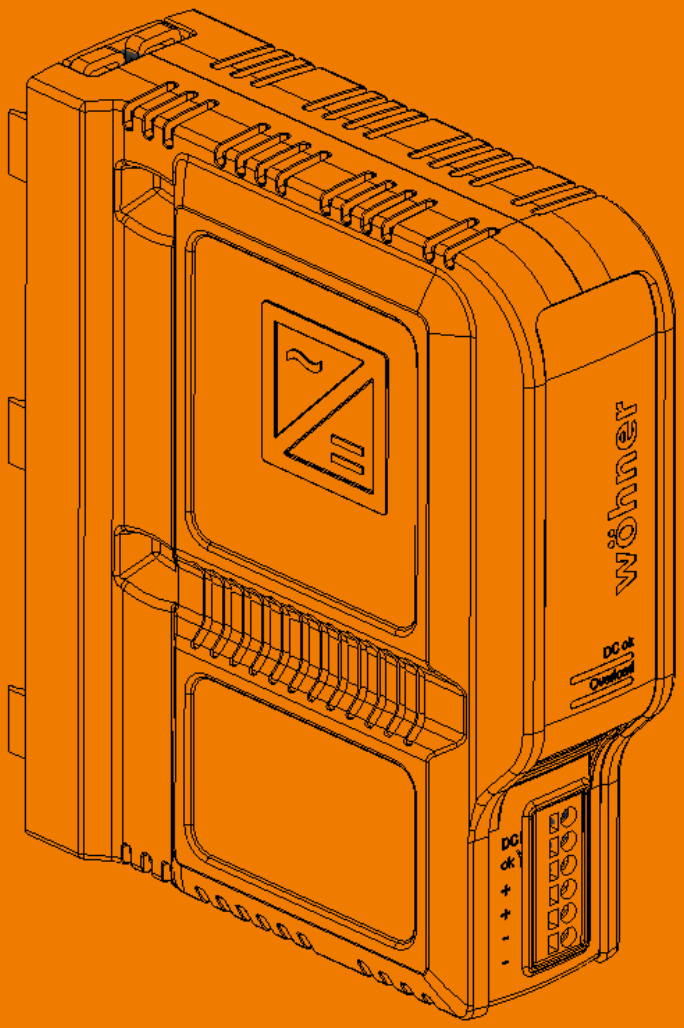
GHV Trading

wöhner



BROOME10 CrossBoard®

24Vdc / 10A Power Supply

Revision 1, November 2017

GB Operating Instructions – 24Vdc / 10A Power Supply

Erfahren Sie mehr über BROOME10 auf unserer Website.
Learn more about BROOME10 at our website.
Apprenez-en davantage sur le BROOME10 sur notre site Internet.
Potete trovare ulteriori informazioni su BROOME10 alla nostra homepage.
Encontrará más información sobre BROOME10 en nuestra página web.

GENERAL DESCRIPTION

BROOME10 is an industrial grade power supply for 3-Phase mains systems designed for use on the Crossboard connection system from company Wöhner.
It provides a floating, stabilized and galvanically separated SELV/PELV output voltage.
The most outstanding features of BROOME10 are the high efficiency, the high immunity to transients and power surges, the advanced inrush current limitation, the active PFC and the wide operational temperature range.

Technical Data		
Output voltage	DC 24V	0/+6% over entire load range
Adjustment range	-	
Output current	10A	Below +50°C ambient
	5A	At +70°C ambient
Derate linearely between +50°C and +70°C		
Input voltage AC	AC 380-480V	-10%/ +15%
Mains frequency	50-60Hz	±6%
Input current AC	0.77 / 0.62A	At 400 / 480Vac
Power factor	0.70 / 0.73	At 400 / 480Vac
Input inrush current	1.5 / 1.5Apk	At 400 / 480Vac
Efficiency	94.9 / 94.8%	At 400 / 480Vac
Losses	12.8 / 13.2W	At 400 / 480Vac
Hold-up time	20 / 20ms	At 400 / 480Vac
Temperature range	-25°C to +70°C	
Size (w x h x d)	45x160x130mm	
Weight	550g / 1.21lb	

ORDER NUMBERS

BROOME10 CrossBoard® **36200**

MARKINGS

For details and a complete approval list see section 18.

in preparation

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The information given in this document is correct to the best of our knowledge and experience at the time of publication. If not expressly agreed otherwise, this information does not represent a warranty in the legal sense of the word. As the state of our knowledge and experience is constantly changing, the information in this data sheet is subject to revision. We therefore kindly ask you to always use the latest issue of this document (consult PULS).

TERMINOLOGY AND ABREVIATIONS

PE and ⏚ symbol	PE is the abbreviation for **P**rotective **E**arth and has the same meaning as the symbol ⏚.
Earth, Ground	This document uses the term “earth” which is the same as the U.S. term “ground”.
T.b.d.	To be defined, value or description will follow later.
AC 400V	A figure displayed with the AC or DC before the value represents a nominal voltage with standard tolerances (usually ±15%) included. E.g.: DC 12V describes a 12V battery disregarding whether it is full (13.7V) or flat (10V)
400Vac	A figure with the unit (Vac) at the end is a momentary figure without any additional tolerances included.
50Hz vs. 60Hz	As long as not otherwise stated, AC 400V parameters are valid at 50Hz mains frequency. AC 480V parameters are valid for 60Hz mains frequency.
may	A key word indicating flexibility of choice with no implied preference.
shall	A key word indicating a mandatory requirement.
should	A key word indicating flexibility of choice with a strongly preferred implementation.

