ELTEK VALERE
always on

DC/AC INVERTER

PWS Series

USER MANUAL

UM_PWS_E_R1.2

Notes to this manual

ATTENTION! Read this manual carefully before installing and commissioning the module.
This manual is a part of the delivered module. Familiarity with the contents of this manual is required for installing and operating the module.
The rules for prevention of accidents for the specific country and the general safety rules in accordance with IEC 364 must be observed.

The function description in this manual corresponds to the date of publishing.
Technical changes and changes in form and content can be made at any time by the manufacturer without notice. There are no obligations to update the manual continually.

The module is manufactured in accordance with applicable DIN and VDE standards such as VDE 0106 (part 100) and VDE 0100 (part 410). The CE marking on the module confirms compliance with EU standards 2006-95-EG (low voltage) and 2004-108-EG (electromagnetic compatibility) if the installation and operation instructions are followed.

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The current revision status of this user manual is the following:

Revision: 1.2

Date: 2009-03-18

Revision	Description of change	Writer	Date
00	Former version "PWS_E1_neutral_20070416.doc" comprehensively reworked	RTH	2008-09-17
1.1	Minor text modifications and the new revision status numbering (X.X) inserted.	RTH	2008-10-29
1.2	Up-to-date photos inserted	RTH	2009-03-18

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1A. Safety Instructions

Warning!

Because several components of operating electrical modules are charged by dangerous voltage, the improper handling of electrical modules may be the cause of accidents involving electrocution, injury, or material damages.

- Operation and maintenance of electrical modules must be performed by qualified skilled personnel such as electricians in accordance with EN 50110-1 or IEC 60950.
- Install the module only in areas with limited access to unskilled personnel.
- Before starting work, the electrical module must be disconnected from mains. Make sure that the module is earthed.
- Do not touch connector pins as they can be charged with dangerous voltage up to 30 seconds after disconnection.
- Only spare parts approved by the manufacturer must be used.

1B. Electric Waste Disposal

Separate collection is the precondition to ensure specific treatment and recycling of waste electrical and electronic equipment and is necessary to achieve the chosen level of protection of human health and the environment.

In the case of waste disposal of your discarded equipment we recommend to contact a waste management company.

2. General information

The PWS inverter family (1kVA–5kVA, 24V version max. 2.5kVA) is equipped with a 50Hz isolation transformer following a primary side pulse-width modulation stage and is available as 19”-compatible rack (PWS-F) or wall mounted cabinet (PWS-W).
PWS inverters are especially suited for applications in power plants, industrial, railroad and shipping AC power supplies. The combination of rugged mechanical construction, high overload ability and electrical isolation between input and output offers a very high flexibility in system configuration.
The inverters can be operated as single unit or in parallel connection (as option) to provide power increase or further improved reliability by (n+1)-redundancy. The operation in combination with a static bypass switch (UNB) is also possible.
The PWS-F is fitted with a rear side connector, the PWS-W is fitted with screw terminals at the bottom. All operation and indication elements are arranged at the front side.

The wall cabinet version includes all necessary input and output fuses and can be directly mounted beside the load distribution. Optionally, versions with an included static bypass switch, special output voltages, special output frequency or further special models are available on request.

