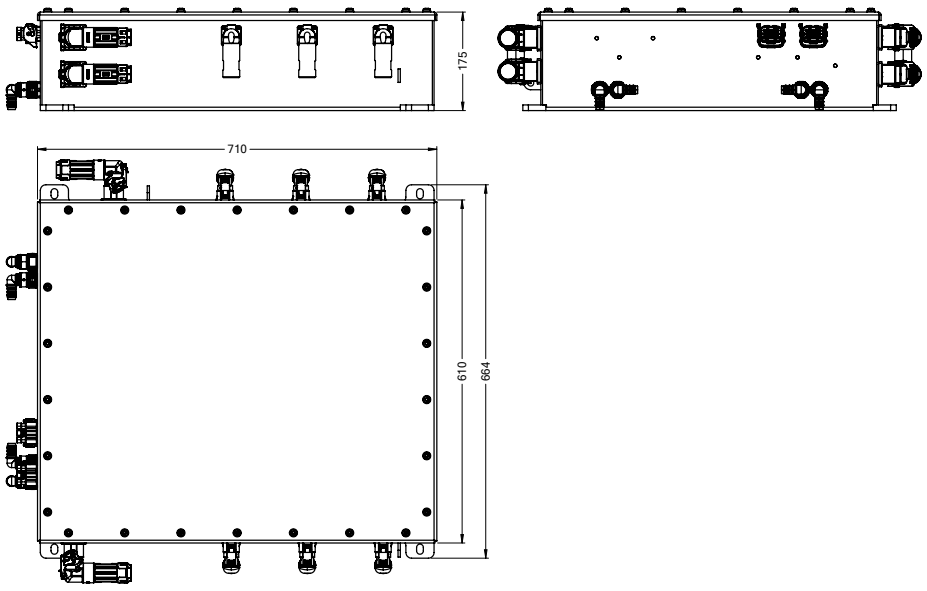
FT-250-600D SiC

The FT-250-600D SiC propulsion inverters are designed to supply motors driving the wheels in an electric bus. Propulsion inverters are designed to be powered from the traction battery. Inverter in the vehicle enables starting, driving at a given torque, accelerating and braking the vehicle with energy regeneration to the traction battery and braking using the braking resistor. The propulsion inverters make it possible to convert the input voltage into a regulated alternating output voltage with a variable value in the range from 0 to the nominal traction motor voltage, while maintaining a constant value between the output voltage and the frequency of this voltage (U/f). The traction drive used in an electric bus consists of a FT-250-600D SiC propulsion inverters, traction motors and a braking resistor. The FT-250-600D SiC propulsion inverters box is equipped with a cooling system that uses a coolant to reduce the temperature of the components of the unit. The inverters are made in silicon carbide (SiC) technology. The control system provides constant torque starting and low loss power. The system has very low levels of low-frequency interferencess. Diagnostics and control of the inverters is carried out via the CAN-Bus interface. The system is adapted to cooperate with a recorder of battery parameters and traction parameters, which allows to replay power supply conditions in the event of malfunctions in operation or in the event of failure of the propulsion system.

FT-250-600D SiC

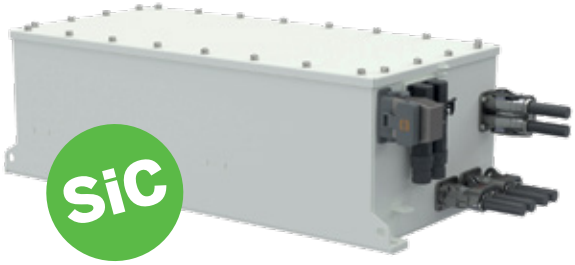
Specification	
Input voltage	**510 ÷ 750 VDC**
Auxiliary voltage	**24 VDC (+25% ÷ -30%)**
Rated power	**2 x 250 kW**
Rated current	**2 x 135 Arms**
Housing	
Dimensions	**710 x 664 x 175 mm**
Cooling	**Liquid (external)**
Weight	**60 kg**
Protection degree	**IP67**

