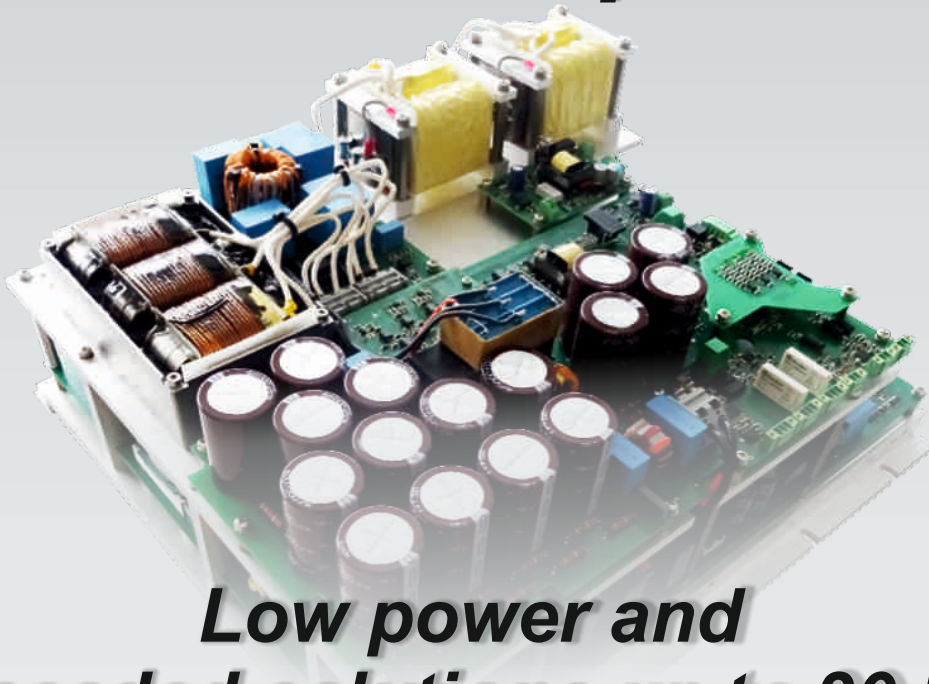


SYKO Gesellschaft für Leistungselektronik



POWER & HYBRID

Your Power Electronics Specialist



***Low power and
cascaded solutions up to 30 kW.***

***SYKO achieves new groundbreaking
innovative solutions. Let us guide you through
our fascinating world of power electronics.***

research & development

administration

production



SYKO - an Expert in Power Electronics

on land - on water - in the air

Research and Development

SYKO Gesellschaft für
Forschung und
Entwicklung
GmbH & Co. KG

Product portfolio

- DC/DC-converter
- AC/DC-converter
- frontend converter
- AC feed-in supplies
- battery charger
- 3 Ph sine wave inverter
- 1/2 Ph sine wave inverter
- frequency inverter
- cascaded Power
up to >30 kW
- operational voltage >5 kV

Modifications

- power range 1 W-10 kW
- high grade functionality
- -46°C-105°C
- complex mechanical
solutions
- strong shock/vibration
resistance
- extreme-EMC

**from the heart of Europe
into the world**



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www.syko.de

Sales and Production

SYKO Gesellschaft für
Leistungselektronik mbH

info@syko.de

Manufacturing

- DIN ISO 9001 certified
- acc. IPC610
- small - high quantities
- SMT production lines
- THT - assembling
- chokes / transformers
- CNC milling centre
- glueing, varnishing, potting
- 100% electrical test
- test documentation
- temperature burn-in,
temperature cycle test

Sales

- standard products
- modifications
- customized solutions
- technical support
- systematic approach
- office and field staff

We define your standards -



groundbreaking - innovative pioneering.

Solutions and Product Portfolio

from low power up to a single power 10 kW/ cascaded power up to >30 kW

DC-low voltage

- 6 - 34 V
- 14 - 154 V
- range up to 1 : 20

DC-high voltage

- 220 - 1270 V / >2000 V
- 1500 V nominal
- 3000 V nominal
- voltage cascades up to >5000 V

AC-input

- 40 - 288 V
- 680 - 3600 V
- sine, rectangle, square shape

Multi-voltage

- complete UIC range DC and AC

selection of topology

- buck or boost
- buck/boost low-/high voltage
- regenerator patent
- voltage/current cascading
- synchronous switch
- housekeeper up to >5000 V
- regenerator/buck construction
- 1/2 Ph-sine wave inverter
- 3 Ph-sine wave inverter
- 3 Ph - frequency inverter
- f-stable, f/U-control, current control
- topology-cascading
- zero load capab. 0 %-100 %-0 %
- galv. isolated/non-isolated front-end supply
- PIC controlled battery charging
- charging of high caps
- charging of Lilon batteries
- external AC feed-in converter
- polarity switch
- regenerator field exciter/ power units
- electronic transformer
- two/three stage-cascading
- current-/slope resonance

DC output

- 1 mA - >800 A
- 1 V - >700 V
- constant/variable
- single/multiple
- current/voltage stable

AC-sinus output

- 1/2 Ph up to >700 VAC
- 3 Ph up to >700 VAC
- 16,7 Hz up to >440 Hz
- harm.distortion up to <1%

