Inverter
INVB-Series
for
Telecom, Industry and Rail Applications

Technical Description – English

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Contents

1 Preface

Dear customer!

Thank you for purchasing a product from Power Innovation GmbH.

This manual contains detailed information about the Power Innovation GmbH device you purchased. It describes the features, basic functions, various applications and offers solutions in case of failure. Instructions on installation, storage and shipping are also included.

Please note that this manual contains the description of an entire series of Power Innovation products. Please check your order and/or device label in order to refer to the corresponding information given in this manual.

This manual addresses mostly to chief operators and system supervisors, electrical consultants and installation electricians. Our devices may only be installed by qualified personnel, according to the following instructions as well as national and international regulations where applicable.

Our products' technology meets all requirements of telecommunications, electric power supply, industry and others. Our product line ranges from small power inverters to large inverter systems.

State of the art circuit design delivers high efficiency. This allows long term operation at low temperature stress. The devices need no servicing.

2 Acceptance test

2.1 Checking for damages

Power Innovation products are manufactured and shipped according to strict quality control standards. If a product proves to be defective in material or workmanship, the warranty will be granted (refer to our “Terms of Warranty”).

- Check the product for damage due to shipment. In case of damage, keep all packing material for further examination.
- If you discover shipping damage after inspection, you must submit a claim for covered shipping damage.
- Inform the forwarder of shipping damage by sending a fax immediately.
- Send a copy of the damage claim to Power Innovation GmbH immediately.

The manufacturer will not be liable for any injury, loss or damage, arising directly or consequentially out of the improper use of this product. It is mandatory to read this manual. Please observe all printed instructions, especially the safety advices.

Please note:
In case of claims, please refer to your specific product information, such as serial number, input and output voltages, as shown on the device label.

3 Installation

Note:
The electrical planning and installation of the device may only be undertaken by qualified personnel. It must comply with all local legislation and regulations.
The installation instructions must be followed carefully. If neglected, safety and health of the personnel involved are threatened and injuries and/or fatality may be caused. Please refer to your country's regulations.

Caution:
Do not operate the inverters in explosive areas. Operation of the inverters in such an environment constitutes a safety hazard. Furthermore, the inverters must not be operated in hermetically sealed cabinets.

3.1 Operational environment

All the requirements concerning environment described in this chapter must be fulfilled. When planning on location and installing the device the following points must be considered:

- For correct function and optimal life span avoid temperature and humidity peaks (non condensing environment).
- Make sure that proper ventilation is guaranteed.
- With forced cooling devices, ensure that cooling air is able to flow unhindered through the front side and the rear side of the inverter (clearance between the front side and rear side min. 150 mm).

Upon disregard of the above hints, Power Innovation GmbH can neither guarantee the safety of personnel involved nor a correct function of the power supply.

3.2 Safety requirements

Explanation of the safety symbols used in this manual:

Warning

Caution

Warning Explosion

The electrical planning and installation of the device may only be undertaken by qualified personnel. It must comply with all local legislation and regulations. The installation instructions must be followed carefully. If neglected, safety and health of the personnel involved are threatened and injuries or fatality may be caused. Furthermore, the device or connected load may be damaged. All wiring must be done in a voltage free state in order to avoid any damage to life and equipment. Make sure that wiring diameters meet the specified system current from/to the device, if applicable. Please refer to your country's regulations.

Warning:
Do not open the device! Some components insides carry high voltages. Disregard threatens the safety and health of personnel involved and may cause injuries or even fatality. There are no maintenance points inside the inverter.

3.3 External fusing

For maintenance and especially for safety reasons, external fusing for DC supply, AC supply and AC output must be provided. It is strongly recommended to use 2-pole circuit breakers for both DC and AC fusing.

3.4 Electrical connections

When connecting the inverter, ensure the correct cable size and diameters. Please find additional information printed in the section 3.7 Control elements and connections.

3.5 Device protection

It is recommended using additional mounting rails to support the sub-rack inside the frame / cabinet. Please contact your cabinet manufacturer for a suitable rail.

3.6 Grounding

Ensure a correct ground connection. The ground contact (PE) must be connected to the DC input of the device, using the largest possible diameter. Furthermore, for all wall mounted devices, connect the PE to the ground bolt, if applicable.

