

# SCHAEFER

## PRODUCT OVERVIEW

### Power Conversion Systems

Power Supplies

Converters

Inverters

Rectifiers

Chargers

Systems



Schaefer – the Power to make it happen.





_____ <i>workforce</i>	Schäfer Elektronik, founded in 1969, has grown to a dedicated workforce of 160 people in Germany, Ireland, and the USA.
_____ <i>experience</i>	Thanks to decades of experience in design and manufacturing of power supplies, Schaefer offers a large variety of products, options, and enhancement features. In the field of high power requirements, Schaefer has achieved and continues to command a leading position.
_____ <i>customer orientation</i>	Requirements are analyzed by a group of experts in dialog with the customer resulting in an individual concept.
_____ <i>flexibility</i>	With the production located next to the development department an optimal interaction can be accomplished during all stages of a project. Hence the customer gets tailor-made solutions for large or small quantity requirements.
_____ <i>reliability</i>	<p>Schaefer power supplies are often used for applications which demand a high level of reliability under severe environmental conditions, e. g.</p> <ul style="list-style-type: none"><li>■ Railroad industry</li><li>■ Automotive industry</li><li>■ Telecommunication</li><li>■ Power generation plants</li><li>■ Chemical plants and oil refinery</li><li>■ Factory automation</li><li>■ Military industry</li></ul>
_____ <i>quality</i>	Development guidelines, arduous selection of industrial components regarding their load criteria and temperature performance as well as many test procedures during all steps of production ensure the highest product quality. In addition, Schaefer pursues a full supplier management according to ISO 9001 which guarantees permanent improvement of the products especially within the turbulent market of electronic components.
_____ <i>contact</i>	Through headquarters in Germany, the USA office, and an international network of representatives prompt technical support is provided worldwide.





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**Switchmode****DC/DC converters****4**

- ▶ from 50 W to 40 kW
- ▶ with isolation

**AC/DC power supplies and battery chargers****5**

- ▶ from 50 W to 40 kW
- ▶ with isolation

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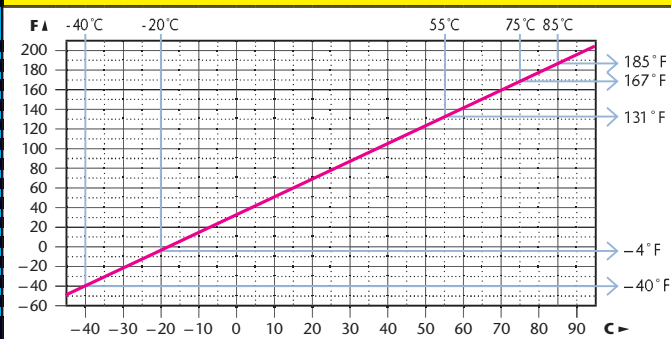
- ▶ from 200 VA to 36 kVA
- ▶ with isolation

**DSP controlled systems****7****Mechanics and accessories****8****Design solutions****10****Thyristor-controlled****Power supplies and battery chargers****12**

- ▶ from 100 W to 500 kW
- ▶ with isolation

**Options and accessories****14****Design solutions****15****Conversion table**

Height:	1 U = 44.45 mm
	1 U = 1.75"
Width:	1 TE = 5.08 mm
	1 TE = 0.2"
	1" = 25.4 mm
Weight:	1 kg = 2.2 lbs

**Conversion diagram °C ► °F**

The manufacturer reserves the right to deviate from technical details given.



**Input voltage:** 10 - 800 VDC  
**Output voltage:** up to 800 VDC  
**Output current:** up to 500 A  
**Output power:** 50 W - 40 kW  
**Additional outputs:** 5 / 12 / 15 / 24 VDC upon request

## Features

- continuous short circuit protection
- overvoltage protection
- thermal shutdown with auto-restart <sup>1)</sup>
- operational from -40 to +75 °C
- industrial grade components
- compact and robust design