2.1 Typical applications

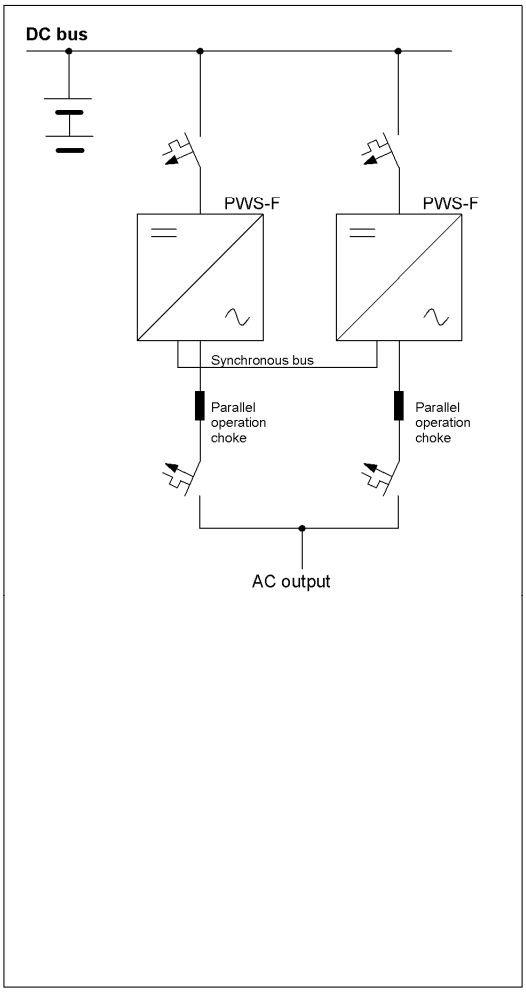


Figure 1) - PWS-F in parallel operation

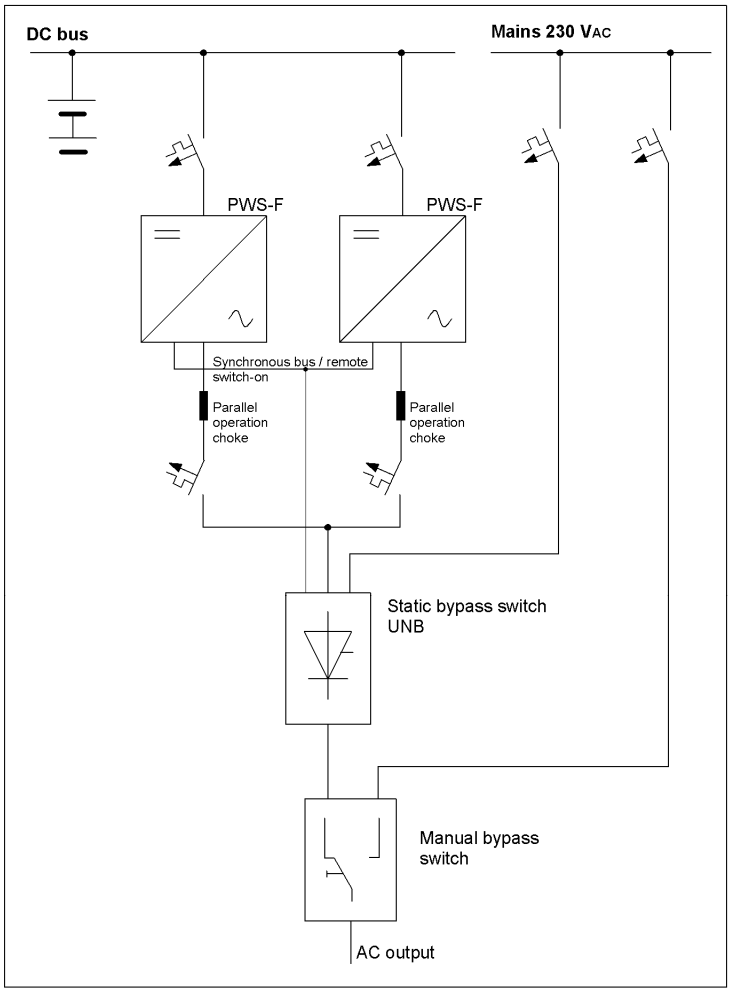


Figure 2) - PWS-F in parallel operation with static bypass switch UNB

2.2 Type list

PWS-F (19" version)

Type designation	Article code	Input voltage (V_{DC})	Output voltage (V_{AC})	Output power (kVA @ cos phi 0.8)
PWS24-1.0F	401-010-411.00	24	230	1.0
PWS110-1.0F	401-010-711.00	108		
PWS220-1.0F	401-010-811.00	216		
PWS24-2.5F	401-025-411.00	24	230	2.5
PWS110-2.5F	401-025-711.00	108		
PWS220-2.5F	401-025-811.00	216		
PWS110-5.0F	401-050-711.00	108	230	5.0
PWS220-5.0F	401-050-811.00	216		

PWS-W (wall cabinet version)

Type designation	Article code	Input voltage (V_{DC})	Output voltage (V_{AC})	Output power (kVA @ cos phi 0.8)
PWS24-1.0W	401-010-412.00	24	230	1.0
PWS110-1.0W	401-010-712.00	108		
PWS220-1.0W	401-010-812.00	216		
PWS24-2.5W	401-025-412.00	24	230	2.5
PWS110-2.5W	401-025-712.00	108		
PWS220-2.5W	401-025-812.00	216		
PWS110-5.0W	401-050-712.00	108	230	5.0
PWS220-5.0W	401-050-812.00	216		

2.3 Available options

Article designation	Article code	Suitable for:
Parallel operation choke	402-POC-012.00	PWS-1.0F
	402-POC-033.00	PWS-2.5F
	402-POC-050.00	PWS-5.0F
Mounting set	880-MEC-MKT.03	PWS-F versions
Internal static transfer switch	Several types, depending on the used PWS	PWS-F and PWS wall cabinet versions
Extended AC distribution board		