AC-square shape output

- 100 kHz (24 - 120) Vrms for an external feed in

Functional outputs

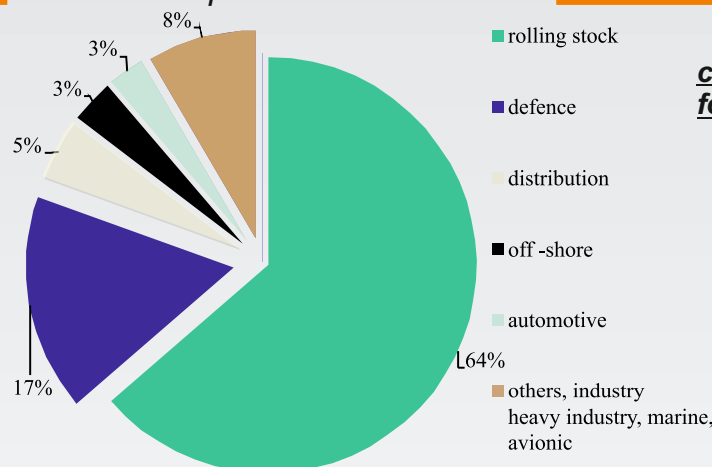
- $V_{out} = f(x)$
x interpretes time/temperature/ set point

Based on standardised circuit topologies SYKO can easily deal with customer-specific modifications and custom developments.

A fully functional prototype can be delivered within a short period of time (including layout design, type testing and adaptation to series maturity)

SYKO generates with about 90 employees in the departments R&D, manufacturing and sales SYKO a yearly turn-over of approx. 9 million Euros. Today SYKO features one of the most extensive programs of standard compliant power supplies for applications in:

railway technology, transportation, vehicle applications, aircraft engineering, ship building, off-shore, defence and special technology.



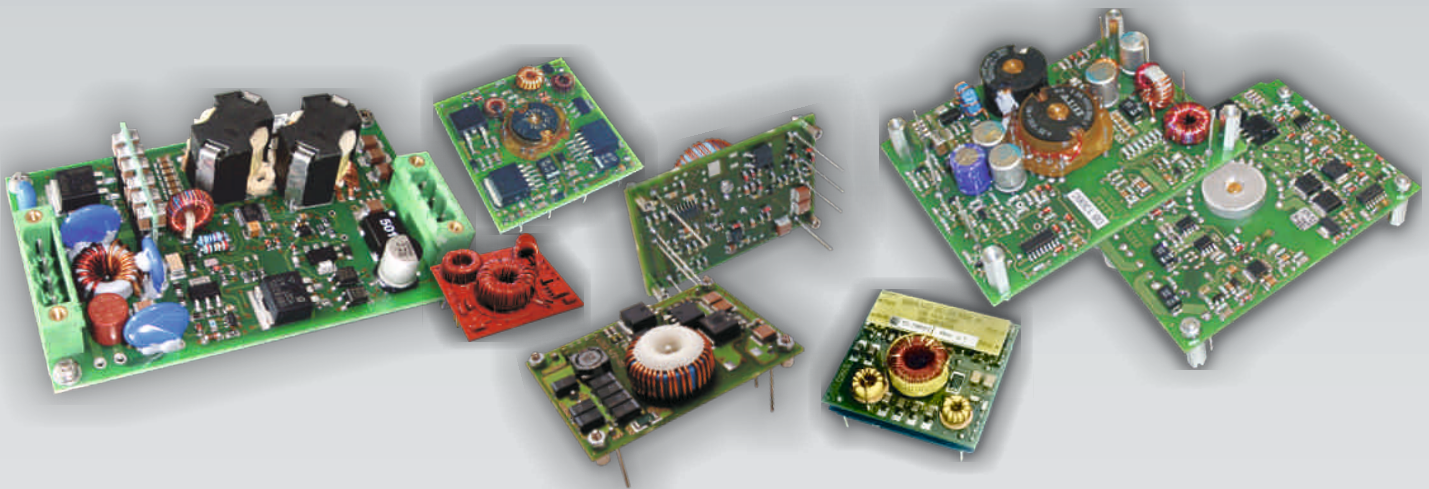
customized solutions for a global market

With the experience and understanding of customer systems our globally available, standard compliant, innovative solutions for stationary and mobile applications are characterized by extreme functionality, quality and extra ordinary durability.

DC/DC Print Converters, Buck Converters, Regenerator up to 70 W

DC converters as PCB modules with a power scale from single watts up to ca. 70W are available with input voltage ranges from 4V up to 170V and with / without galvanic isolation as buck, safety relevant and patented buck/boost topology „Regenerator“ or as a two-stage-principle with galvanic isolation. Single or multiple outputs are possible.

An external filter application to reduce conducted EMC/radio suppression and transient kill can be provided easily by SYKO.