1. Intended Use

This device is designed for installation in an enclosure and is intended for general use such as in industrial control, office, communication, and instrumentation equipment.

Do not use this device in equipment, where malfunction may cause severe personal injury or threaten human life.

2. Installation Requirements

⚠ WARNING Risk of electrical shock, fire, personal injury or death.

- Turn power off before working on the device. Protect against inadvertent re-powering.
- Make sure that the wiring is correct by following all local and national codes.
- Do not modify or repair the unit.
- Do not open the unit as high voltages are present inside.
- Use caution to prevent any foreign objects from entering the housing.
- Do not use in wet locations or in areas where moisture or condensation can be expected.
- Do not touch during power-on, and immediately after power-off. Hot surfaces may cause burns.

Obey the following installation requirements:

- Install device in an enclosure providing protection against electrical, mechanical and fire hazards.
- This device may only be installed and put into operation by qualified personnel.
- Do not plug or unplug the device as long as input voltage is present.
- Use the device in a controlled environment. Do not use the device in pollution degree 3 areas without additional protection or in applications where a degree of protection better than IP30 is required.
- The device is designed for convection cooling and does not require an external fan. Do not obstruct airflow and do not cover ventilation grid.
- Keep the following minimum installation clearances when the device is permanently loaded with more than 50% of the nominal current: 40mm on top, 20mm on the bottom, 0mm left and right side.
- Make sure that the wiring is correct by following all local and national codes. Use appropriate copper cables that are designed for a minimum operating temperature of 60°C for ambient temperatures up to +45°C, 75°C for ambient temperatures up to +60°C and 90°C for ambient temperatures up to +70°C. Ensure that all strands of a stranded wire enter the terminal connection.
- This device does not contain serviceable parts. The tripping of an internal fuse is caused by an internal defect. If damage or malfunction should occur during installation or operation, immediately turn power off and send the device to the factory for inspection.
- The device is designed, tested and approved for branch circuits up T.b.d. ampacity without additional protection device. If an external fuse is utilized, do not use circuit breakers smaller than 6A B- or C-Characteristic to avoid a nuisance tripping of the circuit breaker.

3. AC-INPUT

The device is suitable to be supplied from TN-, TT- and IT mains networks with AC voltage. It operates from a three-phase mains system but is employing only two legs of the three phase system.

AC input	Nom.	AC 380-480V	-10% / +15%
AC input range	Min.	342-552Vac	Continuous operation
Overvoltage resistance	Min.	630Vac	Temporarily allowed
	Min.	630-700Vac	For maximal 10s (occasional)
	Min.	700-800Vac	For maximal 500ms (occasional)
Allowed voltage L to earth	Max.	552Vac	Continuous according to IEC 62477-1
Input frequency	Nom.	50–60Hz	±6%
Turn-on voltage	Typ.	335Vac	Steady-state value, see Fig. 3-1
Shut-down voltage	Typ.	325Vac	Steady-state value, see Fig. 3-1
External input protection	See recommendations in chapter 2.		

		AC 400V	AC 480V	
Input current	Typ.	0.77A	0.62A	At 24V, 10A, see Fig. 3-3
Power factor	Typ.	0.70	0.73	At 24V, 10A, see Fig. 3-4 According to DIN 40110-2 for 3-phase systems
Start-up delay	Typ.	200ms	200ms	See Fig. 3-2
Rise time	Typ.	55ms	55ms	At 24V, 10A resistive load, 0mF load capacitance, see Fig. 3-2
	Typ.	90ms	90ms	at 24V, 10A resistive load, 10mF load capacitance, see Fig. 3-2
Turn-on overshoot	Max.	200mV	200mV	See Fig. 3-2