## Plug-in modules for 19" sub-racks with natural convection

POWER <sup>2)</sup> [WATTS]	WIDTH [TE]	DEPTH [mm]	HEIGHT [U]
50	10	160	3
150	10 or 14		
250	21		
500	42		
400	21	220	3
600	28		
800	42		
200	10		
400	14	160	6
600	21		
1200	42		
850	21		
1250	28	220	6
1700	42		
2500	56		
1600	21		
2500	28	300	6
5000	56		

1 TE = 5.08 mm, 1 U = 44.45 mm

## High power modules with fan cooling

POWER <sup>2)</sup> [kW]	WIDTH [inch]	DEPTH [mm]	HEIGHT [U]
5 / 7.5 / 10	19"	600	4
6 / 8 / 12	19"	360 or 460 <sup>3)</sup>	6 or 9 <sup>3)</sup>
22	19"	600	8
30	19"	600	12

## High power modules with water/liquid cooling

POWER <sup>2)</sup> [kW]	WIDTH [inch]	DEPTH [mm]	HEIGHT [U]
8 / 15 / 30 / 40	19"	600	5 / 5 / 9 / 11

19" = 482.6 mm, 1 U = 44.45 mm

## Specifications

### Input

Immunity	
- Fast transients	acc. to EN 61000-4-4 level 3
- Surges	acc. to EN 61000-4-5 level 3

### Output

Line regulation (±10%)	0.1%
Load regulation (10 - 90%)	0.2%
Ripple and noise	< 1% + 30 mV pk-pk
Overload protection	current limited to 105-110% of full load
Overvoltage protection	OVP switches off module with automatic return to operation
Remote sense	up to 3 V per wire

### General

Efficiency	80 - 95% typical for low input / output voltage: 75% typical
Operating temperature	-20 to +75 °C optional: -40 to +75 °C above +55 °C derating 2.5%/°C
Storage temperature	-40 to +85 °C
I/O isolation voltage	2100 VDC ( $V_{in} < 60$ VDC) 3500 VDC ( $V_{in} > 60$ VDC)
Safety	acc. to EN 60950, class 1
EMI	acc. to EN 55022, class A optional: class B
Connector	H15 acc. to DIN 41612 or terminals / bolts / bars

## Options

- ┌ Inrush current limiting
- ┌ Input polarity protection
- ┌ Output decoupling diode for redundant / parallel operation
- ┌ Active current sharing for parallel operation
- ┌ Remote on / off (inhibit)
- ┌ Output programmable via analogue signal
- ┌ Monitoring of input and output voltage
- ┌ RS232 or IEEE488 interface
- ┌ Wall mount, chassis mount or DIN rail mount
- ┌ Increased mechanical strength
- ┌ Tropical protection

<sup>1)</sup> applicable to power ratings > 800 Watts

<sup>2)</sup> for low input and output voltages there will be less power in relation to the size

<sup>3)</sup> depending on output current



**Input voltage:** 115 / 230 VAC, single phase (with or without PFC) or 200 / 400 / 480 VAC, three phases

**Output voltage:** up to 800 VDC

**Output current:** up to 500 A

**Output power:** 50 W - 40 kW

**Additional outputs:** 5 / 12 / 15 / 24 VDC upon request

## Features

- continuous short circuit protection
- overvoltage protection
- thermal shutdown with auto-restart <sup>1)</sup>
- operational from -40 to +75 °C
- industrial grade components
- compact and robust design

## Plug-in modules for 19" sub-racks with natural convection

POWER <sup>2)</sup> [WATTS]	WIDTH [TE]	DEPTH [mm]	HEIGHT [U]
50	10	160	3
150	10 or 14		
250	21		
500	42		
400	21	220	3
600	28		
800	42		
200	10		
400	14	160	6
600	21		
1200	42		
850	21		
1250	28	220	6
1700	42		
2500	56		
1600	21		
2500	28	300	6
5000	56		

1 TE = 5.08 mm, 1 U = 44.45 mm

## High power modules with fan cooling

POWER <sup>2)</sup> [kW]	WIDTH [inch]	DEPTH [mm]	HEIGHT [U]
5 / 7.5 / 10	19"	600	4
6 / 8 / 12	19"	360 or 460 <sup>3)</sup>	6 or 9 <sup>3)</sup>
22	19"	600	8
30	19"	600	12