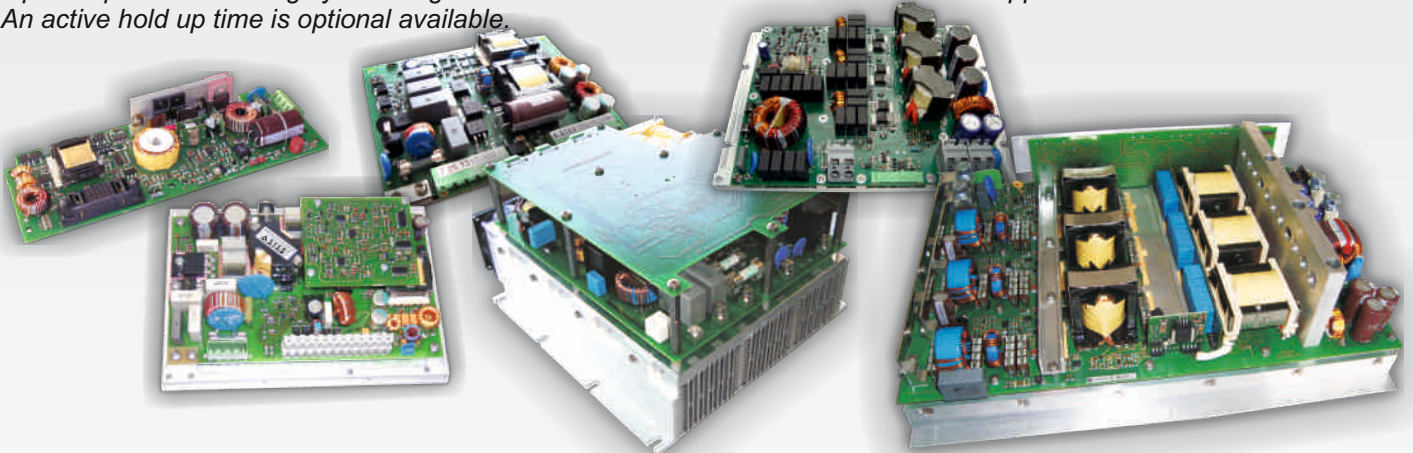


Systems Suitable DC/DC Converters with/without isolation up to 9 kW

To build up a separate voltage network, also onboard applications, are standardized and cascaded products out of product group A up to 9 kW and galvanic isolated low voltage converters from 100 W up to 3 kW with extreme input and various interface requirements in product groups C and E available.

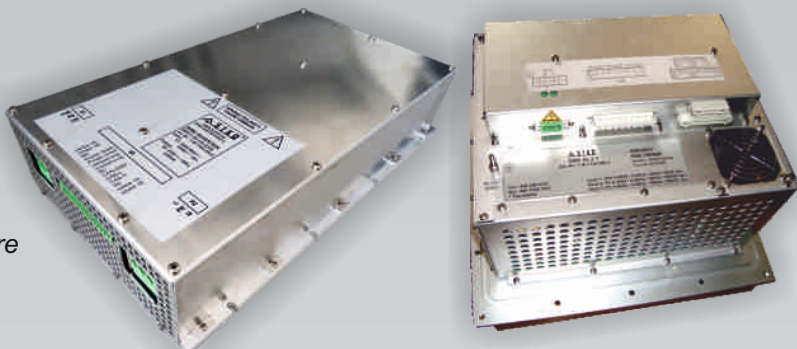
System capability, dealing with norms and guidelines, high reliability/availability in rough ambient conditions from -55°C up to high temperature ranges of 105°C and a robust mechanical construction are quality features of the standard components of SYKO.

Input/output EMC filtering systems against conducted /radiated emission and radio suppression are standard
An active hold up time is optional available

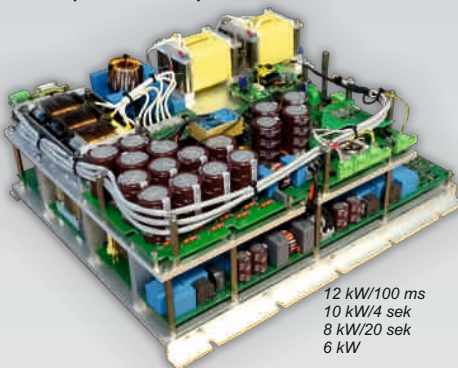
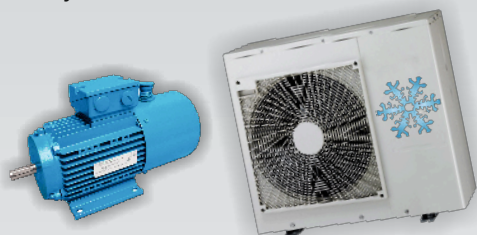


Catenary supplied 1 ph-3 ph Inverters up to 10 kW for air conditioning and forced cooling

With a direct operation at the catenary 600/750 V acc. EN50163 SYKO had designed models with 1 ph/2 ph/3 ph output and increased air/creepage distances, without isolation (safety relevant patented double Regenerator topology). Output power ranges from 2 kW up to dyn. >10 kVA are available. Applications in the field are on vehicles also on/at the track.



1 ph/ 2 ph units with 115/230 V-60/50Hz(16,7 Hz), synthetic sinus, fault-current and isolation protection circuit-breaker (principle acc. relevant norms/guidelines) provide a „socket“ voltage.
3 ph units with 115/230/400 V-400/60/50 Hz, synthetic sinus, single or 3x3 ph-output provide a f/U controlled output and a subordinated current-control-loop and ensure an operation of compressors and fans.
Low inrush and run-up currents (active limiting via external choke ASD), an integral run-up and efficiency optimized topologies with a relevant thermomanagement of all required components ensure extreme reliability and system capability.



12 kW/100 ms
10 kW/4 sek
8 kW/20 sek
6 kW

AC/DC-

Feed-in-Converter up to 3 kW for battery charging and network providing

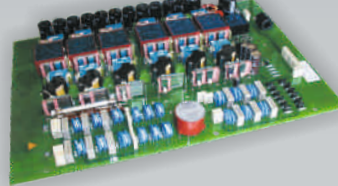
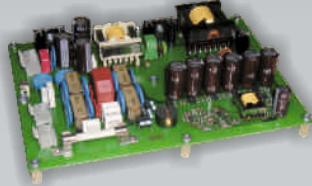
The AC converter in SYKO's portfolio are especially designed for an auxiliary feeded onboard network providing at 1 ph/3 ph input voltages. Beside the wide AC input range in individual cases additional DC voltage feed can be processed. The advantage of this universal input with a very wide range is the capability to operate worldwide incl. the corresponding logistic advantages.

Today SYKO offers following input ranges: (18-360) VDC/(28-288) VAC or (75 -560) VDC/(82-520) VAC incl. long/short term transient protection with output power ranges up to >3 kW.