Fig. 3-1 **Input voltage range**

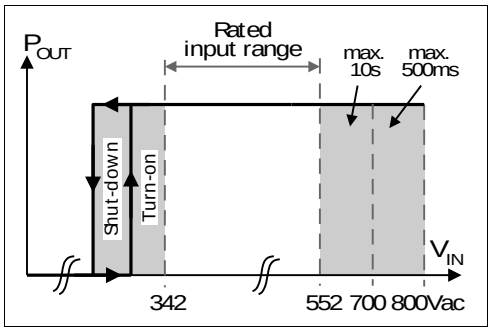


Fig. 3-2 **Turn-on behavior, definitions**

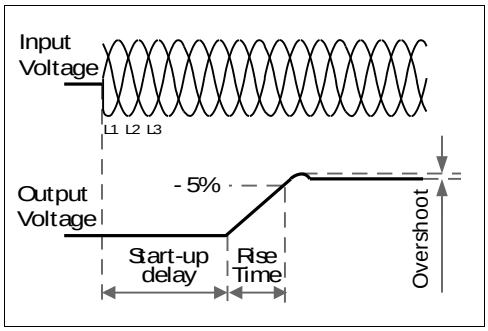


Fig. 3-3 **Input current vs. output current**

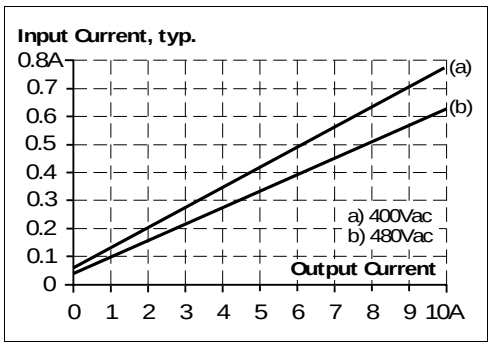
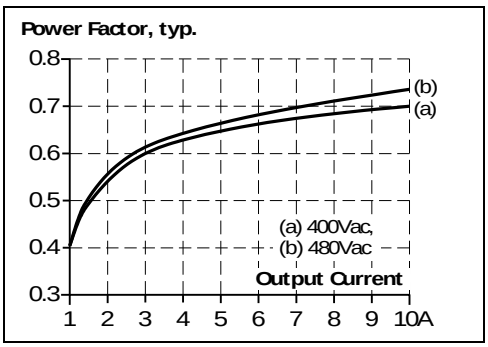


Fig. 3-4 **Power factor vs. output current**



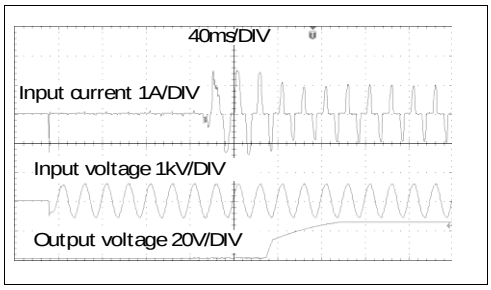
4. INPUT INRUSH CURRENT

An active inrush limitation circuit limits the input inrush current after turn-on of the input voltage.

The charging current into EMI suppression capacitors is disregarded in the first microseconds after switch-on.

		AC 400V	AC 480V	
Inrush current	Max.	2Apeak	2Apeak	Temperature independent
	Typ.	1.5Apeak	1.5Apeak	Temperature independent
Inrush energy	Max.	1A²s	1A²s	Temperature independent

Fig. 4-1 **Typical turn-on behaviour at nominal load, 400Vac input and 25°C ambient**



5. OUTPUT

Output voltage	Nom.	24V	0/+6%
	The device is featured with a “soft output regulation characteristic” (Parallel Use Mode) in order to achieve current share between multiple devices, when they are connected in parallel. The “soft output regulation characteristic” regulates the output voltage in such a manner, that the voltage at no load is approx. 4% higher than at 10A load.		
Adjustment range		-	Not adjustable
Line regulation	Max.	10mV	Between 342 and 552Vac
Load regulation	Typ.	1000mV	Between 0 and 10A, static value, see Fig. 5-1
Ripple and noise voltage	Max.	50mVpp	Bandwidth 20Hz to 20MHz, 50Ohm
Output current	Nom.	10A	At ambient temperatures below +50°C, see Fig. 15-1
	Nom.	5A	At +70°C ambient temperature, see Fig. 15-1
Overload protection		Included	Electronically protected against no-load, overload and short circuit. In case of a protection event, audible noise may occur. No external protection needed.
Overload behaviour		Continuous current	Output voltage above 13Vdc, see Fig. 5-1
		HiccupPLUS mode	Output voltage below 13Vdc, see Fig. 5-1 and Fig. 5-2. The power supply delivers continuous output current for 2.8s. After this, the output is switched off for 7s before a new start attempt with 1.2s is automatically performed. This cycle is repeated as long as the overload exists. If the overload has been cleared, the device will operate normally.
Short-circuit current	Min.	10.4A1)	Load impedance <50mOhm
	Max.	13A1)	Load impedance <50mOhm
	Max.	5.0A	Average (R.M.S.) current, load impedance <50mOhm
Output capacitance	Typ.	4 400µF	Included inside the power supply
Capacitive loads	Max.	1F	Max. 2A additional load during charging
Inductive loads		Unlimited	

1) Discharge current of output capacitors is not included.

Fig. 5-1 **Output voltage vs. output current, typ.**

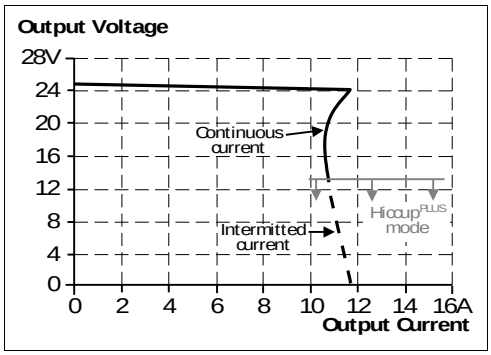
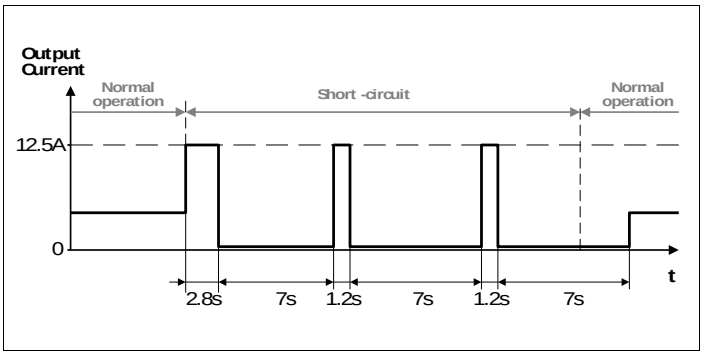