## High power modules with water/liquid cooling

POWER <sup>2)</sup> [kW]	WIDTH [inch]	DEPTH [mm]	HEIGHT [U]
8 / 15 / 30 / 40	19"	600	5 / 5 / 9 / 11

19" = 482.6 mm, 1 U = 44.45 mm

## Specifications

### Input

Frequency	47 - 400 Hz
Immunity	
- Fast transients	acc. to EN 61000-4-4 level 3
- Surges	acc. to EN 61000-4-5 level 3

### Output

Line regulation (±10%)	0.1%
Load regulation (10-90%)	0.2%
Ripple and noise	< 1% + 30 mV pk-pk
Overload protection	current limited to 105-110% of full load
Overvoltage protection	OVP switches off module with automatic return to operation
Remote sense	up to 3 V per wire

### General

Efficiency	80 - 95% typical
Operating temperature	-20 to +75 °C optional: -40 to +75 °C above +55 °C derating 2.5%/°C
Storage temperature	-40 to +85 °C
I/O isolation voltage	3500 VDC
Safety	acc. to EN 60950, class 1
EMI	acc. to EN 55022, class A optional: class B
Connector	H15 acc. to DIN 41612 or terminals / bolts / bars

## Options

- Inrush current limiting
- Automatic selection of 115 / 230 VAC input
- Power factor correction for single phase input
- Output decoupling diode for redundant / parallel operation
- Active current sharing for parallel operation
- Remote on / off (inhibit)
- Output programmable by analogue signal
- Automatic / manual selection of charging characteristic
- Temperature compensated charging voltage
- Monitoring of input and output voltage
- RS232 or IEEE488 interface
- Wall mount, chassis mount or DIN rail mount
- Increased mechanical strength
- Tropical protection



**Input voltage:** 10 - 800 VDC or 115 / 230 VAC, single phase, 47 - 400 Hz

or 200 / 400 / 480 VAC, three phases, 47 - 400 Hz

**Output voltage:** 115 / 230 VAC, single phase or 200 / 400 / 480 VAC, three phases

**Output frequency:** 50 / 60 / 400 Hz or programmable within 40 - 400 Hz

**Output power:** 200 VA - 36 kVA

## Features

- Sine wave
- Continuous short circuit protection
- Thermal shutdown with auto restart for inverters > 1 kVA
- Suitable for complex load
- Surge power capability
- Industrial grade components
- Compact and robust design
- Unsymmetrical load permissible for 3-phase systems

## Modules with 1-phase output

POWER <sup>1)</sup> [kVA]	DEPTH [mm]	WIDTH	HEIGHT
up to 0.6	160	42 TE	6 U
up to 1.2	220		
up to 1.6		56 TE	
up to 2.5	300		
up to 12 <sup>2)</sup>	460	19"	

1 TE = 5.08 mm, 19" = 483 mm, 6 U = 267 mm

## Modules with 3-phase output

POWER <sup>1) 2)</sup> [kVA]	DEPTH [mm]	WIDTH	HEIGHT
0.6 - 10	460	19"	6 U
up to 36	460	19"	3 x 6 U

<sup>1)</sup> for low input voltage there will be less power in relation to the size

<sup>2)</sup> for power ratings > 3.6 kVA the transformer needs to be installed externally because of weight and size

## Specifications

### Input

No-load input power	10 - 30 W
Immunity	
- Fast transients	acc. to EN 61000-4-4 level 3
- Surges	acc. to EN 61000-4-5 level 3

### Output

Line regulation ( $\pm 10\%$ )	2% typical
Load regulation (10-90%)	1% typical, 3% max. (3% typ. 5% max. @ 400 Hz)
Distortion	3% typical (5% @ 400 Hz)
Overload protection (steady state)	current limited to 105% of full load
Short circuit protection	electronically limited to 3 x nominal current
Surge power	2 x nominal power for 1 sec.
Crest factor	approx. 3
Power factor	cos