The inverter, manufactured by Power Innovation GmbH, has a galvanic isolation between DC input and AC output. The generated AC output voltage ($230V_{AC}$/ 50 Hz) is electrically isolated from the DC input and the protective earth (PE)/mechanical housing.

The only connection is a capacitive connection via the EMC Y-capacitors to the mechanical housing. These capacitors are necessary to fulfil the EMC requirements. The electrical capacity of these Y-caps is < 10 nF and the leakage current is < 2,5 mA. The inverter fulfills international norms and is marked with the CE label.

For inverters with integrated bypass switch, which means for inverters providing an AC input fed by the commercial power line (mains), the commercial power line N-wire is linked straight to the AC output of the inverter. Therefore the output potential of the inverter is electrically tied to N, even during inverter operation mode. For inverters with integrated bypass switch we recommend the correct (phase correct) connection to the commercial power line (mains). The isolation to the mechanical housing and the DC input is still there. See figure 1 for reference.

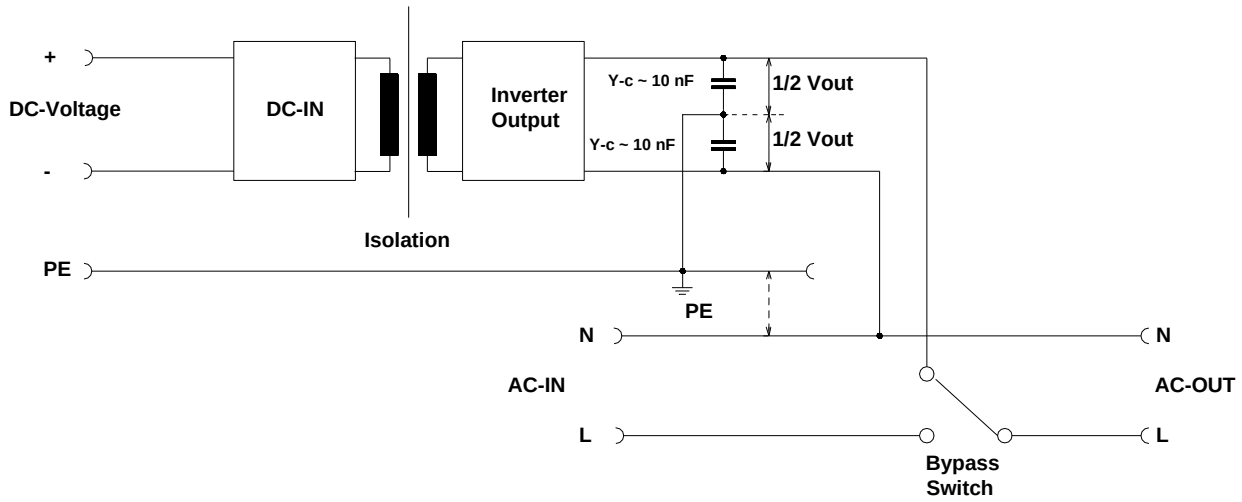


Figure 1

Attention:
If an inverter with integrated bypass switch is used without the AC input connected to the commercial power line, the AC output is a floating output again. The N pole of the AC input connector at the inverter is tied to the floating potential again, caused by the EMC capacitive voltage divider (Y-capacitors). An AC input which is not used shall be protected by the supplied AC input connector (appliance connector) or by a sufficient cover. You can use the supplied AC input connector as a “blind connector”

Attention:
In-phase connection required!
Generally, a fixed installation is required.
(A grounding type plug must not be used!!!)

3.7 Product description

Please note:
The following chapters describe technical features and data that may depend on power version, voltage version or options ordered. If not otherwise mentioned, any information given in these chapters refer to all the series' products. Please check your order and/or device label in order to refer to the corresponding information given.

Warning:
Do not open the device! Some components insides carry high voltages. Disregard threatens the safety and health of personnel involved and may cause injuries or even fatality. There are no maintenance points inside the inverter.

The inverters of the INVB series are described as follows:

Power rating and voltage versions:

Product	Power rating	DC-Input Voltage	AC-Output Voltage
INVB4000	4000 VA/3200 W	48/60, 110, 220V_{DC}	230V_{AC}, 50 Hz
INVB2000	2000 VA/1600 W	48/60, 110, 220V_{DC}	115V_{AC}, 60 Hz

Table 1

The inverters of the INVB series have an integrated bypass switch module. The inverter is a pure stand alone operating unit and has no parallel operating functionality. The inverter can operate either in the ON-Line (load is preferably supplied by the inverter line) or in the OFF-Line (load is preferably supplied by the commercial power line) operation mode. The switch-over time of the integrated bypass contact is less than 4 ms.