2.4 Front view, operating and indicator elements

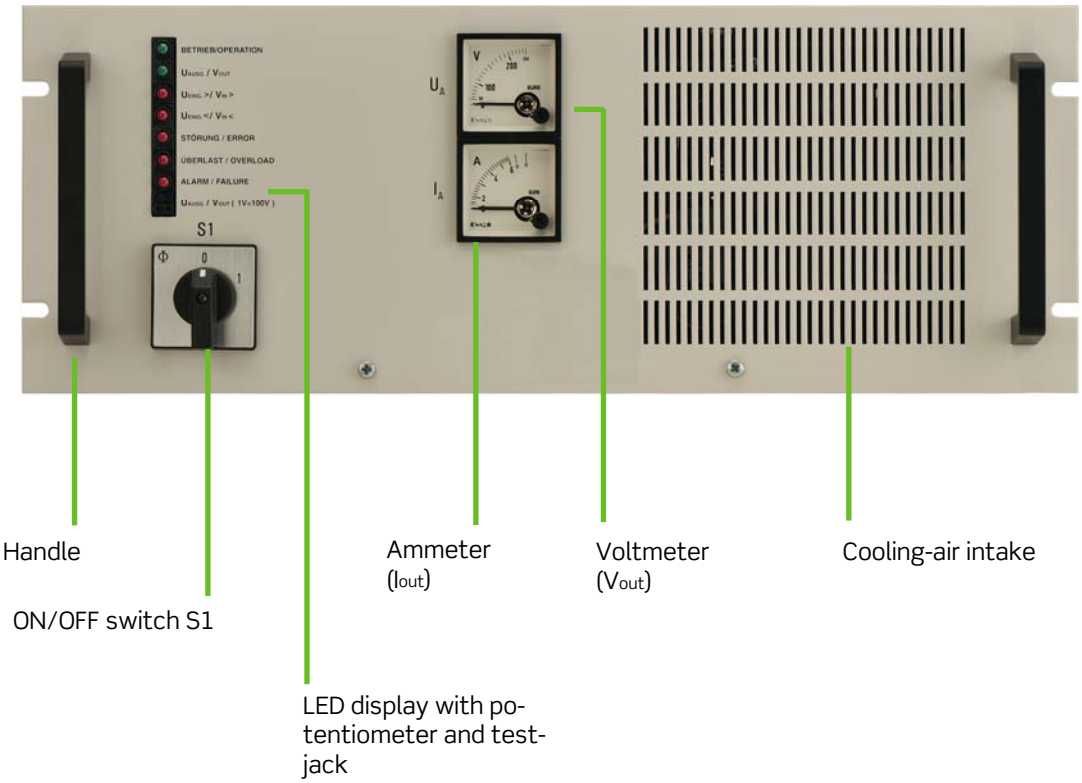


Figure 3) - Front view PWS-F

The PWS is equipped with the following seven LED indicators:

- OPERATION
- Vout
- Vin>
- Vin<
- ERROR
- OVERLOAD/TEMP.>
- COLL. FAILURE

At the bottom of the LED indicators a potentiometer in combination with a testjack is placed. With the potentiometer the AC output voltage can be fine adjusted while the voltage value can be measured at the testjack.

The voltmeter indicates the AC output voltage, the ammeter indicates the AC output current.

With the switch S1 the inverter can be switched ON /OFF.

NOTE: For more information about the indicator and operating elements read the following sections.

2.5 Electrical connectors

2.5.1 Electrical connectors PWS-F

The rear side male connections (DC input voltage, AC output voltage and signals) are shown in figure 4) and are defined in the table below.

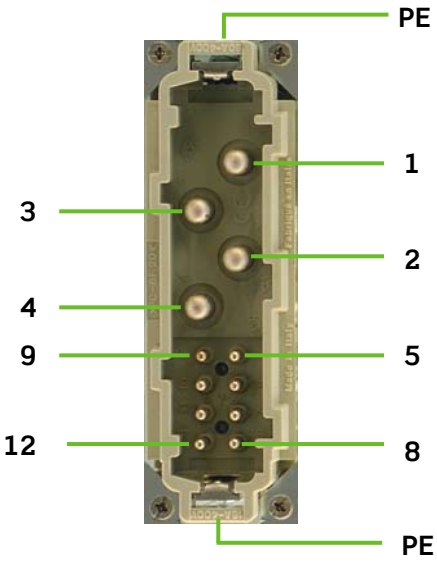


Figure 4) - PWS-F male connectors (shown from the rear side of the module)

Pin assignment of the rear side connector (**except** for PWS24-2.5F):

Pin	Function
1	L+ (DC-INPUT)
2	N (NEUTRAL)
3	L- (DC-INPUT)
4	L1 (Phase L)
5	not used
6	SYNC-GND [1] synchronization ground for paralleling
7	SYNC-SIG [1] synchronization bus for paralleling
8	SYNC-STAT [2] control wire from static bypass switch
9	Remote switch on
10	coll. failure: COM*
11	coll. failure: NO*
12	coll. failure: NC*

* No collective failure is existent: COM and NO are closed.