### General

Efficiency	75 - 94% typical
Operating temperature	-20 to +75 °C optional: -40 to +75 °C above +55 °C derating 2.5%/°C
Storage temperature	-40 to +85 °C
I/O isolation voltage	3500 VDC
Safety	acc. to EN 60950, class 1
EMI	acc. to EN 55022, class A optional: class B
Connector	H15 and F24H7 acc. to DIN 41612 or terminals

## Options

- ▢ Inrush current limiting
- ▢ Input polarity protection for DC input
- Automatic selection for 115 / 230 VAC input
- ▢ Power factor correction for single phase input
- ▢ Remote on / off (inhibit)
- ▢ Monitoring of input and output voltage
- ▢ Output programmable via analogue signal
- ▢ RS232 or IEEE488 interface
- Wall mount
- ▢ Increased mechanical strength
- ▢ Tropical protection
- ▢ Static Switch for uninterruptible power supply from 800 VA to 10 kVA

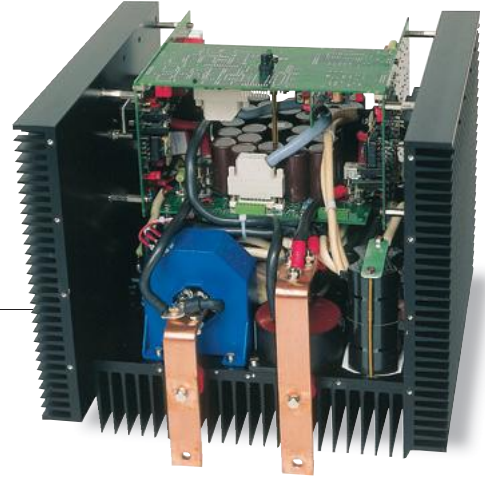


SCHAEFER GmbH has striven to further develop both the current and new product ranges.

The following examples are some of the Digital Signal Processor (DSP) controlled designs, which add to the SCHAEFER principle of constructing and designing for long life, reliable and safe operation.

## AC/DC rectifier

- 3-phase 480 VAC / 400 Hz input  
270 VDC / 10 kW output  
On board aircraft application
- Mil STD 461 E
- Mil STD 1399
- Mil STD 810F
- Extreme shock, vibration, temperature and altitude change  
DSP controlled PFC for near PF unity  
DSP controlled conversion for optimum power control



## DC/AC inverter

- DC input, generator or battery power  
120 VAC / 3 kVA output  
On board mobile application
- Mil STD 461 E
- Mil STD 1322B
- Mil STD 810F
- Extreme shock, vibration, temperature and altitude change  
DSP controlled inversion for optimum power control  
Extremely compact design, to fulfil the End Client design parameters
- Supplies a compressor where the load demand rises repeatedly to three times the nominal current  
Parallel function



Challenged with a Military grade RACK solution, the 5100 series has been developed to give an extremely high power density, flexibility in orientation, and the Mil STD 810F, Mil STD 461E and Mil STD 1399 all tested to the Mil STD 1322B.



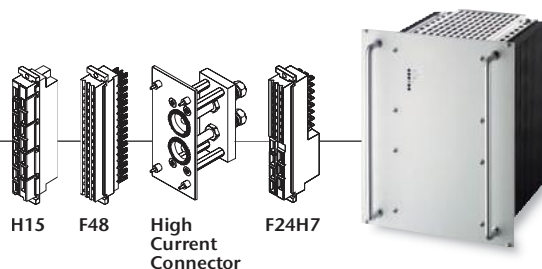
5U, 19" sub-rack with 3 modules;

3U, 19" sub-rack with 2 modules

## Standard

### Plug-in module for 19" sub-rack with natural convection

The standard modules are typically equipped with one or two H15 connectors at the rear. For currents > 50 A „high current connectors“ are used. For inverters with a transformer at the output a F24H7 connector is fitted in addition to the H15 connector and for static switches a F48 connector is fitted in addition to the H15 connector. All these modules are designed for insertion into a 19" sub-rack.