The inverters of the INVB series are forced fan cooled (the speed of the internal fan is depending on the internal inverter temperature and the AC output power).

Our inverters offer the following protective and monitoring functions:

a) Overload- and short circuit protected output

b) DC UVP (under voltage protection) and DC OVP (over voltage protection)

c) AC UVP/OVP at the inverter output

d) AC UVP/OVP at the mains input

e) Protection against excess temperature

f) Frequency monitoring (fixed +/- 3 Hz tolerance range)

g) Protection from reverse connection of the battery

3.8 Control elements and connections

Inverter INVB4000/INVB2000 in 48/60, 110 and 220V_{DC}.

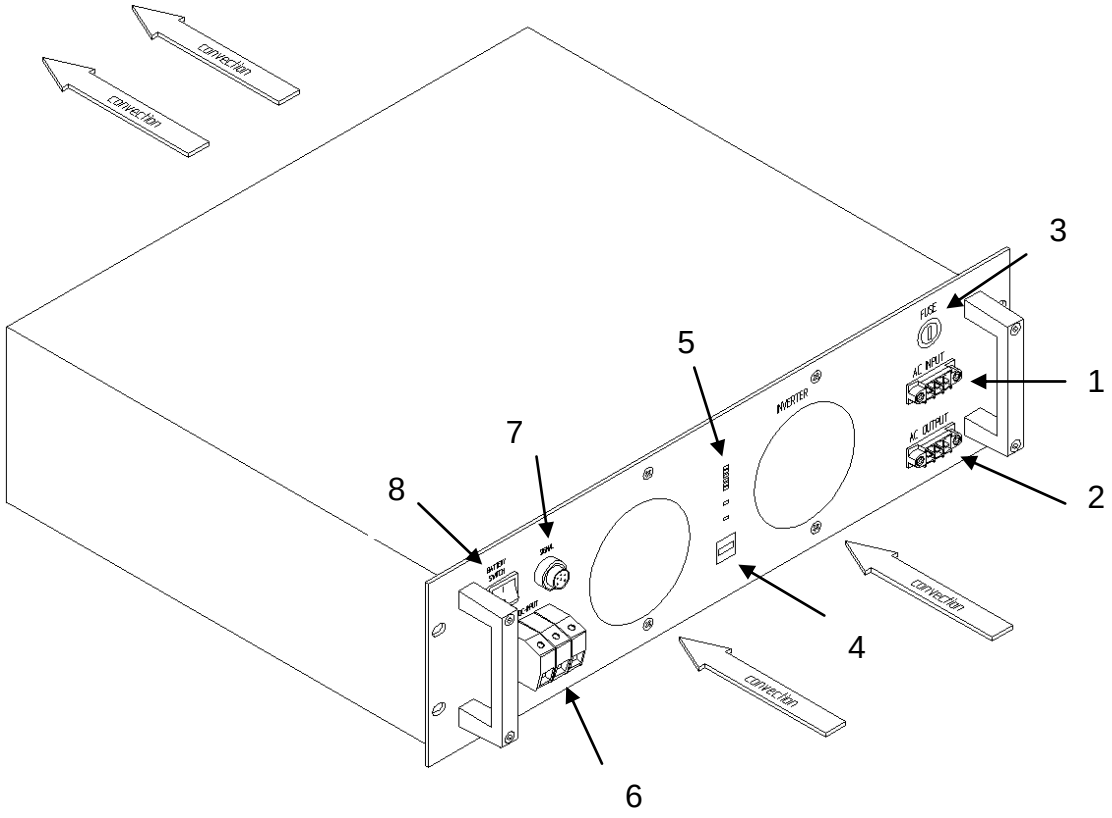


Figure 2

No.	Description	Type
1	AC input, 1-phase commercial power line (mains)	Phoenix Power Combicon
2	AC output, 1-phase,	Phoenix Power Combicon
3	AC input fuse	Commercial power line (mains) input L
4	Control push button	Push button for setup and control settings
5	LED	2+6 Bargraph
6	Input voltage DC	Phoenix HDFK 16 screw clamps, 16mm^2
7	Potential free alarm contact	Binder 6pol. 0,75mm^2 250V/3AAC; DC 300V/0,1A; DC100V/0,2A; DC30V/1A
8	Battery switch	Turns the inverter ON/OFF