HOUSING



FT-250-600D SiC + FCEC-125 + ZB24DC800 + RWN-630-600

Modular Power Converters Set for Hydrogen Buses



FCEC-125

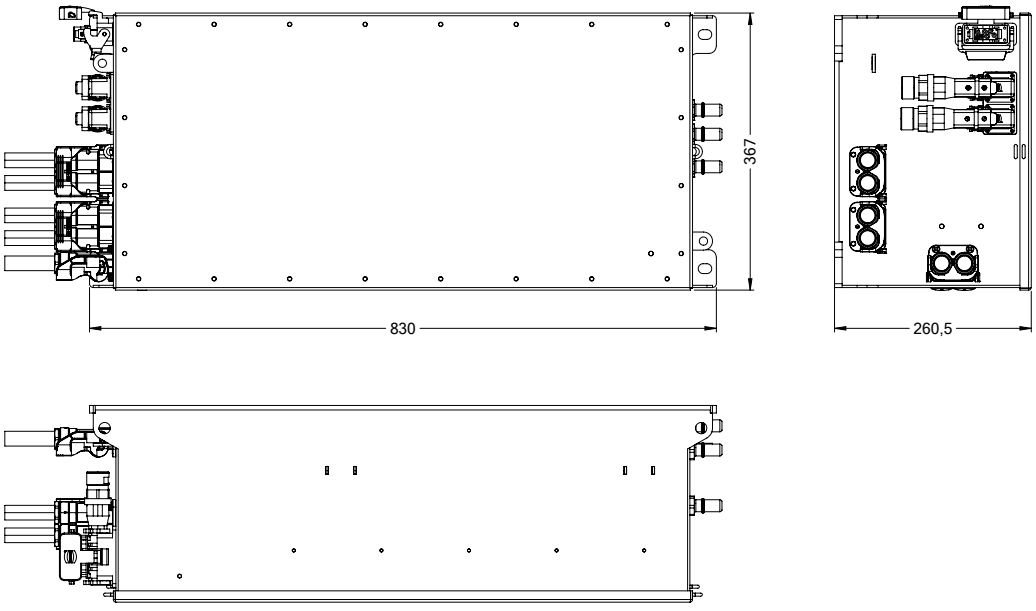
FCEC-125

The FCEC-125 fuel cell energy converter is intended for electric bus with hydrogen fuel cell applications. Box is designed for installation on the roof of the vehicle. The converter is equipped with cooling system, which uses coolant medium to reduce the converter elements temperature. The converter enables:

- charging of traction battery from the fuel cell with charging power regulation according to the battery discharge rate,
- CAN communication with fuel cell and control unit,
- measurement of current and voltage of fuel cell and battery circuits.

Specification	
Input voltage	**224 ÷ 560 VDC**
Input power	**125 kW**
Auxiliary voltage	**24 VDC (+25% ÷ -30%)**
Rated current	**360 ADC**
Output voltage	**468 ÷ 750 VDC**
Output current	**208 ÷ 165 A**
Output protection	**Overcurrent / overvoltage / short-circuit**
Housing	
Dimensions	**830 x 367 x 261 mm**
Cooling	**Liquid (external)**
Weight	**90 kg**
Protection degree	**IP67**

HOUSING



FT-250-600D SiC + FCEC-125 + ZB24DC800 + RWN-630-600

Modular Power Converters Set for Hydrogen Buses

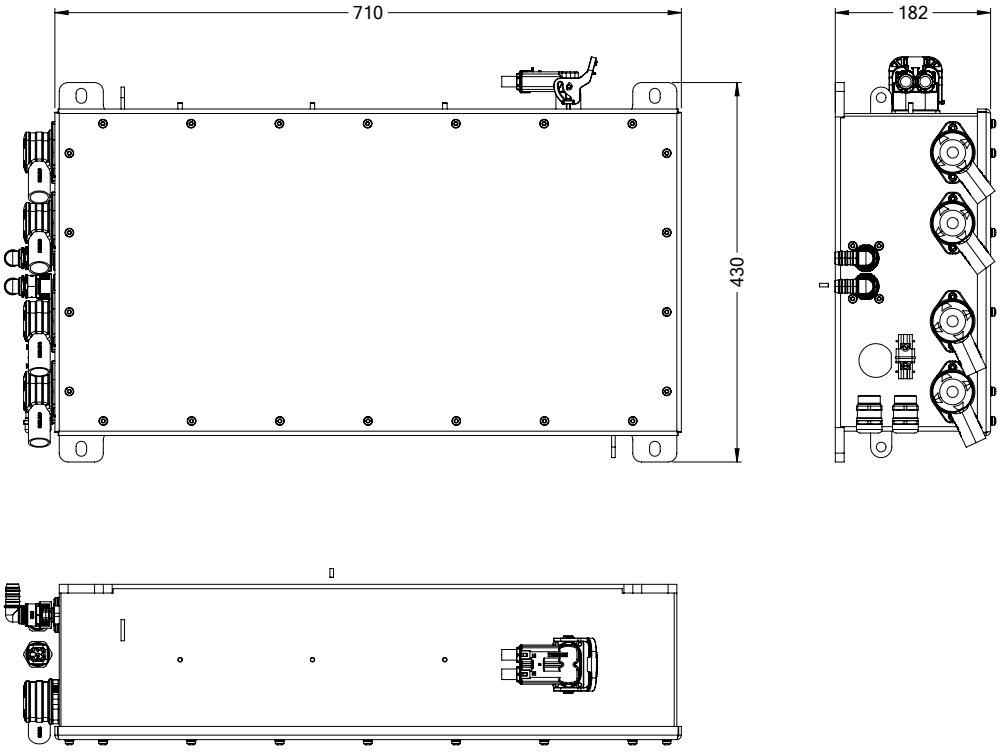
ZB24DC800

Specification	
Input voltage	**510 ÷ 750 VDC**
Output voltage	**24 VDC**
Output voltage stability	**≤ 2%**
Output voltage ripple	**≤ 1%**
Output current	**800 A**
Output power	**23 kW**
Housing	
Dimensions	**710 x 430 x 182 mm**
Cooling	**Liquid**
Weight	**45 kg**
Operating temperature	**-40°C ÷ +40°C**
Protection degree	**IP67**

ZB24DC800

Battery charger ZB24DC800 is designed to convert the voltage from the traction battery to 24 VDC, intended for supplying low-voltage installations. Container is designed for installation inside the vehicle. The battery charger is equipped with cooling system, which uses coolant medium to reduce the temperature of the units components. The battery charger is made in silicone carbide (SiC) technology.