Fig. 5-2 **Short-circuit on output, Hiccup*PLUS* mode, typ.**



6. HOLD-UP TIME

		AC 400V	AC 480V	
Hold-up Time	Typ.	60ms	60ms	At 5A load current
	Min.	49ms	49ms	At 5A load current
	Typ.	20ms	20ms	At 10A load current
	Min.	16ms	16ms	At 10A load current

Fig. 6-1 **Hold-up time vs. input voltage**

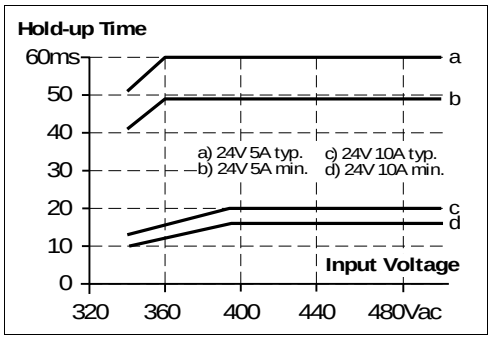
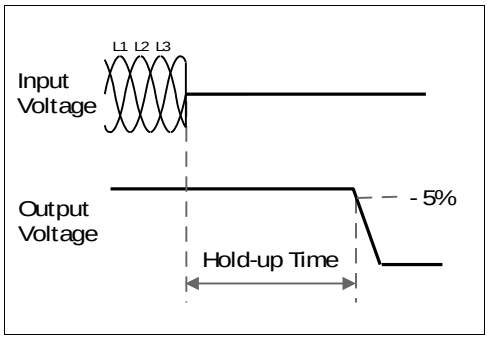


Fig. 6-2 **Shut-down behaviour, definitions**

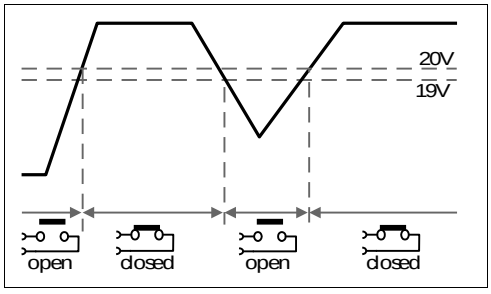


7. DC-OK RELAY CONTACT

This feature monitors the output voltage on the output terminals of a running power supply and is independent of back-fed voltage.

Contact closes	As soon as the output voltage reaches typically 20V.
Contact opens	As soon as the output voltage falls below typically 19V.
Switching hysteresis	1V
Contact ratings	Maximal 60Vdc 0.3A, 30Vdc 1A, 30Vac 0.5A, resistive load
	Minimal permissible load: 1mA at 5Vdc
Isolation voltage	See dielectric strength table in chapter 17.

Fig. 7-1 **DC-ok relay contact behavior**



8. Efficiency and Power Losses

		AC 400V	AC 480V	
Efficiency	Typ.	94.9%	94.8%	At 24V, 10A
Power losses	Typ.	3.3W	4.0W	At 24V, 0A
	Typ.	7.6W	8.2W	At 24V, 5A
	Typ.	12.8W	13.2W	At 24V, 10A

Fig. 8-1 **Efficiency vs. output current, typ.**

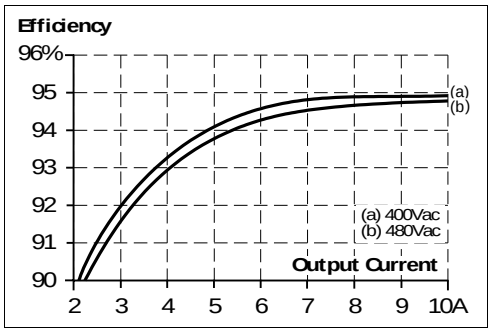


Fig. 8-2 **Losses vs. output current, typ.**

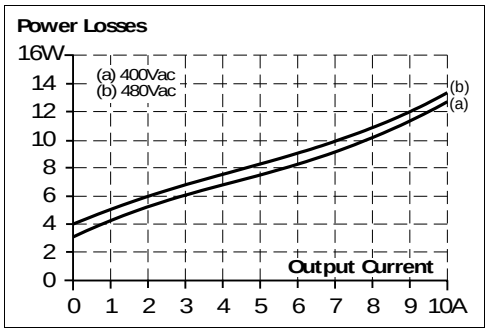


Fig. 8-3 **Efficiency vs. input voltage at 10A, typ.**

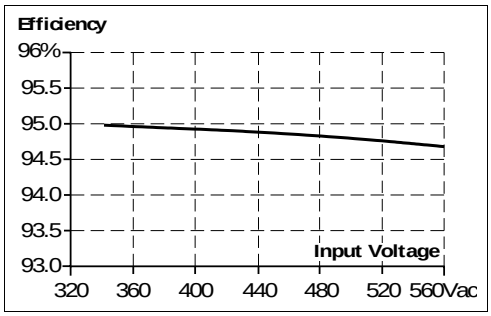
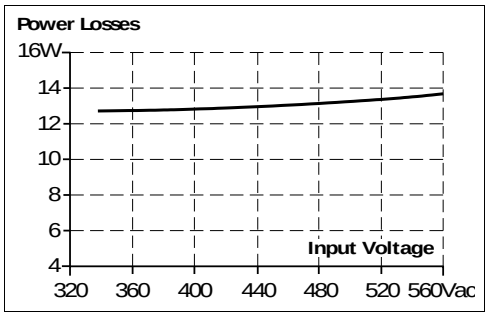


Fig. 8-4 **Losses vs. input voltage at 10A, typ.**



9. Lifetime Expectancy

The Lifetime expectancy shown in the table indicates the minimum operating hours (service life) and is determined by the lifetime expectancy of the built-in electrolytic capacitors. Lifetime expectancy is specified in operational hours and is calculated according to the capacitor's manufacturer specification. The manufacturer of the electrolytic capacitors only guarantees a maximum life of up to 15 years (131 400h). Any number exceeding this value is a calculated theoretical lifetime which can be used to compare devices.