Table 2

3.9 Block diagram

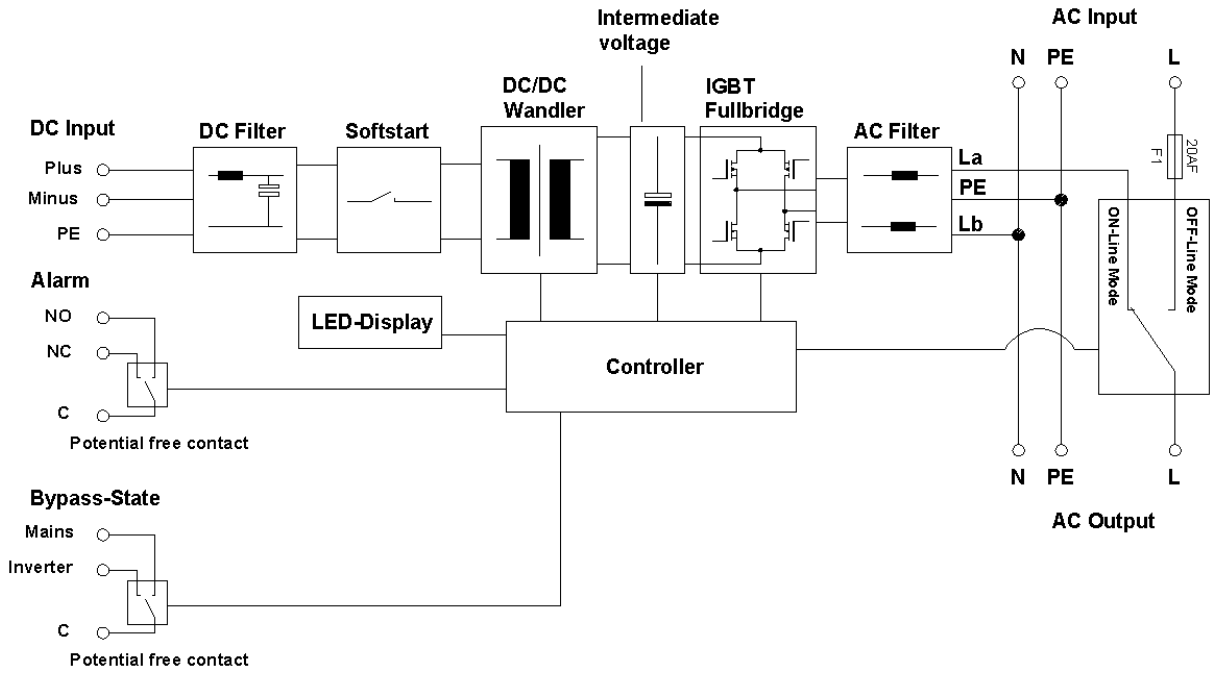


Figure 3

3.10 Fuse

The integrated electronic bypass switch of the INVB inverters has one fuse in the AC input line, F1. This fuse is implemented as a protection of the inverter bypass switch and the electrical contacts used. Even if these fuses protect the commercial power line path to the inverter AC input in case of a short circuit condition on the load circuit side, the additional external fusing with automatic circuit breaker is recommended to switch the inverter voltage free for installation or maintenance purposes.