HOUSING



FT-250-600D SiC + FCEC-125 + ZB24DC800 + RWN-630-600

Modular Power Converters Set for Hydrogen Buses

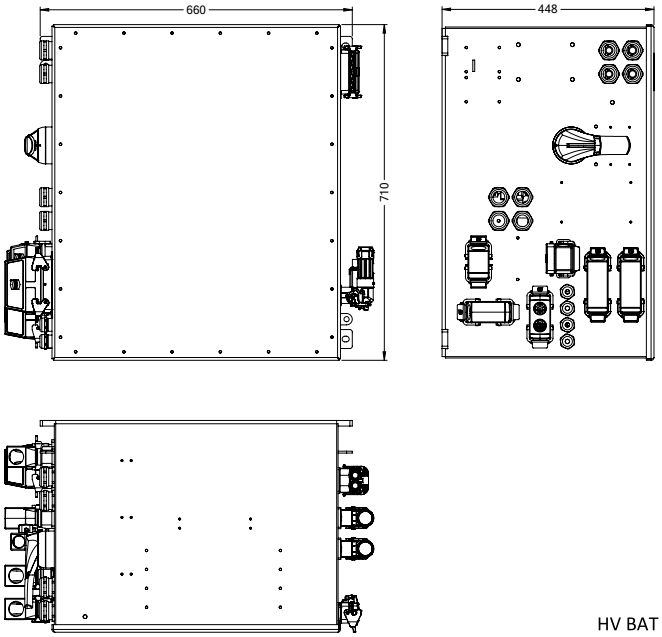
RWN-630-600

RWN-630-600

The RWN-630-600 switchgear is powered from traction batteries. It is fully automated device and it contains switching and control apparatus. The switchgear supplies voltage from the traction batteries to the FT-250-600D SiC propulsion inverters circuits, ZB24DC800 battery charger and the vehicle heating. The RWN 630-600 must be immune to disturbances caused by the higher harmonic content of the voltage. The control circuit is supplied with nominal voltage of 24 VDC.

Specification	
Input voltage	**510 ÷ 750 VDC**
Auxiliary voltage	**24 VDC (+25% ÷ -30%)**
Output voltage	**510 ÷ 750 VDC**
Rated current	**800 A**
Isolation strength	**2.3 kV**
Housing	
Dimensions	**660 x 710 x 448 mm**
Cooling	**Natural**
Weight	**90 kg**
Protection degree	**IP65**

HOUSING



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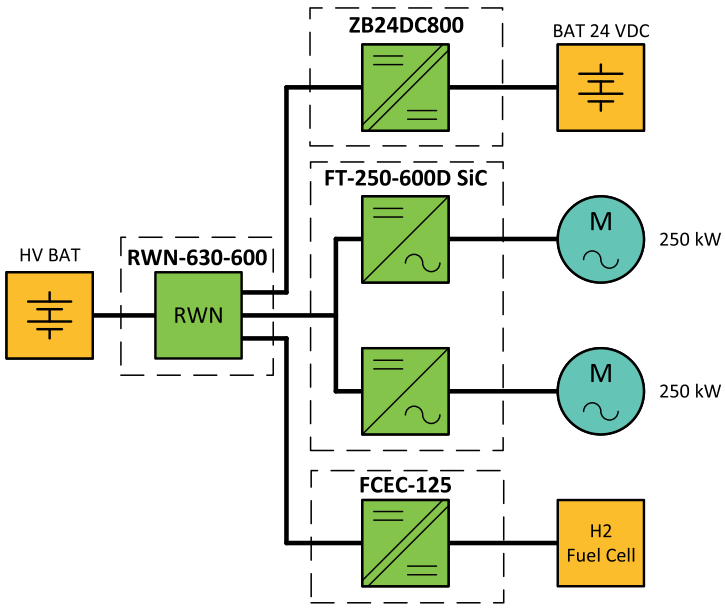

EBC-60M

Battery Charger for eBuses

A mobile one-output charging station for electric vehicles with a maximum power of 60 kW and a maximum charging current of 120 A. Possibility of limiting the power, which is an advantage in the event of temporary unavailability of a specific connection power. The device is characterized by small size and convenience of use. The charger powered by 3x400 VAC, 50 Hz equipped with a CCS Combo Type 2 or CHAdeMO connector, allows charging traction batteries in the voltage range of 150-1000 VDC or other range - depending on requirements. The device is equipped with a control panel, function buttons and a readiness indicator. The charger communicates with the vehicle in the ISO 15118 standard. OCPP or MODBUS comunication for a management system is available as an option. It is possible to implement a twin device in terms of design, powered by direct voltage and a bidirectional charger.
Stationary version of the charger also available.