	AC 400V	AC 480V	
Lifetime expectancy	T.b.d.	T.b.d.	At 5A and 25°C
	T.b.d.	T.b.d.	At 10A and 25°C
	T.b.d.	T.b.d.	At 5A and 40°C
	53 000h	T.b.d.	At 10A and 40°C

10. MTBF

MTBF stands for **M**ean **T**ime **B**etween **F**ailure, which is calculated according to statistical device failures, and indicates reliability of a device. It is the statistical representation of the likelihood of a unit to fail and does not necessarily represent the life of a product.

The MTBF figure is a statistical representation of the likelihood of a device to fail. A MTBF figure of e.g. 1 000 000h means that statistically one unit will fail every 100 hours if 10 000 units are installed in the field. However, it can not be determined if the failed unit has been running for 50 000h or only for 100h.

For these types of units the MTTF (**M**ean **T**ime **T**o **F**ailure) value is the same value as the MTBF value.

	AC 400V	AC 480V	
MTBF SN 29500, IEC 61709	T.b.d.	T.b.d.	At 10A and 40°C
	T.b.d.	T.b.d.	At 10A and 25°C
MTBF MIL HDBK 217F	T.b.d.	T.b.d.	At 10A and 40°C; Ground Benign GB40
	T.b.d.	T.b.d.	At 10A and 25°C; Ground Benign GB25
	T.b.d.	T.b.d.	At 10A and 40°C; Ground Fixed GF40
	T.b.d.	T.b.d.	At 10A and 25°C; Ground Fixed GF25

11. CONNECTION TERMINALS AND WIRING

The terminals are IP20 Finger safe constructed and suitable for field- and factory wiring.

	Output and DC-OK
Type	Push-in termination
Solid wire	Max. 2.5mm²
Stranded wire	Max. 2.5mm²
Stranded wire with ferrules	T.b.d.
American Wire Gauge	AWG 24-12
Max. wire diameter (including ferrules)	2.3mm
Wire stripping length	10mm / 0.4inch
Screwdriver	3.0mm slotted to open the spring

Instructions for wiring:

a) Use appropriate copper cables that are designed for minimum operating temperatures of:
60°C for ambient up to 45°C and
75°C for ambient up to 60°C and
90°C for ambient up to 70°C minimum.

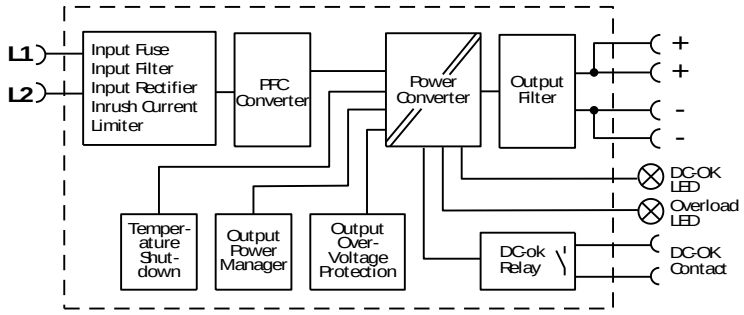
b) Follow national installation codes and installation regulations!

c) Ensure that all strands of a stranded wire enter the terminal connection!

d) Ferrules are recommended.

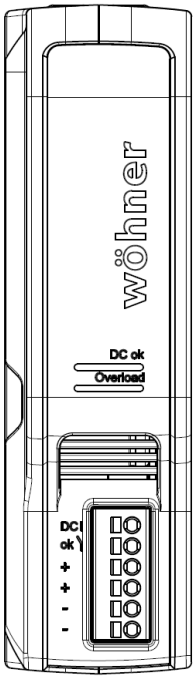
12. FUNCTIONAL DIAGRAM

Fig. 12-1 **Functional diagram**



13. FRONT SIDE AND USER ELEMENTS

Fig. 13-1 **Front side**



A **DC-OK LED**
The LED is on when the output voltage of a running device is above 20V.

B **Overload LED**
The LED is on when the output voltage falls below 19V or in case of a short circuit in the output.
The LED is flashing when the device has switched off due to over-temperature. Input voltage is required.

C **Output Terminals** (push-in terminals)
(two identical + poles and two identical - poles)
+ Positive output
– Negative (return) output

D **DC-OK Relay Contact** (push-in terminals)
Monitors the output voltage, see chapter 7 for details.