3.11 Connection

3.11.1 VDC input

Inverter with 48/60, 110 and 220V_{DC} input

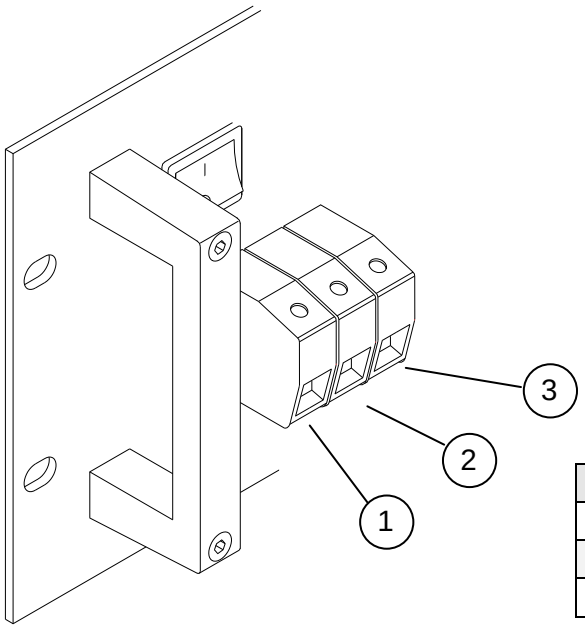


Figure 4

Pin	Function	Abbreviation
1	Input voltage reference	0V U_{in}
2	Ground wire	PE
3	Input voltage positive	+ U_{in}

Table 3, DC IN: 3x HDFK 16mm²

3.11.2 LED display

Load display

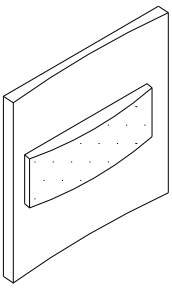
LED 6	(red)	150% overload
LED 5	(red)	125% overload
LED 4	(green)	100% load
LED 3	(green)	75% load
LED 2	(green)	50% load
LED 1	(green)	25% load

Online display

Online LED green	Signalizes Inverter operation
Online LED red	Signalizes Mains operation

Power display

Power-LED	orange	Standby mode
Power-LED	green flashes	Selftest
Power-LED	green	Normal operation
Power-LED	red	Internal failure
Power-LED	red flashes	Setup failure
Power-LED	off	Inverter is off / no DC supply



Push button

For operation/standby mode switching and Setup setting
(Please refer to chapter 4 Setup).

3.11.3 Mode Changeover

By shortly pressing the pushbutton the Online LED shows the stored operation mode. Green = normal-inverter, Red = normal-mains mode.

By long pressing, after 3 sec. the operation will be changed and displayed. The new mode is stored permanently.