Shock and vibration resistance, ambient temperatures (-40...+85)°C, optional radiation resistant, PFC input for 16,7 Hz up to 800 Hz are standard. 2 ph or 3 ph inputs voltages with square, rectangle or sinus shape are available. An efficiency up to >94% is an indices for our groundbreaking technology.



Catenary/UIC-Converters **up to 8 kW for a DC network supply** **or flat battery emergency start-up**



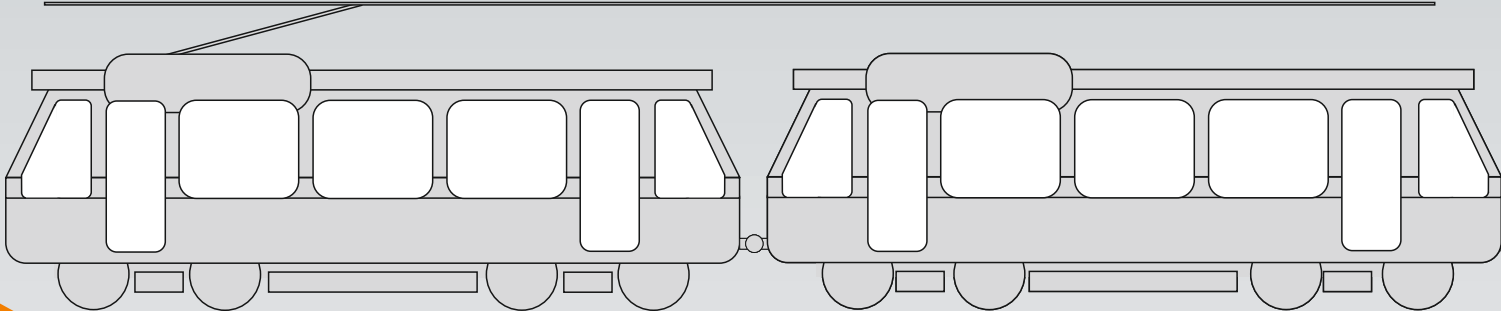
catenary - converters

SYKO defines a DC-converter in a category of catenary feeded converters, if they operate on voltages of 600/750 V and 1200/2400 V. The group of available catenary feeded converters is power limited at the moment up to 8 kW.

UIC converters operate acc. UIC550 on voltages of nominal 1000 VAC/16,7 Hz, 1500 VAC/50 Hz, 1500 VDC, 3000 VDC and optional 30000 VAC/50 Hz with a single or universal input range as frontend unit for several applications (DC network build up/battery charging/inverter).

dead/flat battery start-up for rolling stock/railway applications

The models for a flat battery start-up are suitable to operate permanently on the provided high voltage supply and feed the system 3x3 min from the UIC network or catenary voltage, if the battery is in flat or damaged conditions. During this operation time the auxiliary/battery converter unit will be supplied, the system can start and the battery charging will be initiated.



Battery feeded 1 ph/3 ph **and Frequency Inverter** **up to 12 kVA** **for passenger/service socket supply** **and emergency cooling**



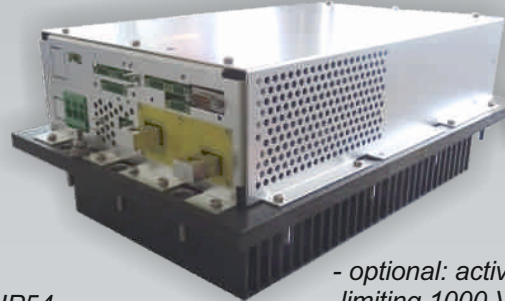
Out of a DC or AC network the inverters generate a galvanic isolated, synthetic 1 ph/2 ph or 3 ph-sinus output voltage with a power range 0,3A-12 kVA. These 1 ph/3 ph inverters and the frequency inverters, are designed to operate at low/high voltage batteries, catenary or intermediate circuits.

These models are capable to operate in mobile applications of 24-110 V, 450/600/800 V intermediate circuits, 600/750 V catenary acc. EN50163 and on UIC voltages acc. UIC550.

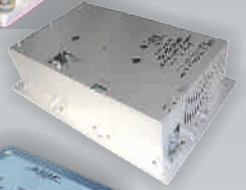


Catenary supplied Battery Chargers & auxiliary voltage up to $n \times 6$ kW

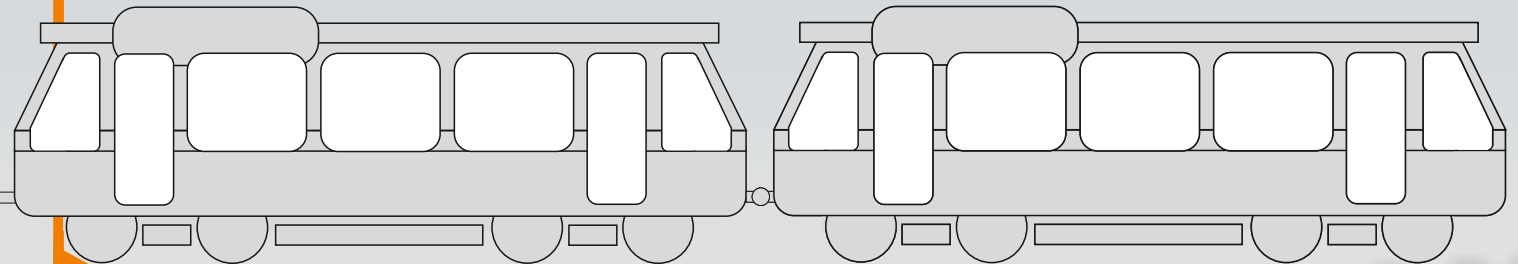
- output as function of the battery temperature
- parallel operation of battery and DC network
- controlled current splitting into the battery
- power-sharing of up to 4 units
- controlled load sharing without decoupling diode
- input current controlling [$I_E = f(\text{fuel cell})$]
- communication RS232, RS485, CAN-BUS
- GUI programmable Vout-charging curve
- ribbed heat sink/cooling plate/water cooling
- open frame construction or incl. cover better than IP54