* Collective failure is existent: COM and NC are closed.

[1] If Inverters are connected in parallel, interconnect all SYNC-GND (pins 6) with each other and interconnect all SYNC-SIG (pins 7) with each other.
[2] If the inverters operate in combination with a static bypass switch UNB, it is also necessary, to interconnect all SYNC-STAT (pins 8) with each other, including SYNC-STAT of the UNB.

REMARK: The pinning of the PWS24-2.5F is different due to the higher input current flow!

Pin assignment of the rear side connector for PWS24-2.5F:

Pin	Function
1	L+ (DC-INPUT)
2	L+ (DC-INPUT)
3	L- (DC-INPUT)
4	L- (DC-INPUT)
5	L1 (Phase L)
6	SYNC-GND [1] synchronization ground for paralleling
7	SYNC-SIG [1] synchronization bus for paralleling
8	SYNC-STAT [2] control wire from static bypass switch
9	N (NEUTRAL)
10	coll. failure: COM*
11	coll. failure: NO*
12	Remote switch on

* No collective failure is existent: COM and NO are closed.

* Collective failure is existent: COM and NO are open.

[1] If Inverters are connected in parallel, interconnect all SYNC-GND (pins 6) with each other and interconnect all SYNC-SIG (pins 7) with each other.
[2] If the inverters operate in combination with a static bypass switch UNB, it is also necessary, to interconnect all SYNC-STAT (pins 8) with each other, including SYNC-STAT of the UNB.

2.5.2 Electrical connectors PWS-W

The electrical connectors (screw terminals, see Figure 5) for a sample) are located at the bottom of the module. They are accessible after opening the front door. The wires are to be inserted through the grommets at the bottom and connected to the screw terminals according to the following table.

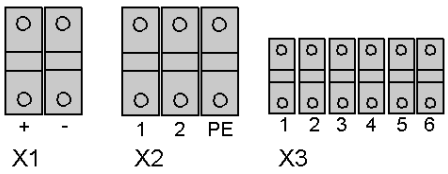


Figure 5) - Screw terminals PWS-W

Figure 5) shows a sample. The genuine screw terminals may look a little bit different depending on the PWS type.

Terminal/designation	Function
X1	DC input
+	**+**
-	**-**
X2	AC output
1	L
2	N
PE	PE
X3	Signals
1	coll. failure: COM*****
2	coll. failure: NO*****
3	coll. failure: NC*****
4	SYNC-GND
5	SYNC-SIG
6	SYNC-STAT

***** No collective failure is existent: COM and NO are closed.

***** Collective failure is existent: COM and NC are closed.

2.6 Cooling and air flow direction

The PWS units are cooled with an internal fan. The airflow is from the front to rear side (PWS-F version), from bottom to top (PWS wall cabinet version). The fan is monitored and speed-controlled dependent on module temperature. To provide sufficient air flow, a minimum space (see figure 6a), item “A”) of 50 mm is required between the rear panel of the module and the rear cabinet wall as well as an unobstructed supply of air to the front of the module. For PWS-W a minimum space of 2U (approx. 90mm) above the top of the module (see figure 6b), item “A”) is recommended.