### High power module with fan cooling

The high power modules are constructed in 19" format, having a terminal block at the rear. Depending on the current, bolts or bars may also be available for connection. Typically, these modules are cooled through air supply entering below and exiting above (see photo), with the exception of some modules whose airflow is from front to back.



### High power module with liquid cooling

High power modules with liquid cooling are also constructed in 19" format, having bolts or bars and eventually Sub D connectors at the rear. The connections for the liquid inlet / outlet are also located at the rear.



rear view

## Options



### w wall mount

Modules, which have the wall mount option, are typically fixed to a structure or within a cabinet. Depending on the size of the module, this may be done with a flat or angled plate (see photo). The load connections are typically a terminal block. Should the application not require a pluggable module / rack solution, wall mounting presents an alternative for the customer to choose from.



### cha chassis mount

Module is designed for installation to a structure or within a cabinet. Screw type mating connectors are supplied with the module. Due to the limited number of connector pins this option is not available for modules with dual AC input or for multi-output converters with output 4 supplying more than 10 A.



rear view

### din DIN rail mount

Module is designed for DIN rail mounting to a structure or within a cabinet. Screw type mating connectors are supplied with the module. Due to the limited number of connector pins this option is not available for modules with dual AC input or for multi-output converters with output 4 supplying more than 10 A.

## 19" Sub-Racks

As standard, all of the modules are designed and manufactured for insertion into 19" sub-racks. Higher power modules are already constructed in 19" format.

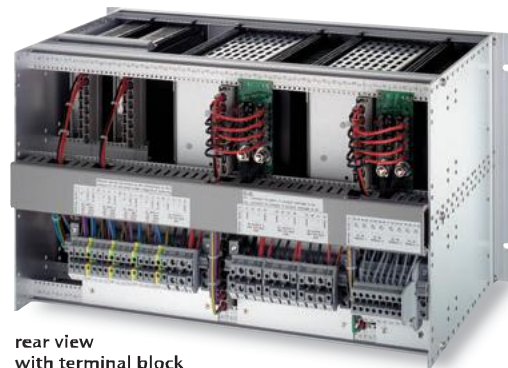
19" sub-racks can be configured as 3U or 6U allowing any mix of units and can be upgraded in accordance to the customers' requirements, e.g.

- mating connectors wired to a terminal block
- fuses or circuit breakers
- hot swappable configuration upon request
- analog or digital meters
- switches
- fans
- filters
- decoupling diodes
- provisions for keying the modules to ensure module / slot designation

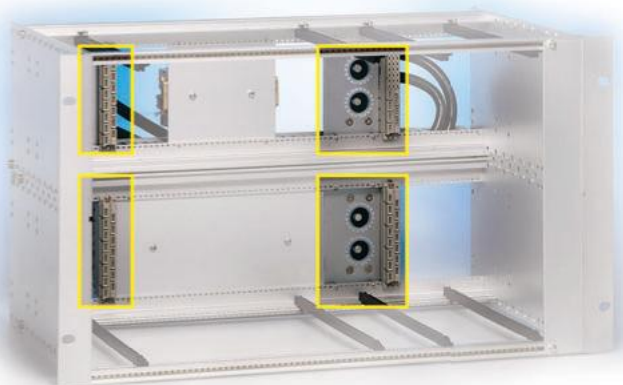
Alternatively, the racks can be provided in 23" format.



front view



rear view  
with terminal block



internal front view showing various mating connectors



rear view showing high current mating connectors

## Enclosures

wall-mounted enclosure designation	weight (empty) [kg]	height	width	depth
		dimensions [mm]		
R2	9	300	380	210
R3	12	380		
R4	17	600		
R4+	26	380	600	350
R4T	22	600		
R5	31	760		
R5+	38			