- optional: active inrush/reflecting current limiting 1000 V/<70 As



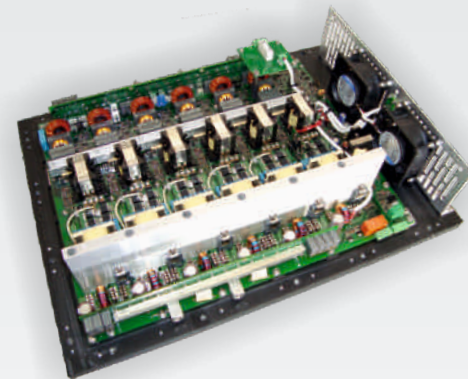
The battery chargers from SYKO are designed for an intelligent, temperature controlled charging in rolling stock/railway, on boats and vehicles. The used topologies result in a high and stable efficiency over a wide input voltage range. System capability will be approached by a large scope of available options, such as a galv. isolated, controlled and short circuit protected 24 V auxiliary voltage, the opportunity of a programmable current splitting to increase the life time of the battery, the optionally controlled parallel operation and the simultaneous operation of battery charging and network supply without diodes, also the new designed zero load capability.



DC/DC Converters DC Frontend supply

with/without galvanic isolation

**for applications in railway/rolling stock
up to 9 kW**



The product groups A, B, C, D and E differentiates from each other by the used topology and an output power up to 9 kW is available for mobile/stationary and high graded applications.

These converters are available as front module, 19" pluggin card or in a chassis mountable construction. Depending on the solution are functions such as active reverse polarity protection, active hold up time, active transient absorption, active inrush current limiting, controlling and monitoring options integrated.

The models of these product groups are ideal for using in battery voltage provided applications. Efficiencies up to 97% show our innovation power.

Reliability , Power and Functional Redundancy for Auxiliary Power Units

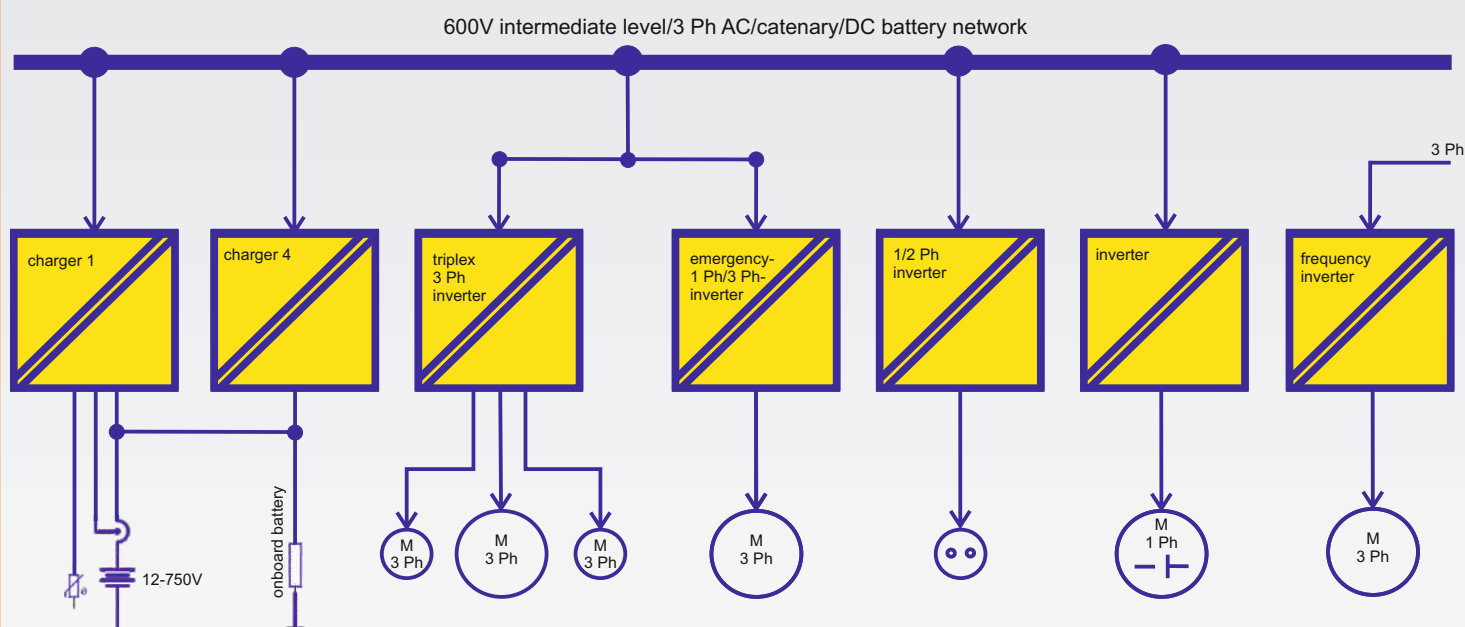
The principle “put a few small power units to a big solution” designed by SYKO is successful introduced into the market. The advantage of this concept is that the miniaturized and cascaded power units fulfill the latest market requirements according logistical flexibility and functionality (smaller dimensions, lower weight and thermal durability). These components are battery chargers, one-, two- or three-sine wave inverters and frequency inverters and can be combined in an Auxiliary Power Unit. They are designed to work at input voltages of 420-850 V DC dyn. 950V DC / 320-600 V DC- three phase 50/60 Hz and/ or for an operation at the catenary 420 – 1000V DC – 1270V/20ms – 1950 V/2 ms or for an emergency operation at all battery network voltage values according specific market requirements on land and on water.