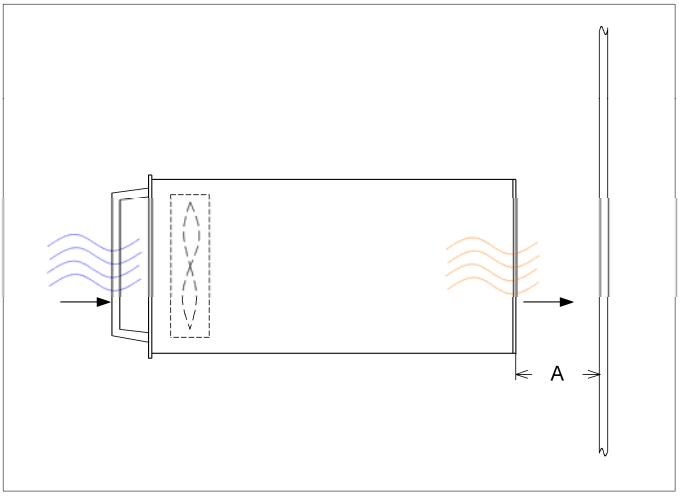


Figure 6a) - Module air flow, PWS-F

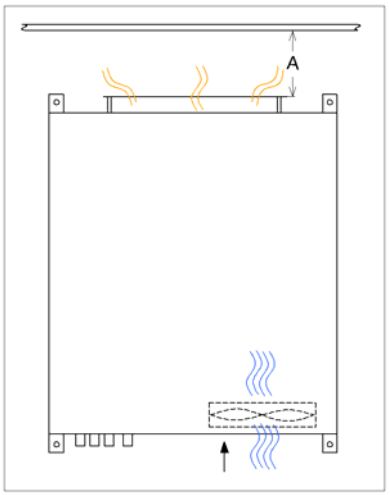


Figure 6b) - Module air flow, PWS-W

3. Handling

3.1 Storage

The modules must be stored in a dry, dust free environment with a storage temperature in accordance with the technical specifications (see section 6).

3.2 Commissioning

Note: Before commissioning the module make sure that the input voltage level corresponds to the nominal input voltage of the unit according to the type plate.

To mount the inverter in a 19" compatible cabinet, a mounting set is necessary (see figure 7).

After unpacking the unit put it upon the rails and slide in the unit carefully over the rails until the module connector gets in touch with the backplane connector. Increase the pressure a little bit until the unit fits in completely. Please avoid too much pressure. If the unit does not fit in please start again with the complete slide-in process.
Mount the unit with 4 screws (M4x12).

Figure 7) - Mounting set for PWS-F (the picture shows not a PWS but a similar module)

For the connection of DC input and AC output the PWS-F is fitted with a backside panel connector (the PWS-W is fitted with screw terminals at the bottom). The DC input is protected against incorrect polarity (if the polarity is reversed, the unit does not switch on).
The PWS-W serially is equipped with an internal input and output fuse (see section 6.2 "Specific data").
The PWS-F has no internal fuses. Therefore the module is to be fused with external fuses according to section 6.2 "Specific data".
Check the load current before connecting the module.
A permanent overload is not allowed and decreases the inverters lifetime. Especially the inrush currents of consumer loads have to be observed (e.g. the inrush current of a common used computer monitor can be more than 50 A!).
For the safety of individuals, the connection of a non-fused protective earth conductor generally is required. Due to the specific overload and short circuit behaviour of the PWS, additional safety measures are to be arranged at the output (e. g. ground fault circuit interrupter).

Connect the input, output and signalling wires according to section 2.5 “Electrical connectors”. Wires in accordance with VDE 0100 or equal standard are to be used. To decrease voltage losses on cables the usage of larger wire cross sections as specified is recommended. For instance, a high voltage loss on battery wires can decrease the backup time.

Following installation rules should be observed:

3.2.1 Single inverter

1. check the system wiring (polarity of DC- supply line)
2. check that the inverter is switched off
3. connect DC input with open DC busbar fuses
4. connect AC loads
5. close the DC busbar fuses
6. switch on the unit with front side switch S1. The rear side switch S2***** must be in position “I”.
7. switch on the load

*** REMARK:** For more information about switch S2, see section 3.6.

3.2.2 Operation in parallel

REMARK: For parallel operation of PWS inverters it is necessary to use **parallel operation chokes** at the outputs of the inverters as shown in figure 1+2). The article codes of the parallel operation chokes are listed in section 2.3 “Available options”.

1. make shure that the inverters to be paralleled are identical in type.
2. check the system wiring (polarity of DC- supply line, synchronous bus)
3. check that the inverters are switched off
4. connect DC input with open DC busbar fuses
5. check the wiring between the inverters (synchronization wires)
6. connect AC loads
7. close DC busbar fuses
8. switch on the units with front side switches (rear side switch S2 in position “0” for remote switch-on function in combination with a static bypass switch UNB).
9. switch on the load

One of the paralleled inverters operates as master and synchronizes the other inverters to a given frequency.

Note: The unit which first of all feeds in is the master. If the master unit fails or is switched off, another unit overtakes the master function.

If paralleled inverters operate in combination with a static bypass switch (UNB), the UNB automatically is the master. The connected inverters are synchronized by the UNB via the control wire SYNC-STAT. For a faultless function it is important that the wiring between the inverters (and static bypass switch) is correct.
The inverters connect themselves to the AC output (over an internal output-side contactor) not till then the output voltage reaches the nominal value.