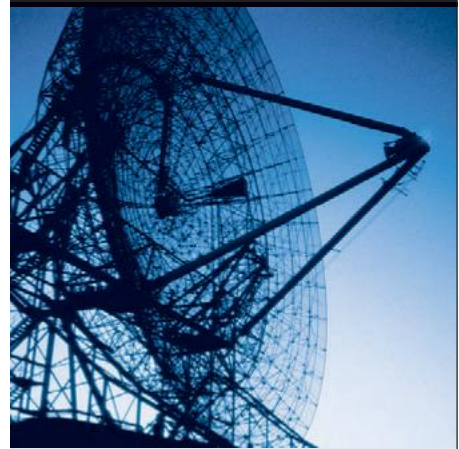
floor-mounted enclosure designation	weight (empty) [kg]	height*	width	depth
		dimensions [mm]		
R6	66	1200	600	400
R6+	80		800	
R7	127	1800	600	
R7+	150		800	500
R8	147	2000	600	
R8+	175		800	
R9	250		1200	600

\*) The height of the base frame, elevated roof and suspension eyes is to be added, if needed.



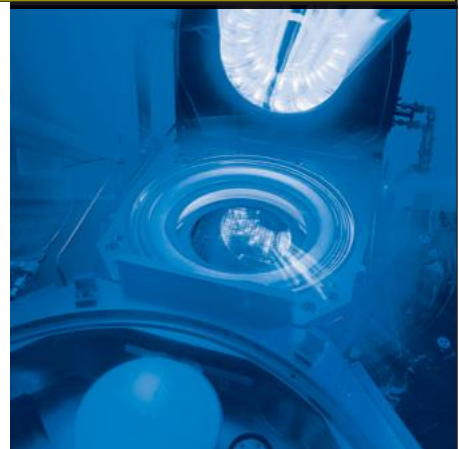
## 500 W power supply in paperback size

- ┆ for mobile telecommunication networks
- UMTS / GSM / DCS applications
- ┆ compact and robust design
- ┆ thermal discharge through heat pipes



## 40 kW liquid cooled power supply

- ┆ for semiconductor manufacturing industry
- ┆ highly demanding environment
- ┆ extreme load variations
- ┆ transfer of thermal energy into a fluid for heat exchange re-capture



## 24 kW switch mode battery charger

- ┆ with high power density for installation on board a train
- ┆ designed for high level of shock and vibration
- ┆ totally sealed for protection against dust and dirt IP66
- ┆ operational under environmental temperatures of -40°C to +80°C



## Multi input / output converter



- ┌ for supply of mobile measurement systems during summer and winter test drives
- ┌ intelligent energy management with battery back up and load simulation
- ┌ various inputs for DC and AC supply
- ┌ various DC outputs and one optional AC output
- ┌ CAN bus interface



## 4 kW converter for mains simulation



- ┌ for testing of equipment on the latest generation fighter aircraft
- ┌ output selection, 3-phase AC or 3 individual DC voltages
- ┌ each output is individually programmable via RS232 interface



## Dual redundant, fault tolerant, power supply system



- ┌ for installation in explosive environments (hazardous area 1)
- ┌ assisting the industry in the search for mineral resources
- ┌ allowing the failure of a single power supply, not affecting the controlled output
- ┌ the overall power supply unit is housed within a certified Exd enclosure
- ┌ an Exe enclosure being attached to the Exd enclosure contains all terminations, operator indications and switches