Specification	
Charging type	**DC**
Maximum rated power	**60 kW**
Maximum charging current	**120 A**
Charging rated voltage range	**150 ÷ 1000 VDC**
Efficiency	**≥96%**
THDi	**≤5%**
Active power factor cos (Φ)	**≥0.99**
Housing	
Dimensions	**1200 x 1080 x 843 mm**
Weight	**230 kg**
Cooling	**Forced air**
Ambient temperature	**-30°C ÷ +45°C**
Connector type	**CCS type 2, CHAdeMO**
Protection degree	**IP54**

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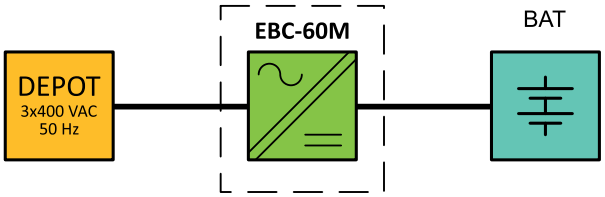

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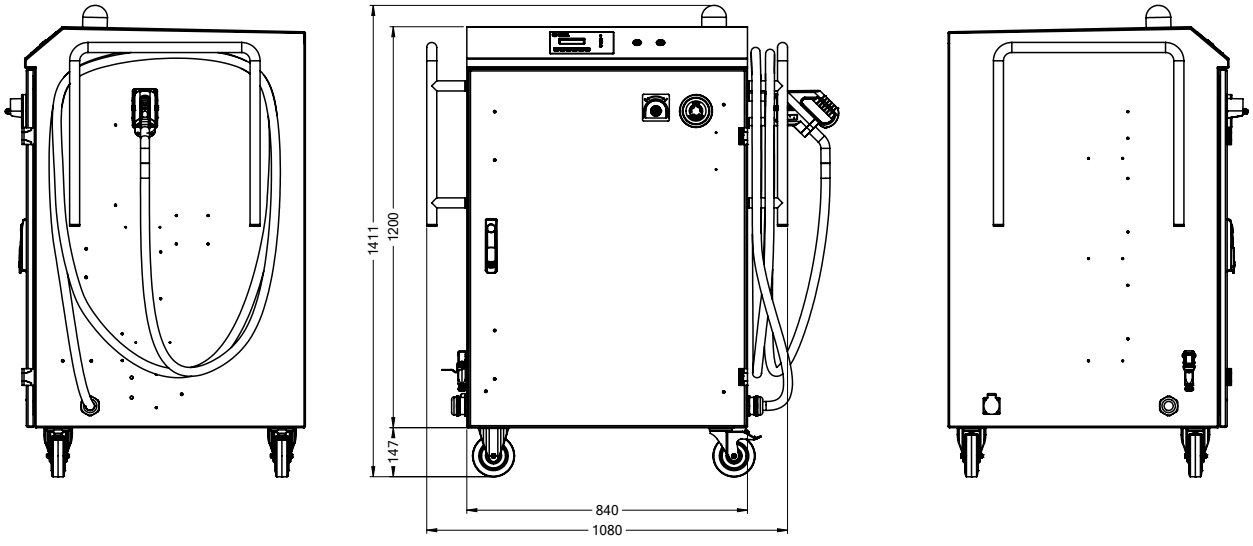

EBC-120S-2 SiC

Battery Charger for eBuses

Double output charging station used to charge one or two vehicles at the same time. The maximum power of the device is 120 kW (or 2 x 60 kW) and the maximum current is 240 A (or 2 x 120 A). The device communicates with the vehicle in the ISO 15118 standard. It is possible to equip the charger with a OCPP or MODBUS protocol to connect it to management system. Moreover, as an option, the charger can support the VDV 261 standard. As in the case of one output mobile charger, there is a possibility of limitation power independently, from the device user panel. Powered by 3x400 VAC, 50 Hz or DC voltage, depending on requirements. Bidirectional version of the charger also implemented.
Mobile version of the charger available.

Specification	
Charging type	**DC**
Maximum rated power	**120 kW**
Maximum charging current	**240 A**
Charging rated voltage range	**150 ÷ 1000 VDC**
Efficiency	**≥ 96%**
THDi	**≤ 5%**
Active power factor cos (Φ)	**≥ 0.99**
Housing	
Dimensions	**1500 x 780 x 1325 mm**
Weight	**477 kg**
Cooling	**Forced air**
Ambient temperature	**-30°C ÷ +45°C**
Connector type	**CCS type 2, CHAdeMO**
Protection degree	**IP54**

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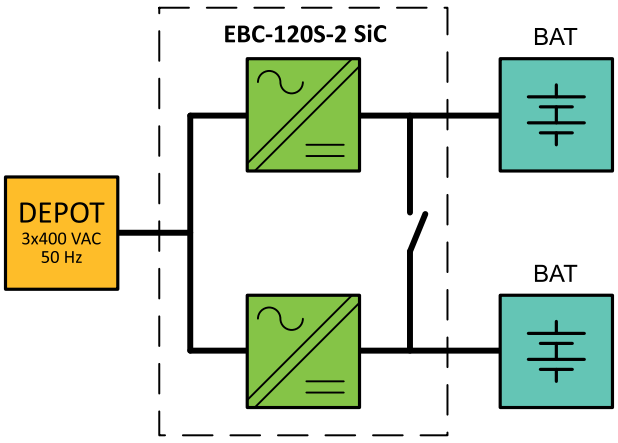