14. EMC

EMC Immunity	According to EN 61204-3			
Electrostatic discharge	EN 61000-4-2	Contact discharge Air discharge	8kV 8kV	Criterion A Criterion A
Electromagnetic RF field	EN 61000-4-3	80MHz - 6GHz	T.b.d.	Criterion A
Fast transients (Burst)	EN 61000-4-4	Input lines Output lines DC-OK signal (coupling clamp)	4kV 2kV 2kV	Criterion A Criterion A Criterion A
Surge voltage on input	EN 61000-4-5	T.b.d.	2kV 4kV	Criterion A Criterion A
Surge voltage on output	EN 61000-4-5	T.b.d.	1kV 2kV	Criterion A Criterion A
Surge voltage on Signals	EN 61000-4-5	T.b.d.	1kV	Criterion A
Conducted disturbance	EN 61000-4-6	0.15-80MHz	T.b.d.	Criterion A
Mains voltage dips	EN 61000-4-11	0% of 380Vac 40% of 380Vac 70% of 380Vac 0% of 480Vac 40% of 480Vac 70% of 480Vac	0Vac, 20ms 152Vac, 200ms 266Vac, 500ms 0Vac, 20ms 192Vac, 200ms 336Vac, 500ms	Criterion A Criterion B Criterion B Criterion A Criterion B Criterion A
Voltage interruptions	EN 61000-4-11	0% of 380Vac (=0V)	5000ms	Criterion B
Powerful transients	VDE 0160	Over entire load range	1584V, 1.3ms	Criterion A

Criterions:

A: Power supply shows normal operation behavior within the defined limits.

B: Temporary loss of function or performance during the tests - self recoverable.

EMC Emission	According to EN 61204-3	
Conducted emission input lines	EN 55011, EN 55015, EN 55022, FCC Part 15, CISPR 11, CISPR 22	Class A
Conducted emission output lines 2)	IEC/CISPR 16-1-2, IEC/CISPR 16-2-1	Not required, not considered to be a DC-mains
Radiated emission	EN 55011, EN 55022	Class A
Harmonic input current	EN 61000-3-2	Class A fulfilled
Voltage fluctuations, flicker	EN 61000-3-3	Fulfilled, tested with constant current loads, non pulsing
This device complies with FCC Part 15 rules. Operation is subjected to following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.		

Switching Frequencies		
PFC converter	25-120kHz	Input voltage dependent
Main converter	100 to 130kHz	Output load dependent
Auxiliary converter	30kHz	Fixed frequency

15. ENVIRONMENT

Operational temperature 1)	-25°C to +70°C (-13°F to 158°F)	Reduce output power according to Fig. 15-1
Storage temperature	-40°C to +85°C (-40°F to 185°F)	For storage and transportation
Output de-rating	6W/°C	Between +50°C and +70°C (122°F to 158°F)
Humidity	5 to 95% r.h.	According to IEC 60068-2-30 Do not energize while condensation is present.
Vibration sinusoidal 2)	T.b.d.	According to IEC 60068-2-6
Shock 2)	T.b.d.	According to IEC 60068-2-27
Altitude	0 to 2000m (0 to 6 560ft)	Without any restrictions
	2000 to 4000m (6 560 to 13 120ft)	Reduce output power or ambient temperature, see Fig. 15-2.
Altitude de-rating	15W/1000m or 5°C/1000m	Above 2000m (6500ft), see Fig. 15-2
Over-voltage category	T.b.d.	According to IEC 62477-1 for altitudes up to 2000m
	T.b.d.	According to IEC 60950-1 for altitudes from 2000m to 4000m
	T.b.d.	According to IEC 62477-1 for altitudes from 2000m to 4000m
Degree of pollution	2	According to IEC 62477-1, not conductive
LABS compatibility	The unit does not release any silicone or other LABS-critical substances and is suitable for use in paint shops.	
Audible noise	Some audible noise may be emitted from the power supply during no load, overload or short circuit.	

1) Operational temperature is the same as the ambient or surrounding temperature and is defined as the air temperature 2cm below the unit.

2) Tested when device is mounted onto the CrossBoard.

Fig. 15-1 **Output current vs. ambient temp.**

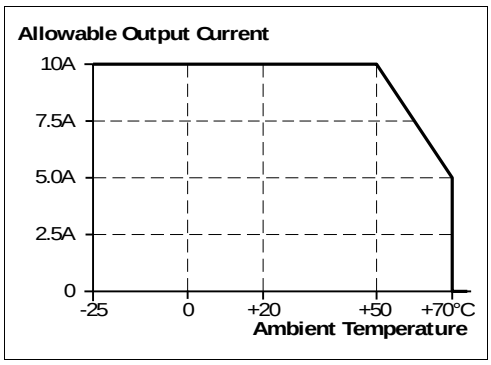
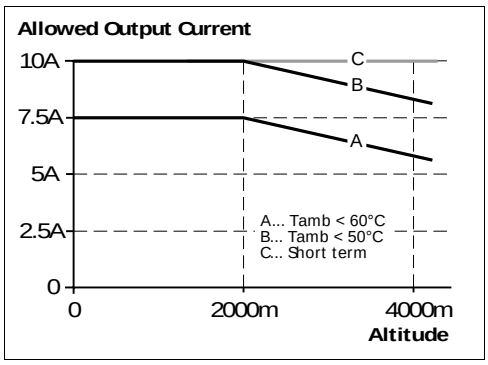