Models BLG.M (600 V), HBL.S (600 V) and HBL.H (catenary) charge low voltage batteries (24 - 110 V) with current values up to 200 A and in a parallel cascade up to 800 A. Also output voltage requirements up to 700 V are applicable with this topology. The three-phase output inverters (DRR.02, DRR.H750, DRR.F, DRR.BAT) provide between 400 V and 480 V rms/three-phase with an output power up to 5.5 kW/4 sec. - 7.5 kW/100 ms - 12 kVA with or without galvanic isolation.

One/two phase inverter models WER.F, WER.H750, WER.BAT provide an isolated 230 V rms with a grounded (TN) or potential-free network (IT) with output power up to 5.5 kW/4 sec. - 6 kW/100 ms - 7.5 kW. The frequency inverter (FUR 04) provides between 400 V and 480 V rms with an output power 4.4 kW/4 sec. - 6.5 kW without primary/secondary isolation.

The model HBL.H charger operates according to the catenary requirements relating to existing norms and guidelines with an efficiency of more than 93 % and can operate in a parallel cascade up to four units (from 200 A up to 800 A). According to the ambient temperature at the batteries and its charging curve the output voltage can be adjusted automatically by a PTC and the splitting current provided to the batteries will be controlled to its setting point. According the monitored battery temperature the voltage/ current curve will be adapted. The maximum permanent ambient temperature of the charger without any derating according EN 60950 and considering EN 60068-2-2 is 60°C.

In single mode or in parallel cascade up to four units the output is capable to deal with load changing 0 to 100 % without any deviation - battery connected or not. The charger can be equipped with ribbed heat sink, a heat sink with mounted fans or with a standard mounted base plate with additional centered mounting hole for a water cooling system. The operation software detects wiring faults (row/parallel) to the batteries, the failure protocol can be also read out without existing input voltage, a second temperature sensor can be used, three potential-free relay connectors for monitoring/diagnose purpose are individually programmable, potential-free and polarity interfaces (6 - 52 V) are resistant against disturbances, the communication protocol is RS 232 or CAN applicable and the parameters will be shown via a GUI.



The three-phase inverters can be offered with or without galvanic isolation depending on the needs of the customer system. The advantage of the SYKO regenerator concept without isolation is the higher efficiency, but not in all cases suitable. In general the SYKO three-phase inverters have over the whole input range a very constant output voltage. All outputs are open circuit proof, short circuit and overload protected. The sine wave is a synthetic sinus, the common mode dV/dt values are kept low by a small conducted capacity and the filter design. The output is EMC filtered and supported by a screened wire customer sided. The output has a high static overload capability and the output load can be dynamically reduced - without influencing the input – by controlling the frequency to voltage characteristics and further three-phase components could be supplied in case of emergency or redundancy operation.

For air conditioning of the driver's cabs are triplex outputs available with three independent and adjustable three-phase outputs. The one-, two- or three-phase inverters are applicable to run at each battery voltage also for an emergency operation. The potential-free one/two-phase inverters are available with strengthened primary/secondary isolation. The output amplitude is a synthetic sine wave form and got an EMC filtering system. The 100Hz ripple don't reflect much into the input, the output amplitudes run-up with a fixed frequency related to a Vout/time run up characteristic. The output is capable to deal dynamically with a short time high power demand without influencing the input side. For the operation mode like the one-phase grounded network the customer needs to use an external fault current device. For the two-phase potential-free IT network SYKO has developed a verified and certified safety concept by monitoring the insulation. This functionality is requested in mobile applications e.g. for fire service or defence. SYKO fulfils IP22 requirements and can offer a solution for a IP6K8 design with an output power 550W/750VA and 2500 W/3000 VA.

The frequency inverter model FUR 04 is designed for the operation of air conditioning systems of the driver's cab and for the cooling of high power modules. Important for the three phase output is that the output voltage depends on the frequency to voltage characteristic and can be up to 480V/AC -60Hz. Other values are programmable by the GUI. The output has a synthetic sine-wave form, furthermore it is open circuit proof and dynamic/static short circuit protected.

Available are three programmable relay connectors and interfaces with potential-free and polarity independent inputs (inhibit/rotating speed/ rotating direction etc.).