REMARK: Due to the connected parallel operation chokes in combination with the resistance of the wiring the short circuit detection of the units will be affected.
For this application, it is recommended to check individually the short circuit behavior of the system. Due to the voltage losses at the inductance of the parallel operation choke, the voltage deviation value exceeds the specified data of the data sheet of the PWS.

3.3 LED indications

The following functions are indicated with front side LED indicators:

LED	Colour	Designation	Meaning
	green	OPERATION	Inverter is switched ON, internal supply voltage available
	green	Vout	Inverter output voltage available
	red	Vin>	Input overvoltage; inverter switched OFF
	red	Vin<	Input undervoltage; inverter switched OFF
	red	Error	Output voltage distorted due to short circuit or overload at the output
	red	OVERLOAD/ TEMP.	Overheating of the inverter /continuous overload.
	red	COLL. FAILURE	Collective failure: The delay time is 20s; the relay contact* reacts at the same time. The following failures are combined: Vin<, Vin>, ERROR, OVERLOAD/TEMP.

* Maximum contact load: Vmax. 110V_{DC}/Imax. <0.45A_{DC}
Vmax. 60V_{DC}/Imax. <1A_{DC}
Vmax. 24V_{DC}/Imax. <8A_{DC}

3.4 Monitoring

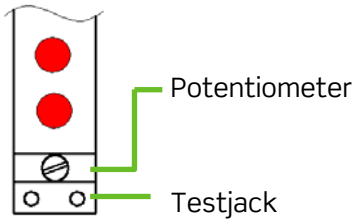
Monitored values	Criteria	Function
DC input voltage	Input voltage <85% (±2%) Vi nom.	LED "Vi<" = ON. The module automatically undelayed switches off. It automatically switches on when the input voltage reaches 103% (±2%) Vi nom. The hysteresis prevents oscillating of the automatic switch-off.
	Input voltage >128% (±2%) Vi nom.	LED "Vi>" = ON. The module automatically undelayed switches off (overvoltage protection). It automatically switches on when the input voltage decreases to 125% (±2%) Vi nom.
AC output voltage	Output voltage <90% Vout nom.	LED "ERROR" = ON. The module automatically switches off, time delay = 2.5s. An automatic restart with progressive run-up follows after 15s. Due to this the module is continuous short circuit proof.
Over-load/temperature*	Heat sink temperature of the power amplifier of the inverter >90°C.	LED "OVERLOAD/TEMP.>" = ON. The module automatically switches off if the temperature does not decrease. It automatically switches on when the heat sink cools down to ≤70°C.

* Possible reasons: Elevated ambient temperature, continuous overload (approx. 20-25%) or a defective fan. Overload capability: See section 6 "Technical specification".

REMARK: Keep the maximum allowed overload time because the module does not automatically switch off.

3.5 Potentiometer

Below the LED indicators the PWS-F is fitted with a potentiometer for fine adjustment of the AC output voltage.



With the potentiometer the AC output voltage can be fine adjusted (e.g. for the compensation of voltage losses at the parallel operation choke). Adjustment range: ±2VAC.
The output voltage can be measured at the testjack. Ratio= 1:100 (1V =100V). But it is recommended to measure the output voltage at the output of the module with consideration of possible voltage losses at the internal wiring and parallel operation choke.

Figure 8) - Potentiometer and testjack

3.6 Rear-side switch S2 (remote switch-on function)

The remote switch-on function is designed to switch on/off all paralleled PWS-F inverters simultaneously.
For this function the DC input voltage monitoring function of the static bypass switch UNB is used. If the UNB detects "DC input voltage is okay" the signal for remote switch-on is sent via the wire connected to pin 9 (pin 12 respectively) of the PWS connector.
In reverse: If the DC input voltage is not okay, the remote switch-off signal is sent.

With switch S2 (see figure 9)) fitted on the rear side of the PWS-F it is possible to enable/disable the remote switch-on function depending on the intended use.

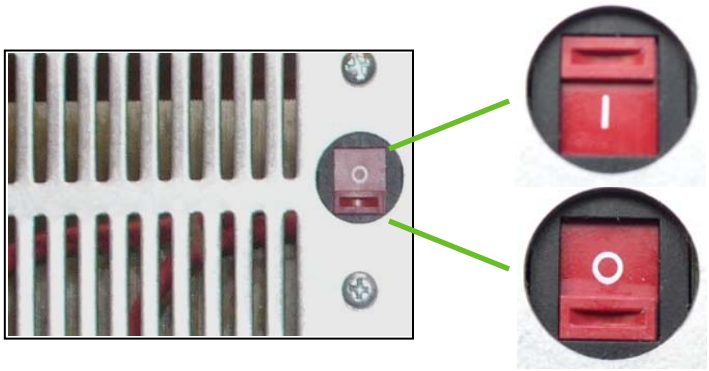


Figure 9) - Detail: Rear side switch S2

Switch 2 position "**1**"= remote switch-on function disabled. In this position, the module can be switched ON and OFF with the front side switch S1.