Fig. 15-2 **Output current vs. altitude**



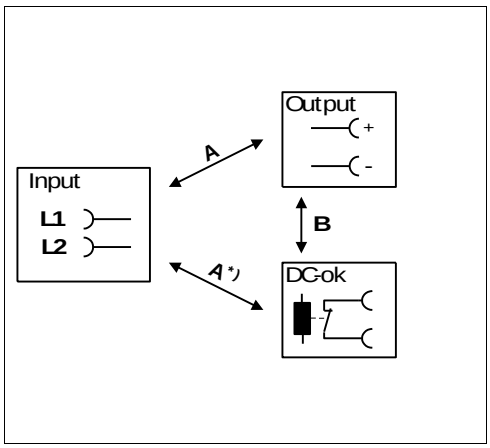
16. SAFETY AND PROTECTION FEATURES

Input / output separation	Double or reinforced galvanic isolation	
	SELV	According to IEC/EN 60950-1
	PELV	According to IEC/EN 60204-1, EN 62477-1, IEC 60364-4-41
Isolation resistance	> 500MOhm	At delivered condition between input and output, measured with 500Vdc
	> 500MOhm	At delivered condition between output and DC-OK contacts, measured with 500Vdc
Output over-voltage protection	Typ. 30.5Vdc Max. 32Vdc	In case of an internal power supply defect, a redundant circuit limits the maximum output voltage. The output shuts down and automatically attempts to restart.
Class of protection	II	According to IEC 61140 A PE (Protective Earth) connection is not required
Degree of protection	IP 30	EN/IEC 60529
Over-temperature protection	Yes	Output shut-down with automatic restart. The temperature sensor is installed on critical components inside the unit and turns the unit off in safety critical situations, which can happen e.g. when de-rating requirements are not observed, ambient temperature is too high, ventilation is obstructed or the de-rating requirements for different mounting orientation is not followed. There is no correlation between the operating temperature and turn-off temperature since this is dependent on input voltage, load and installation methods.
Input transient protection	MOV (Metal Oxide Varistor)	For protection values see chapter 14 (EMC).
Internal input fuse	Included	Not user replaceable slow-blow high-braking capacity fuse.
Touch current (leakage current)	Max. 0.25mA	

17. DIELECTRIC STRENGTH

The output voltage is floating and has no ohmic connection to the ground. Type and factory tests are conducted by the manufacturer. Field tests may be conducted in the field using the appropriate test equipment which applies the voltage with a slow ramp (2s up and 2s down). Connect all input-terminals together as well as all output poles before conducting the test. When testing, set the cut-off current settings to the value in the table below.

Fig. 17-1 **Dielectric strength**



		A	B
Type test	60s	3400Vac	500Vac
Factory test	5s	2500Vac	500Vac
Field test	5s	2000Vac	500Vac
Cut-off current setting for field test		> 2mA	> 1mA

To fulfil the PELV requirements according to EN 60204-1 § 6.4.1, we recommend that either the + pole, the – pole or any other part of the output circuit shall be connected to the protective earth system. This helps to avoid situations in which a load starts unexpectedly or can not be switched off when unnoticed earth faults occur.

B*) When testing input to DC-OK ensure that the maximal voltage between DC-OK and the output is not exceeded (column D). We recommend connecting DC-OK pins and the output pins together when performing the test.

18. NORMS AND APPROVALS

EC Declaration of Conformity	CE	The CE mark indicates conformance with the - EMC directive and the - Low-voltage directive (LVD).
UL 61010-2-201 planned	c UL US LISTED IND. CONT. EQ.	Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use Part 2-201: Particular Requirements for Control Equipment; Listed product E-File: T.b.d.
IEC 61010-2-201 planned	IECEE CB SCHEME	CB-Scheme Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use Part 2-201: Particular Requirements for Control Equipment
IEC 62477-1 T.b.d.		Safety requirements for power electronic converter systems and equipment T.b.d.
IEC/EN 61558-2-16 (Annex BB)	Safety Isolating Transformer	Safety Isolating Transformers corresponding to Part 2-6 of the IEC/EN 61558
RoHS Directive	RoHS ✓	Directive 2011/65/EU of the European Parliament and the Council of June 8th, 2011 on the restriction of the use of certain hazardous substances in electrical and electronic equipment.
REACH Directive	REACH ✓	Directive 1907/2006/EU of the European Parliament and the Council of June 1st, 2007 regarding the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH)

19. PHYSICAL DIMENSIONS AND WEIGHT

Width	45mm 1.77"
Height	160mm 6.3"
Depth	130mm 5.12"
Weight	550g / 1.21lb
Housing material	T.b.d.
Installation clearances	See chapter 2