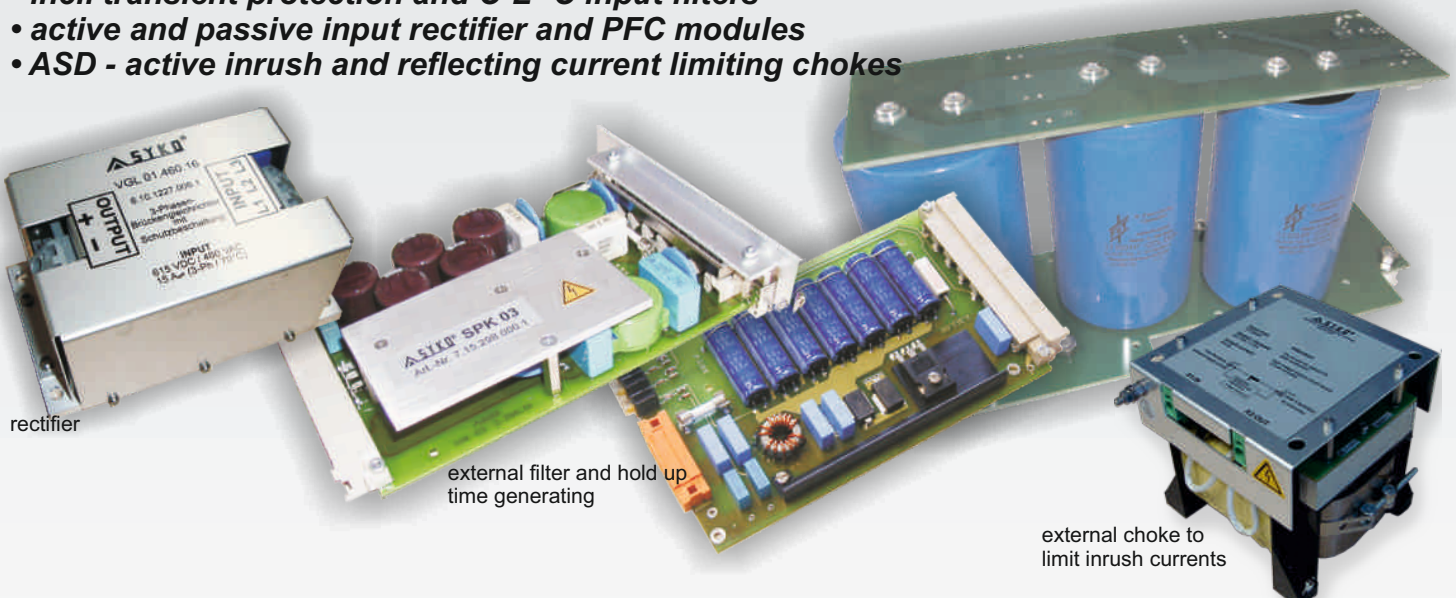
SYKO's main focus is on front end supplies, battery chargers, one-, two- or three-phase inverters, frequency inverters, DC generator extender, feed-in modules and system solutions.

SYKO can deliver a product range from an input voltage 4V up to 5000 V DC/AC, currents up to 800 A, cascaded solutions (power/safety/functionality) up to n x 6kW, modifications according customer specification, standard and custom solutions based on the capability of system thinking for the markets of railway/ rolling stock, defence, offshore, customized/special vehicles.

Accessories

In the system business for mobile applications it must be dealt with very high and long term transients with low impedance. Simultaneous input interruptions must be covered during the crank of motors/ start of engines. SYKO supports the customers to fulfill their system requirements with technical accessories like active transient filter (AFI), passive or active hold up time construction, PFC front end module or external rectifier.

- **energy storages working with a minimum input voltage to deal with mains failure bridging**
- **incl. transient protection and C-L²-C input filters**
- **active and passive input rectifier and PFC modules**
- **ASD - active inrush and reflecting current limiting chokes**



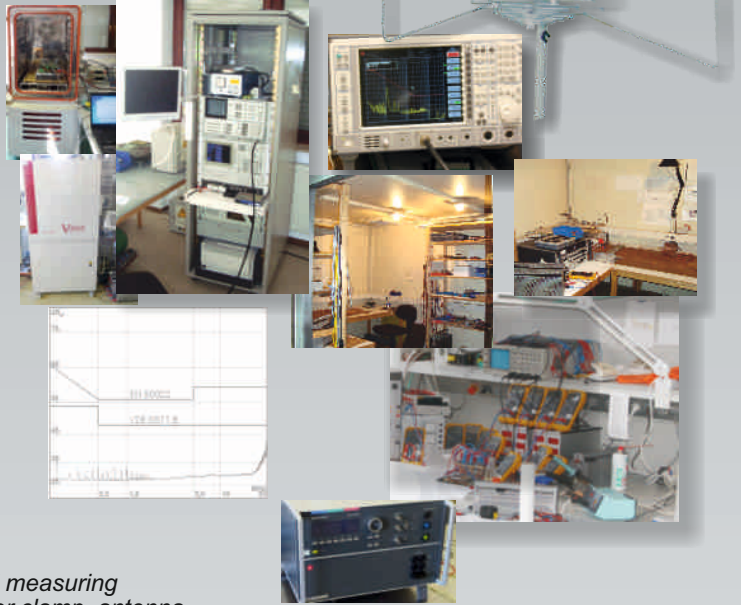
Research and Development

software/ IT

- production planning system PSI-Penta
- company detailed work information tables
- sales software SmartCRM
- service data Access

research and development

- 10 CAD-work stations Altium Designer drawing + layouting
- 3D-Platz LT
- development of new topologies (patents)
- support during of realizing of projects
- modification of catalogue and standardized components
- tailor made solutions
- development acc. related norms & guidelines such as
 - protection, EMC, disturbances, temperature,
 - shock, vibration
- documented first article inspection/verification
- temperature tests, cycle tests, thermal camera 3
- EMC work stations ESI (R u. S) 20 Hz-7 Ghz
- radio interference absorber cabin Siemens
- mobile EMC and components test station
- transients test station burst/surge/radio suppression
- EMC test stations for comparable and a research attended measuring
- spectrum analyzer, phase gain amplifier, test probe absorber clamp, antenna, disturbance-references
- certified measurements are performed by accredited test laboratories