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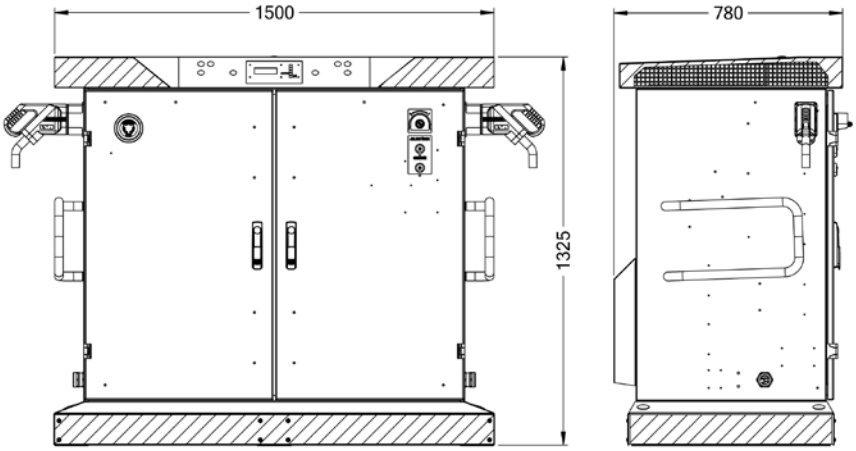


EBC-B-150S SiC V2G

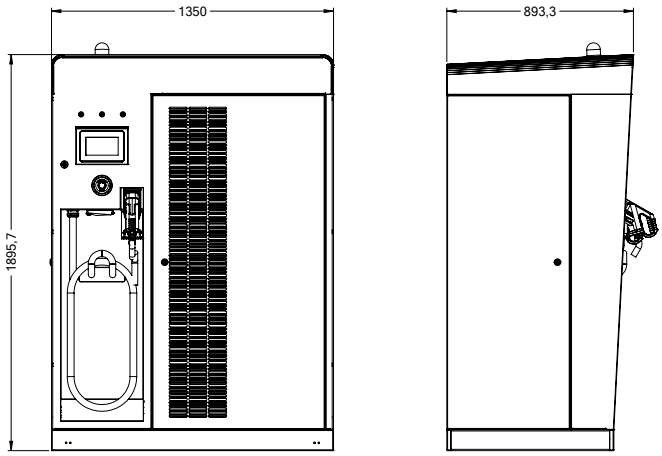
Battery Charger for eBuses

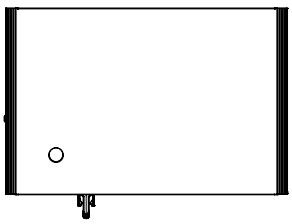
The EBC-B-150S charger is a bidirectional device. In charging operation mode, the device converts the AC supply voltage into DC voltage for charging the traction batteries located on the electric vehicle. The charger cabinet is supplied with 3 x 400 VAC and converts AC voltage to DC voltage in the range of 200 ÷ 800 VDC. The unit also allows the return of power to the grid when the energy storage (traction batteries) is discharged. Charging or discharging is performed via CCS Type 2 interface. The user has the option of setting limit values for charging and discharging modes. The device has a communication interface for remote supervision by the dispatcher.
The device is equipped with:

- LED indicators informing about the charger status
- Main operator panel
- Emergency button
- Key switch enabling the operation
- Visual error signaling
- Battery charge status signaling.

Specification	
Input voltage	**3x400 VAC ±10%, 50 Hz**
Active power factor cosΦ	**≥ 0.99**
THDi	**≤ 5%**
Output voltage	**200 ÷ 800 VDC**
Maximum output power	**150 kW**
Maximum charging current	**250 A**
Efficiency	**≥ 96%**
Housing	
Dimensions	**1350 x 1895 x 894 mm**
Weight	**735 kg**
Connector type	**CCS type 2, CHAdeMO**
Ambient temperature	**-30°C ÷ +40°C**
Cooling	**Forced air**
Protection degree	**IP54**

HOUSING





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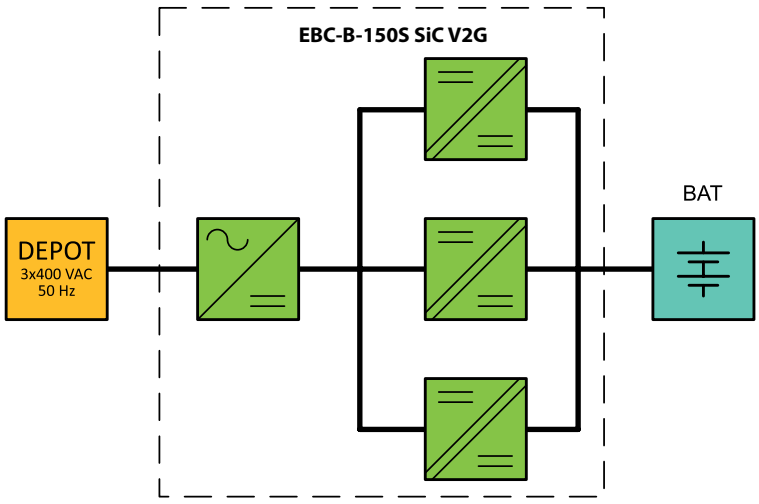