Fig. 19-1
Front view

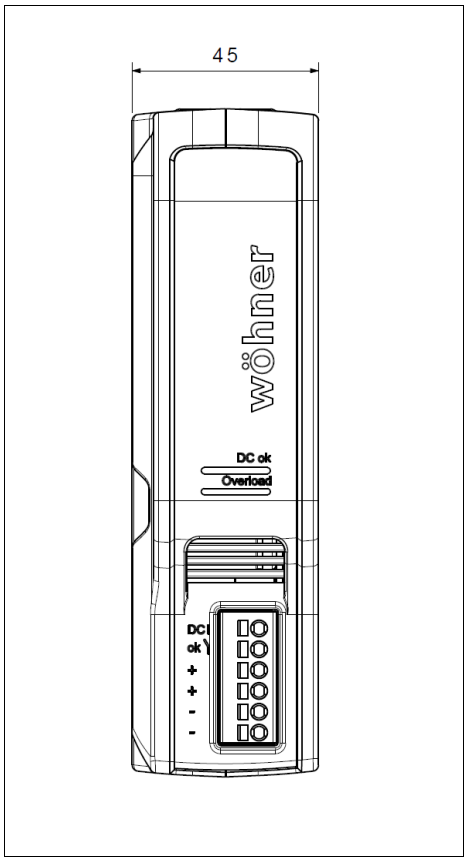
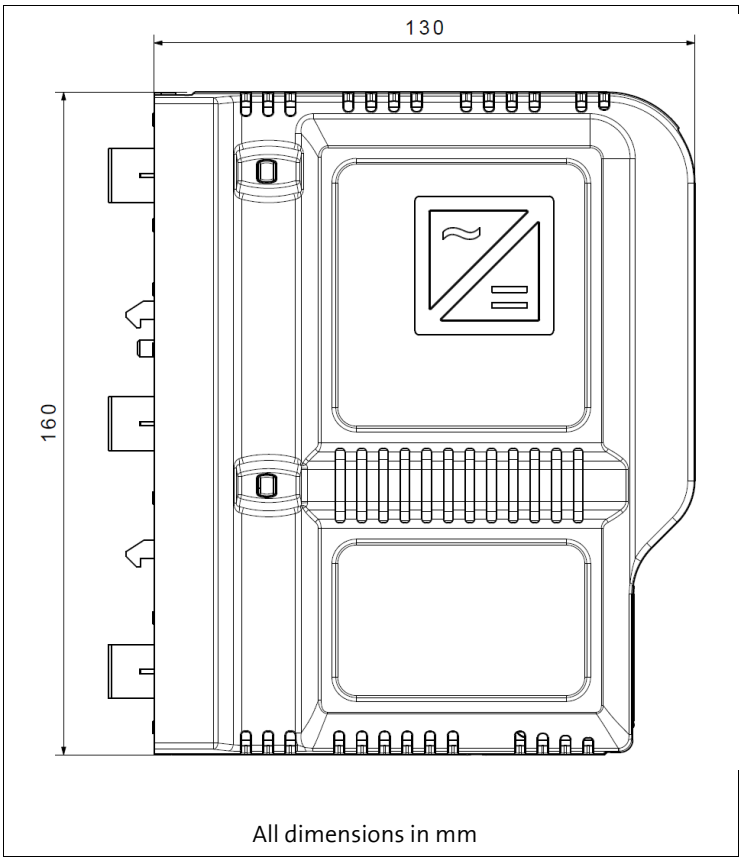


Fig. 19-2
Side view



All dimensions in mm

20. Application Notes

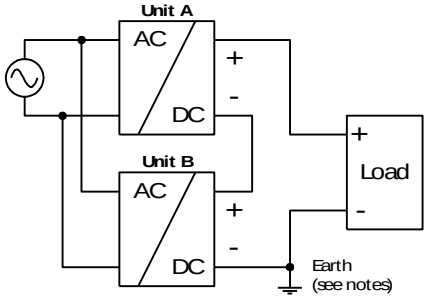
20.1. Back-feeding Loads

Loads such as decelerating motors and inductors can feed voltage back to the power supply. This feature is also called return voltage immunity or resistance against Back- E.M.F. (Electro Magnetic Force).

This power supply is resistant and does not show malfunctioning when a load feeds back voltage to the power supply. It does not matter whether the power supply is on or off.

The maximum allowed feed-back-voltage is 35Vdc. The absorbing energy can be calculated according to the built-in large sized output capacitor which is specified in chapter 5.

20.2. Series Operation



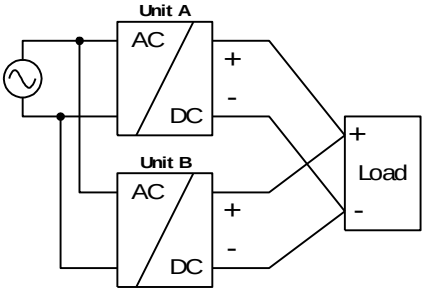
Up to three power supplies can be connected in series for higher output voltages.

Please note: Voltages with a potential above 60Vdc are not SELV any more and can be dangerous. Such voltages must be installed with a protection against touching. Earthing of the output is required when the sum of the output voltage is above 60Vdc.

Avoid return voltage (e.g. from a decelerating motor or battery) which is applied to the output terminals.

Pay attention that leakage current, EMI, inrush current, harmonics will increase when using multiple power supplies.

20.3. Parallel Use to Increase Output Power



A parallel connection of power supplies for higher output power is allowed for ambient temperatures up to +45°C.

The device is featured with a “soft output regulation characteristic” (Parallel Use Mode) in order to achieve current share between multiple devices, when they are connected in parallel. The “soft output regulation characteristic” regulates the output voltage in such a manner, that the voltage at no load is approx. 4% higher than at 10A load. See also chapter 5.

If more than three units are connected in parallel, a fuse or circuit breaker with a rating of 15A or 16A is required on each output. Alternatively, a diode or redundancy module can also be utilized.

Energize all units at the same time to avoid the overload Hiccup^{PLUS} mode. It also might be necessary to cycle the input power (turn-off for at least five seconds), if the output was in Hiccup^{PLUS} mode due to overload or short circuits and the required output current is higher than the current of one unit.

Pay attention that leakage current, EMI, inrush current, harmonics will increase when using multiple power supplies.