Manufacturing

- nitrogen double wave soldering system SEHO
- 3 fully automatic high intelligent SMT assembling machines with connection to the CAD system and PPS system incl. automatic feeding and charging stations
- dispenser and convection soldering oven SEHO
- 4 optical control workplaces
- 4 manual assembling workplaces SMD
- 25 conventional assembly workplaces (THT)
- department for mechanical integration
- CNC milling centre, turning/milling machines Spinner
- series production (metal) by sub suppliers
- department for winding components small series
- series production for winding comp. by sub supplier
- automatic silk-screen printer/pad printer EKRA
- fully automatic stencil printer
- vacuum casting compound machine
- department for coating and adhesive bonding
- PCB cleaning/washing station

test field

- 14 independent equipped test workplaces
- 2 computer controlled end test places for series testing
- 6 high/low temperature ovens -60 +125°C (computer controlled)
- 3 burn-in test cabins with computer documentation
- 3 cycle test ovens -60 +125°C for documented series testing
- Mobile measurement place for prototypes (documented) R&D
- 100% functional testing for all series units at temperature limits
- Modern and extensive test equipment
- 100% series test according test data sheet of internal and external interfaces
- Test data sheet is object of technical agreement



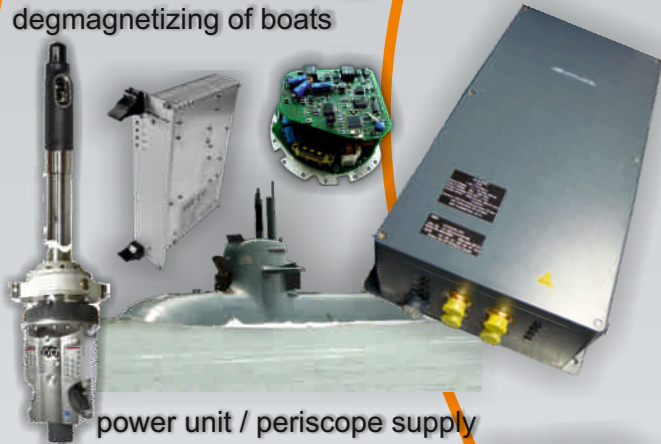
56 kW- sun powered global air conditioned production and administration areas

Customer specific - Global - Customer oriented

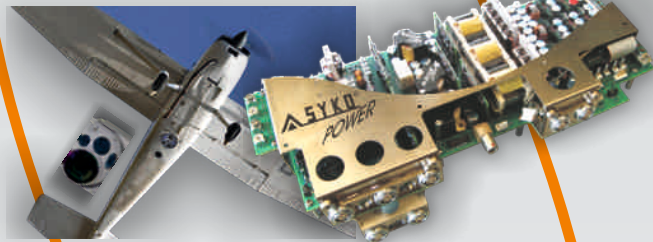
*in projects
on land - on water - in the air
in Europe, North/Southamerica, Asia, Australia*



degmagnetizing of boats



power unit / periscope supply



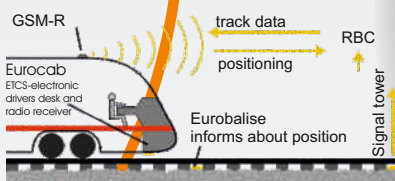
avionics / detect / land survey



electronic timetable display



GPS supply



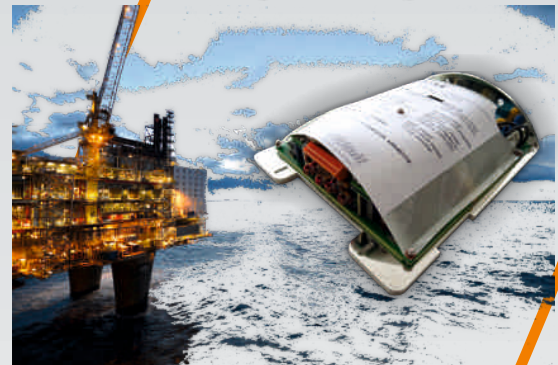
automatic train control



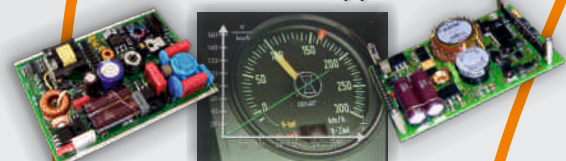
avionics comms infotainment



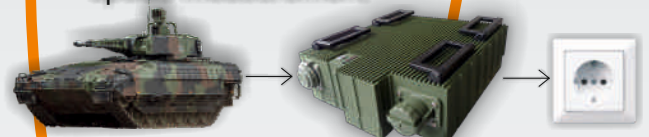
coding / decoding



2000m subsea application



end car - radar sensors
speed measurement



230Vrms feed out



optical systems

Philosophy

Quality is a basic requirement across the whole organisation of SYKO and it is the daily goal to achieve a zero failure rate. Our focus is not only on internal cost effectiveness, furthermore on achieving customer satisfaction. SYKO lives by these basic guidelines within our internal quality management, which results in the DIN ISO 9001 certification. The effectiveness and realisation of this high standard is confirmed in practice by numerous positive customer audits and customer experiences.

SYKO generates products of the highest quality, based on process monitoring and documented manufacturing instructions. This starts with the engineering of the first prototype and also guarantees the theoretical possibility of re-manufacturing for an unlimited time. At the same time, we create transparent traceability.



In practice, this is realised through our implemented comprehensive change management tool and communicated to the customers, within the scope of form, fit and function. All relevant tests are integrated in a product-specific test data sheet for standard or customised solutions. Our clients can influence or adapt the electrical serial end-tests that have to be performed. For example, individual temperature burn-in and cycle tests can be agreed.

SYKO implements the acquired knowledge of 45 years into new projects for small and medium-sized production batches, with highest requirements in the scope of manufacturing quality and standard compliance in accordance to functionality, shock/vibration, temperature and EMC. The key to SYKO's market success is not only its long-term experience but also its realised investment volume in modern production and research facilities.

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