EBC-540S

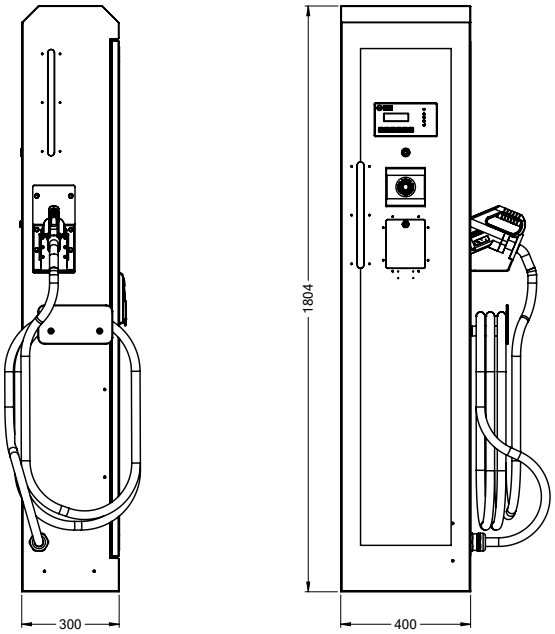
Battery Charger for eBuses

Scalable charging stations connected to charging points/satelites in the form of stands/distribution points or plug-in boxes, with plug--in outputs. The posts can be equipped with CCS Combo Type 2 or CHAdeMO plugs, or both (or even mixed combination of plug-in and pantograph connectors- other type mentioned in further part of folder). It is a completely individual project that allows for the provision of many solutions, both in terms of functionality and power configuration. A perfect solution for depots - also those that want to expand or public charging areas. Each version is a completely individual project, none of the configurations should be standardized, this is a type of device created only for specific customer needs.
The high power of the device allows you to charge the vehicle with a current of up to 500 A using a liquid-cooled cable or up to 400 A using a standard cable (or more if it has pantograph connectors which is also possible). An additional solution is the boost mode function, which allows for current overload, in accordance with the cable manufacturer's recommendations, which allows for faster charging of the vehicle and even more effective use of the device's power.
The posts, as charging points, can be equipped with an RFID reader or a payment system. It is possible to deliver single or double posts.

Specification	
Charging type	**DC**
Maximum rated power	**540 kW***
Maximum charging current	**500 A per output (or 600 A boost mode)***
Charging rated voltage range	**150 ÷ 1000 VDC**
Efficiency	**≥ 96%**
THDi	**≤ 5%**
Active power factor cos (Φ)	**≥ 0.99**
Housing	
Cooling	**Forced air**
Ambient temperature	**-30°C ÷ +45°C**
Connector type	**CCS type 2, CHAdeMO***
Protection degree	**IP54**

*possible higher power (even more than 3MW), current using MSC connector type - also predict to this type of stations

HOUSING



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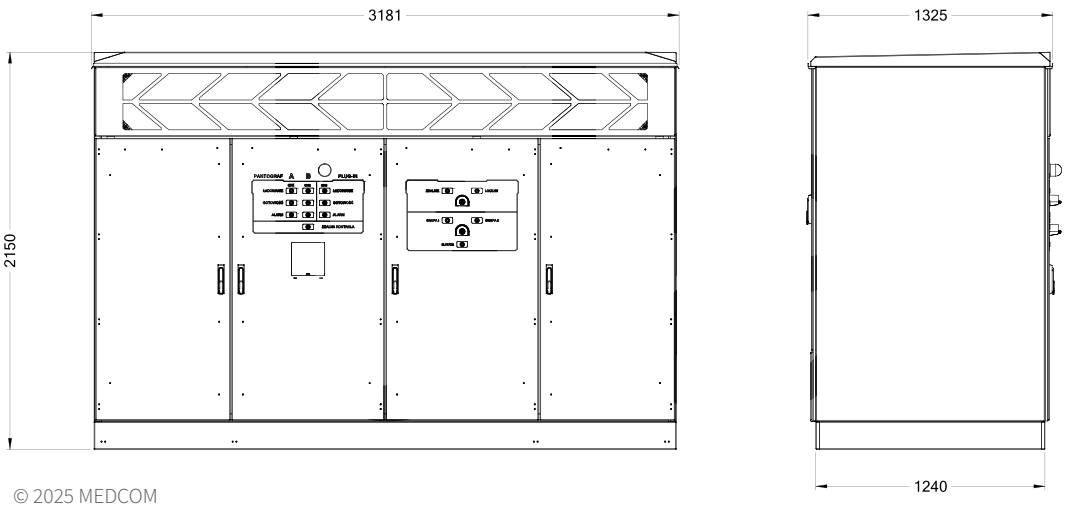

EBC-480PO-2

Battery Charger for eBuses

MEDCOM fast charging stations in an integrated version, with built--in power modules in the pantograph pole. Integrated fast charging station allows to charge an electric vehicle via a pantograph connector. Power up to 480 kW. Connection to the vehicle via inverted pantograph or docking station. Optionally equipped with a plug-in emergency connector in the charger pole. Possible interface for remote dispatcher supervision, wireless communication via Wi-Fi, LTE. Pantograph chargers can also be supervised via mobile applications with data saved in the cloud, reporting, data archiving, by OCPP or MODBUS TCP protocol. Inverted pantograph chargers are equipped with the OppCharge system. State of charge visible on the vehicle.