Switch 2 position "**0**"= remote switch-on function enabled. In this position, the module can be remotely switched ON and OFF by the static bypass switch UNB.

Table "Function of switch 1 and switch 2":

Switch position of		
S1	S2	Function
0	1	Module manually switched OFF, remote switch-on function disabled.
1	1	Module switched ON, remote switch-on function disabled (stand-alone mode)
0	0*	Module manually switched OFF, remote switch-on function enabled.
1	0*	Module switched ON, remote switch-on function enabled.

*** REMARK:** When the PWS is used as stand alone module, it can not be switched ON with S1 if the position of S2 is "0".

For a faultless remote switch on function it is important that the wiring between the inverters and static bypass switch (remote switch on wire) is correct.

INFO: The PWS-F series is serially fitted with the rear side switch since August 2008 (date of manufacture).

4. Maintenance

In general, the module is maintenance-free.
A yearly inspection with following checks is recommended:

- Optical/mechanical inspection
- Fan function
- Removal of dust and dirt, especially on radiator surfaces
- Check for internal dust or humidity

Attention! Dust combined with moisture or water may influence or destroy the internal electronic circuits.
Dust inside the unit can be blown out with dry compressed air.
The interval between the checks depends on ambient conditions of the installed module.

5. Trouble shooting

Symptom	Possible reason	Corrective action
No output voltage	• DC input voltage ok? • main switch (MCB) on? • green LED „OPERATION“ on? • Incorrect polarity at the input? • DC input fuse (at DC busbar) ok? • signalling LED “Vin>” or “Vin<” on ? • short circuit or overload at the output? • output fuse ok? • Unit switched off due to overheating (LED “OVERLOAD/TEMP.>” on)?	→ check → check → check → check → check → check → check/reduce load → check → search for the cause of the overheating
Deviation of the output voltage	• overload at the output? • Is the voltage adjustment (potentiometer) correct?	→ check/reduce load → check/adjust

If the unit still does not work even though all checks are done, please contact your sales agent or the Eltek Valere Deutschland service department.

6 Technical specifications

6.1 General technical specifications

Input:	
Input voltage	according to the type list (see section 2.2)
Input voltage range	+20%/-15% Vnom
Input current	according to the table “specific data” (see section 6.2)
Inrush current	≤nominal input current
Output:	
Output power factor range	0 inductive – 1 – 0 capacitive
Output voltage	230V_{AC} ±0.5%*****; sinusoidal
Output power	according to the type list (see section 2.2)
Output frequency	50Hz ±0.05%
THD	≤3% at linear load
Efficiency	85 – 91% (depending on the type, see section 6.2)
Crest factor	≤2.5
Dynamic behaviour*****	≤3% at load variations of 10% - 100% - 10% Inom (transient time ≤1.5ms)

***** PWS modules in parallel operation: Due to the external parallel operation chokes to be used, the static and dynamic output voltage deviation increases to the following values: static= ±5%; dynamic= ±10%.

Short circuit protection	continuous short circuit proof; 2 - 2.5 Inom for approx. 2.5s.
Monitoring:	
DC input voltage	Vin<; Vin> (with switch-off and automatic switch-on)
AC output voltage	Vout; overtemperature (with switch-off); overload (without switch-off)
Overload capability	160% for 1 min./130% for 10 min. (without switch-off)
LED indicators	OPERATION, Vout, Vin<, Vin>, ERROR, OVERLOAD/TEMP., COLL. FAILURE
Relay contact	Collective failure; maximum contact load: Vmax. 110V_{DC}/Imax. <0.45A_{DC} Vmax. 60V_{DC}/Imax. <1A_{DC} Vmax. 24V_{DC}/Imax. <8A_{DC}
Parallel operation	max. 12 modules with external parallel operation choke, load sharing approx. 5%,
External synchronization	yes
Analogue measurement instruments	Vout, Iout
Environmental:	
Ambient temperature	Operation: -20°C to +55°C, storage: -40°C to +85°C
Climatic conditions	according to IEC 721-3-3 class 3K3/3Z1/3B1/3C2/3S2/3M2