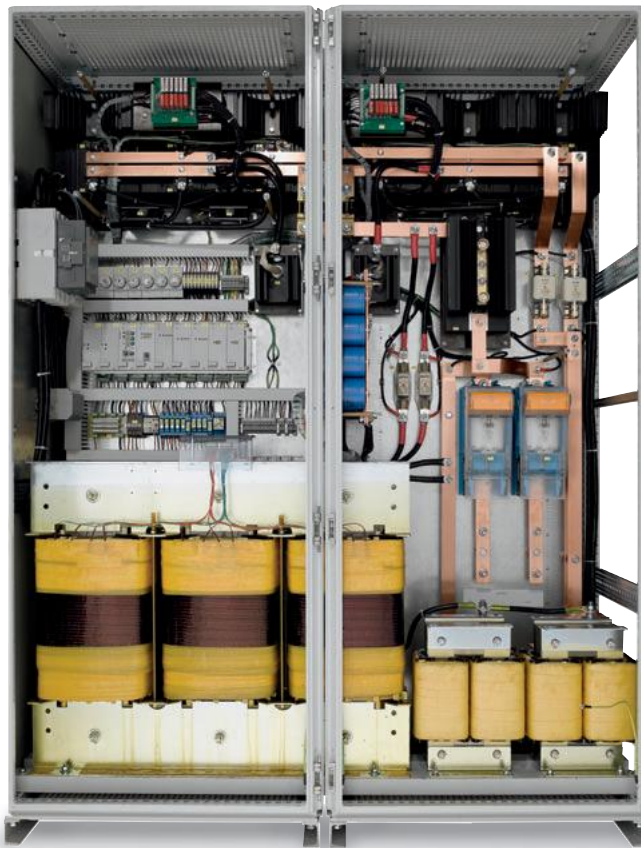


**Input voltage:** 115 / 230 VAC, single phase, 50 / 60 Hz  
or 208 / 400 / 480 VAC, 3-phase, 50 / 60 Hz  
**Output voltage:** 12 / 24 / 48 / 60 / 72 / 110 / 220 / 400 VDC  
**Output current:** up to 3250 A  
**Output power:** 100 W - 500 kW

The thyristor-controlled power supplies and battery chargers present the conventional method of rectifying and controlling electric power. The advantages of thyristor-controlled units are given by a simple technical concept resulting in robustness and reliability.

## Typical applications

- Power stations
  - Switch gear stations
  - Oil & Gas industry
    - pumping stations
    - valve stations
    - corrosion protection systems
    - DC systems
  - Desalination plants
  - Chemical plants
  - Industrial automation
- Telecommunication
- Transport on board & way side
- Hospitals



Schaefer has the flexibility to tailor the output settings to suit the battery, be it nickel-cadmium batteries, flooded or valve regulated lead-acid batteries or any other selected to be within the power supply system. Each type of battery requires an individual charging characteristic which can be accomplished by the control cards. In addition, there is a number of options and accessories for individual configuration of the charger system.

## Specifications

### Input

Voltage . . . . . 115 / 230 VAC  $\pm 10\%$ , 1-phase or  
208 / 400 / 480 VAC  $\pm 10\%$ , 3-phase  
Frequency . . . . . 50 or 60 Hz  $\pm 5\%$   
Protection . . . . . by fuse

### Output

Nominal voltage . . . . . 12 / 24 / 48 / 60 / 72 / 110 / 220 / 400 VDC  
adjustable from 90 – 120 % of  $U_{nom}$   
Line regulation ( $\pm 10\%$ ) . . . . .  $\pm 0.5\%$   
Load regulation (10 – 90 %) . . .  $\pm 1\%$   
Dynamic load (10-90-10 %) . .  $\pm 10\%$  typical  
Ripple . . . . .  $\leq 5\%$  rms without battery, optional:  
< 2 % rms or 2 mV frequency weighted  
Nominal current . . . . . with electronic current limitation  
adjustable from 60 – 105 % of  $I_{nom}$   
Overload protection . . . . . short circuit protected by fuse,  
optional: by electronic fuse  
Charging characteristic . . . . . IU acc. to DIN 41773 for Pb batteries /  
DIN 41774 for NiCd batteries  
Charging voltage  
- float . . . . . 2.23 – 2.27 V/cell for Pb batteries /  
1.4 V/cell for NiCd batteries  
- equalize . . . . . 2.35 – 2.4 V/cell for Pb batteries /  
1.55 V/cell for NiCd batteries  
- boost (manual activated) . . . 2.7 V/cell for Pb batteries /  
1.7 V/cell for NiCd batteries

### General

Efficiency  
- Series QE  
(1-phase input models) . . . . . 78 – 90 %  
- Series QD  
(3-phase input models) . . . . . 82 – 92 % for models < 48 VDC  
85 – 95 % for models  $\geq 48$  VDC  
Operating temperature . . . . .  $-10$  to  $+40^\circ\text{C}$ , optional up to  $+65^\circ\text{C}$   
Humidity . . . . . up to 95 % RH, non-condensing  
Altitude . . . . . up to 1000 m asl  
Cooling . . . . . natural convection  
Audible noise . . . . . 50 – 70 dB(A) depending on power  
Safety / Construction . . . . . acc. to DIN / EN 60950-1: 2003  
EMI . . . . . acc. to EN 55022, class A  
Enclosure  
- Protection category . . . . . IP20 acc. to EN 60529,  
optional up to IP55  
- Color . . . . . RAL 7035, others upon request  
Transformer . . . . . acc. to IEC 76 / IEC 14 / EN 60591 /  
DIN VDE 0532