Specification	
Charging type	**DC**
Maximum rated power	**480 kW**
Maximum charging current	**960 A**
Charging rated voltage range	**150 ÷ 1000 VDC**
Efficiency	**≥ 96%**
THDi	**≤ 5%**
Active power factor cos (Φ)	**≥ 0.99**
Housing	
Dimensions	**5202 x 4897 x 1492 mm**
Weight	**3055 kg**
Cooling	**Forced air**
Ambient temperature	**-30°C ÷ +45°C**
Connector type	**pantograph dome/inverted pantograph (emergency plug-in output as an option)**
Protection degree	**IP54**

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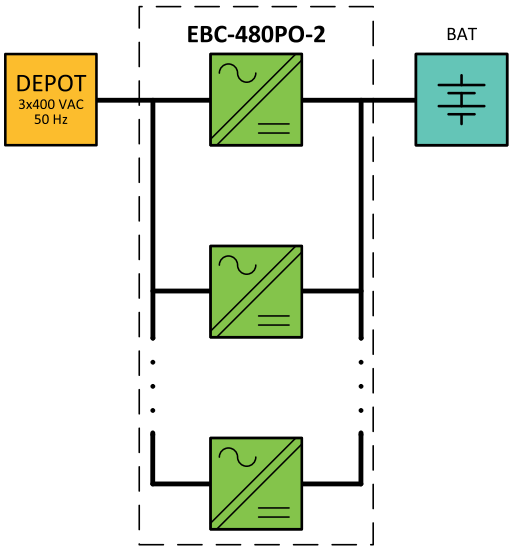

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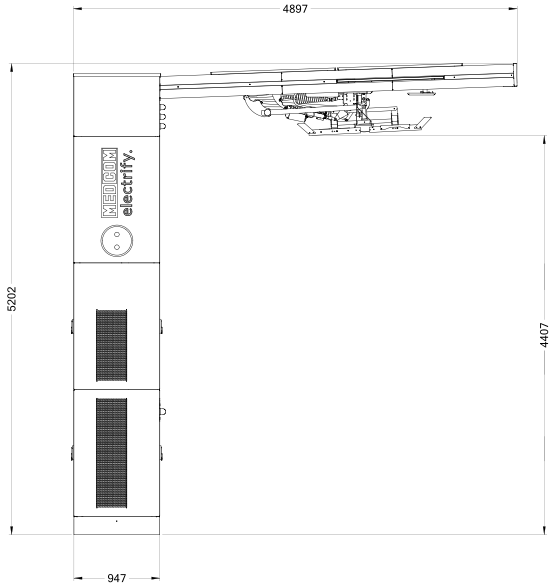
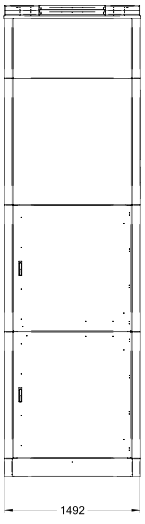




EBC-600SP-2

Battery Charger for eBuses

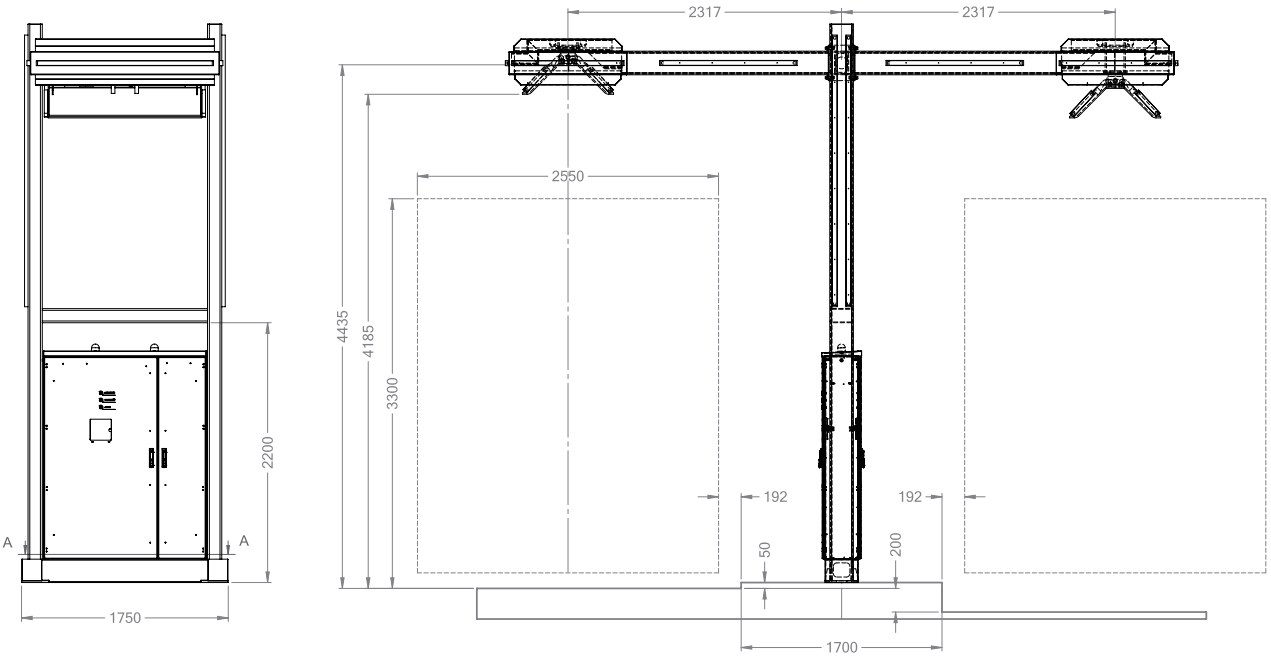
Fast charging station with a separate charger and pantograph pole(s). It is possible to equip it with all types of connectors - contact dome, inverted pantograph (also plug in). Moreover, again as in the case of chargers with distribution posts (satellites), it is possible to dynamically configure the power between the outputs, e.g. output for fast charging, slow charging (e.g. overnight), or battery balancing. This implementation is particularly useful when looking at savings when tariffing energy prices.
This is a special version designed specifically to meet the customer's needs. we provide support in selecting the most optimal solution for User needs.