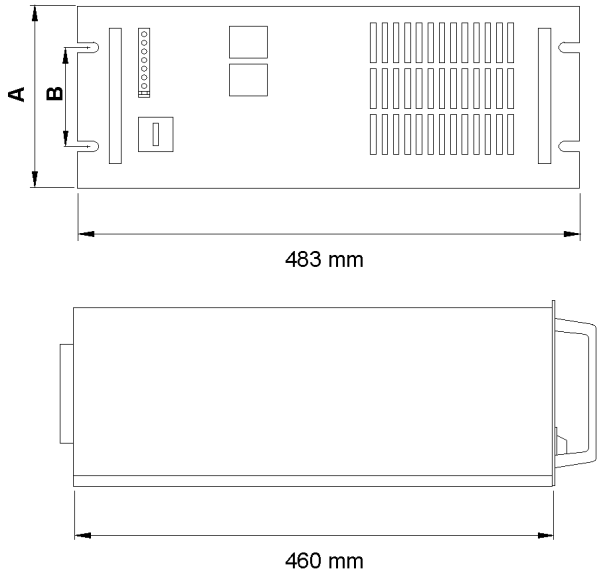
Max. installation altitude	≤ 1500m
Noise emission	<45dBA
Mechanical:	
Type of construction	19" compatible casing or wall cabinet (depending on the type)
Cooling	Fan cooling (temperature regulated and monitored)
Dimensions/weight	according to the table "specific data" (see section 6.2)
Surfaces	Front panel (PWS-F) and wall cabinet: powder-coated, RAL7035
Compliances:	
Type of enclosure/ protection class	Mechanical: IP20; electrical: according to EN60950-1
CE conformity	Yes
Compliance to safety standards	EN60950-1; VDE0100 T410; VDE0110; EN50178; EN60146
Compliance to EMC standards	EN 55011; EN 55022 class "B"; EN 61000-4, part 2-5

6.2 Specific data

Input voltage (V_{DC})	Output power (kVA @ cos phi = 0.8)	Effi-ciency (%)	Input current (A_{DC})	Output current (A_{AC})	Input/ output fuses* (A)	Weight 19" rack/ wall cabinet (kg) approx.	Dimen-sions 19" rack	Dimen-sions wall cabinet
24	1.0	85	38.8	4.35	50/6	20/24	E1	C2
108	1.0	90	8.2	4.35	10/6	19/23	E1	C2
216	1.0	90	4.1	4.35	6/6	19/23	E1	C2
24	2.5	86	96.9	10.9	125/16	34/42	E2	C4
108	2.5	91	20.4	10.9	25/16	34/42	E1	C2
216	2.5	91	10.2	10.9	16/16	34/42	E1	C2
108	5.0	91	39.9	21.7	50/25	52/64	E2	C5
216	5.0	91	20.0	21.7	25/25	52/64	E2	C5

* The PWS-W is serially fitted with internal input and output fuses.
The PWS-F has no internal fuses. It is recommended to use external fuses according to the table above.

6.3 Dimensional drawings PWS-F



PWS-F	A (mm)	B (mm)
E1	177 (4U)	101.7
E2	221 (5U)	146.1

Figure 10) - PWS-F dimensions

6.4 Dimensional drawings PWS-W

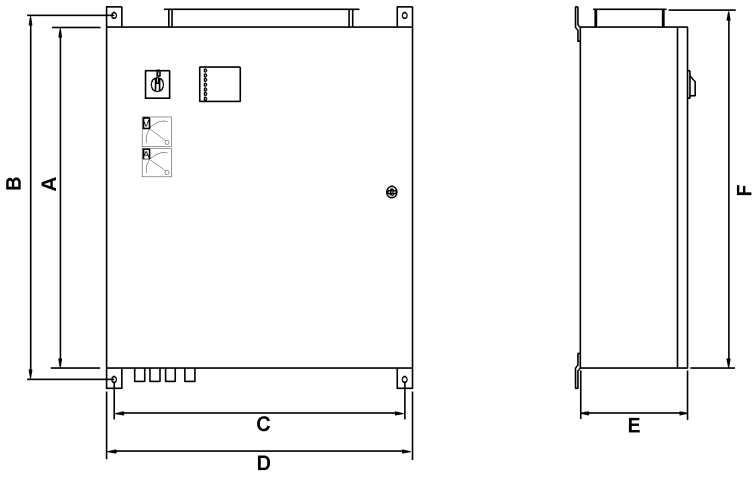


Figure 11) - PWS-W dimensions

PWS-W	A (mm)	B (mm)	C (mm)	D (mm)	E (mm)
C2	600	666	365	400	210
C4	600	666	565	600	300
C5	800	866	565	600	300

The dimensions of the slotted holes of the wall holder mountings are 8.5 x 12.5mm.

7. Notes

Notes

Supplier:

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