## Input

MCB, MCCB or isolator  
soft-start

## Output

- parallel operation
- redundant operation
- overload protection by electronic fuse
- 6 or 12-pulse performance filtering up to 0.1 % pp (corresponding to 0.035 % rms) or 2 mV frequency weighted
- voltage stabilization

## Control

- IU characteristic acc. to DIN 41773 and 41774
- manual selection of charging characteristic (float / equalize / boost)
  - automatic selection of charging characteristic with timer
  - temperature compensated charging voltage

## Supervision

- analogue or micro-processor-controlled
- input voltage
  - output voltage
  - battery circuit
  - ground insulation failure
  - over temperature
  - fuses

## Interface card

- RS 232
- LAN
- TCP/IP
- others available on request

## Battery

MCB, MCCB or isolator  
deep discharge protection

## DC distribution panel

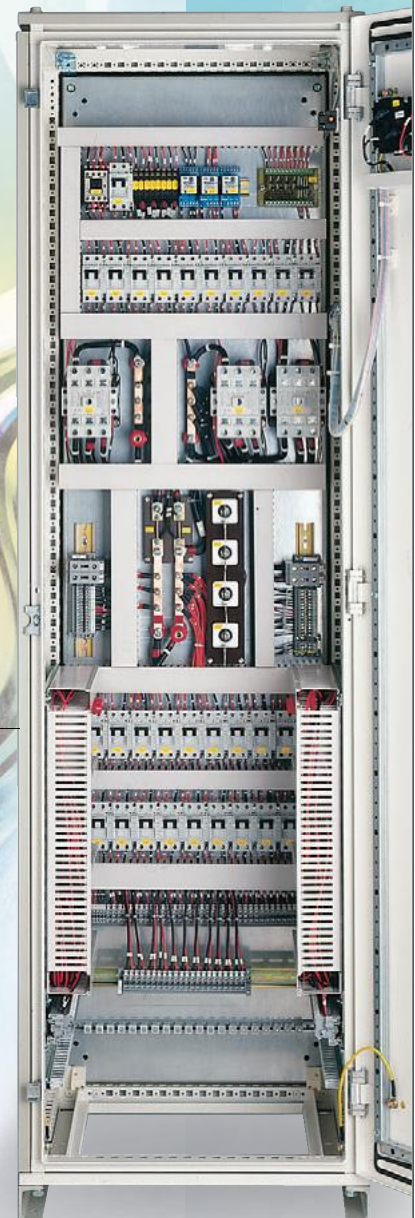
wired acc. to customer's specification

## Mechanics / environment

- enclosures, IP 20 up to IP 55, for charger and / or batteries
- analogue or digital meters
- operating temperature up to +65 °C (standard –10 to +40 °C)
- tropical protection
  - earthquake-proof
  - vermin-proof

## Converters and Inverters

- switchmode DC/DC converters from 50 W to 40 kW
- switchmode DC/AC inverters, frequency converters and static switches from 200 VA to 36 kVA



**400 kW Aircraft Starter System**

- 290 VDC Power Supply System
- Dual 700 A configuration
- For a highly inductive turbine load

**200 kW DC Power Network**

- 110 VDC Power Supply System
- Dual 800 A configuration
- Fully operational up to +55 °C
- IP42

# www.schaeferpower.com

The Portal – [www.schaeferpower.com](http://www.schaeferpower.com)

## Specialities

- Complete product portfolio overview
- In excess of 6000 Schaefer products
- Provision to download mechanical and electrical specifications
- Individual and tailored product design, according to application specifics
- User friendly method of data entry
- Fast track search ability

# SCHAEFER

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