Specification	
Charging type	**DC**
Maximum rated power	**600 kW***
Maximum charging current	**1200 A**
Charging rated voltage range	**150 ÷ 1000 VDC**
Efficiency	**≥ 96%**
THDi	**≤ 5%**
Active power factor cos (Φ)	**≥ 0.99**

*higher power possible, even up to over 3 MW, including pantographs and MCS connectors

Housing	
Cooling	**Forced air**
Ambient temperature	**-30°C ÷ +45°C**
Connector type	**contact doome/inverted pantograph (emergency plug-in as an option)**
Protection degree	**IP54**

HOUSING



EBC-450SP-10

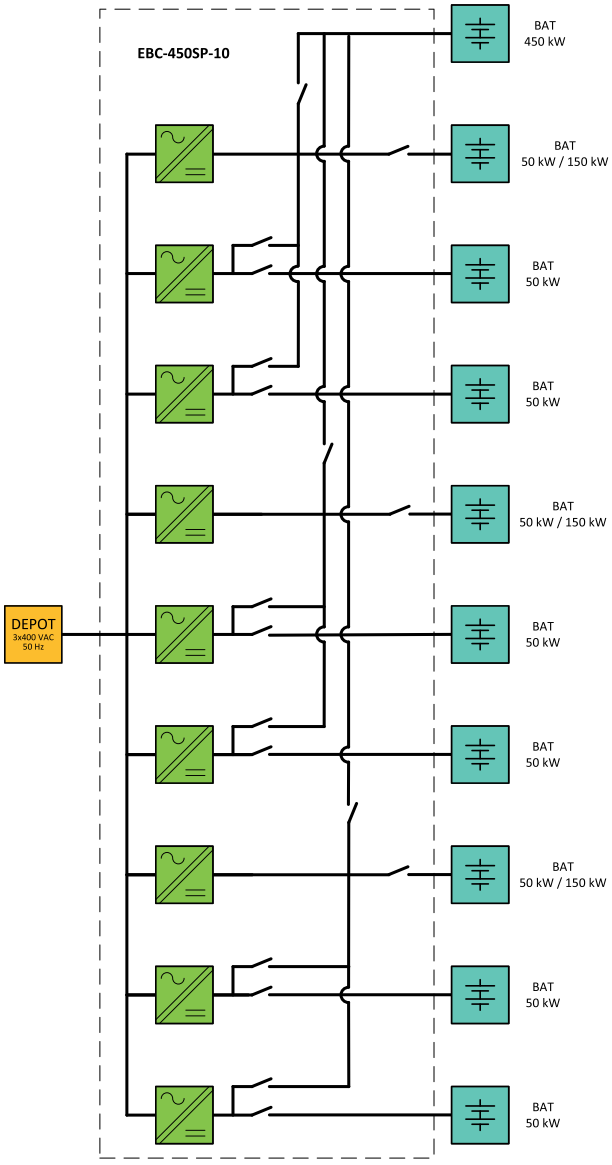
Specification										
Output number	CH1	CH2	CH3	CH4	CH5	CH6	CH7	CH8	CH9	CH10
Output voltage range	150 ÷ 1000 VDC									
Maximum charging power	450 kW	150 kW / 50 kW	50 kW	50 kW	150 kW / 50 kW	50 kW	50 kW	150 kW / 50 kW	50 kW	50 kW
Maximum charging current	900 A	300 A / 100 A	100 A	100 A	300 A / 100 A	100 A	100 A	300 / 100 A	100 A	100 A
Efficiency	≥ 95%									
THDi	≤ 5%									
Active power factor cos (Φ)	≥ 0,99									
Ambient temperature	-30°C ÷ +40°C									
Connector type	inverted pantograph / docking station	docking station / CCS Type 2								
Protection degree	IP 54									

EBC-450SP-10

Examplary high power charger from special implementation at Oslo depot - 139 charging points, including chargers with reversed pantographs, docking stations and CCS Type 2 connectors. Power configuration according to design requirements, different for each charging zone. Local and remote (via OCPP system) switching of power configuration. Ability to charge buses traveling in both directions from a single charging point.
Sixteen units of 300-450 kW chargers have been produced, examples :

- EBC-450SP-9, a 450 kW charger with nine outputs - docking stations, power configuration of 1 x 450 kW or 9 x 50 kW
- EBC-450SP-10, 450 kW charger with ten outputs -docking sta--tions, plug-in, power configuration 1 x 450 or 3 x 150 kW or 9 x 50 kW
- EBC-300SP-7, 300 kW charger with seven outputs - reverse pantograph, plug-in, power configuration 1 x 300 kW or 2 x 150 kW or 6 x 50 kW.

BLOCK DIAGRAM



HOUSING