3.11.4 Alarm contact

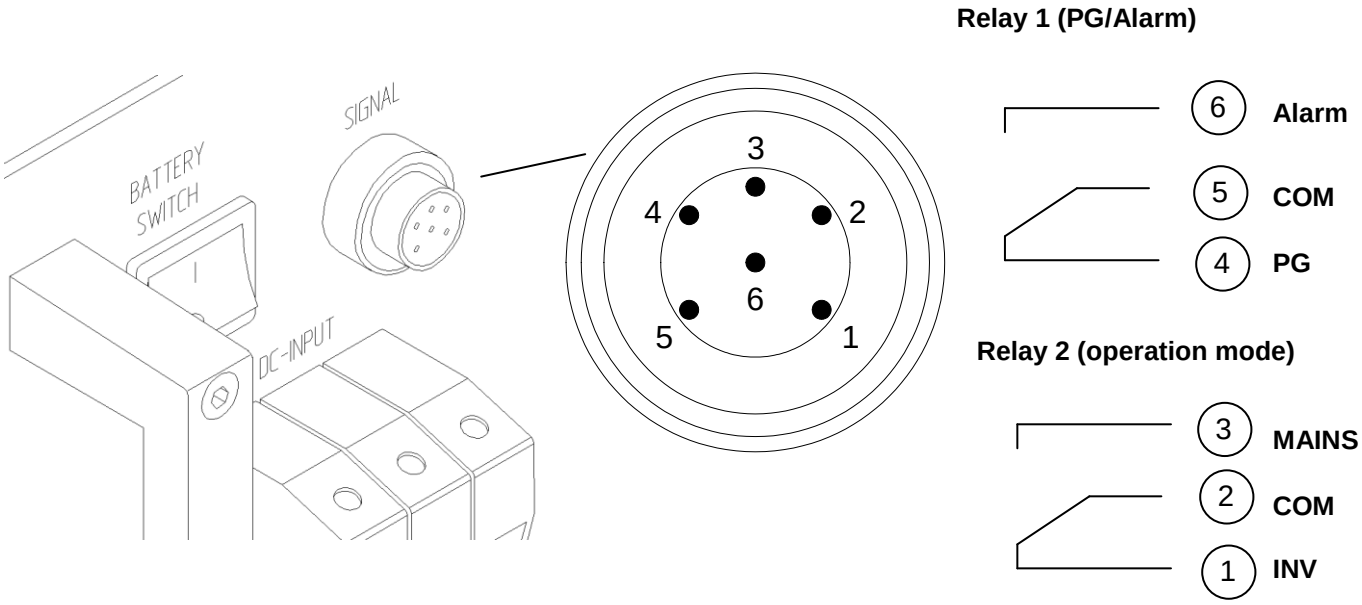


Figure 5

Pin	Inverter	Abbreviation
1	Bypass status “Inverter operation mode”	Inverter / NC
2	C (**C**ommon)	C
3	Bypass status “Mains operation mode”	Mains / NO
4	Power Good (**n**ormal **c**losed)	Inverter o.k. / NO
5	**C**ommon	Alarm C
6	Alarm (**n**ormal **o**pen)	Inverter alarm / NC

Table 4

3.11.5 AC input/output

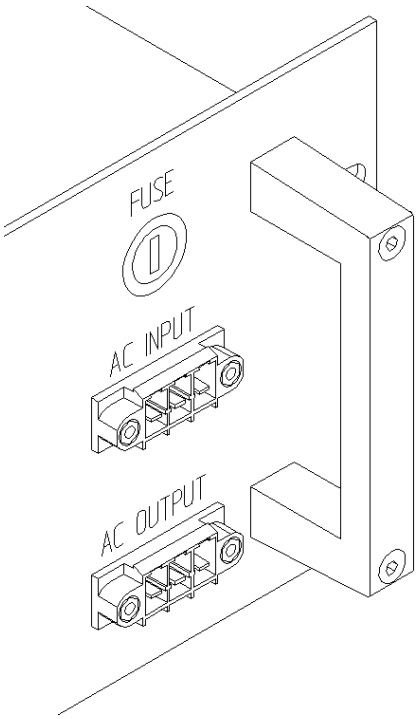


Figure 6

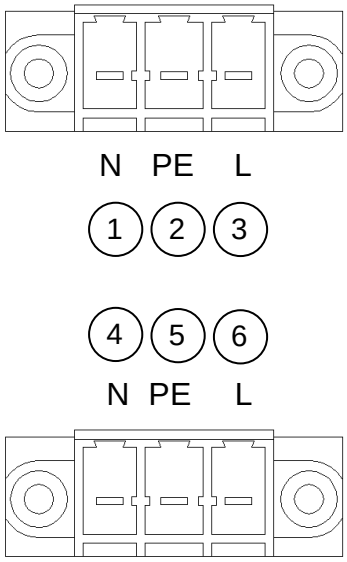


Figure 7

Pin	Function	Abbreviation
1	AC in, ∅ = 1,5mm²	N
2	Ground wire, ∅ = 1,5 – 2,5mm²	PE
3	AC in, ∅ = 1,5mm²	L

Table 5, AC input IEC appliance connector, 3-pole, male

Pin	Function	Abbreviation
4	AC out, ∅ = 1,5mm²	N *
5	Ground wire, ∅ = 1,5 – 2,5mm²	PE
6	AC out, ∅ = 1,5mm²	L*

Table 6, AC output appliance connector, 3-pole, female

*** Note:**

If the external commercial power line is not connected, the inverter output is floating (see chapter 3.5 Grounding).

Caution:
The inverters of the INVB series can only operate as stand alone units. The inverter output is „floating“, when the AC input is not connected to the external commercial power line. If the external mains are connected, the inverter output has an L/N/PE configuration. Observe the polarity (L/N) of the external mains, when connecting them to the inverter AC input. The neutral (N) and the protective earth (PE) wires are straightly connected. The L (Phase) is switched by the internal bypass. (See chapter 3.7 Control elements and chapter 3.8 Block Diagramm.)

3.12 Operation

Note:
The following chapters describe technical features and data that may depend on power version, voltage version or options ordered. If not otherwise mentioned, any information given in these chapters refer to all the series’ products. Please check your order and/or device label in order to refer to the corresponding information given.

Caution:
Do not open the device! Some components insides carry high voltages. Disregard threatens the safety and health of personnel involved and may cause injuries or even fatality. There are no maintenance points inside the inverter.

3.12.1 Prerequisites

Before switching on the device(s), make sure that the following conditions are given:

- Ensure that all external fusing (DC input and AC input) is set to 0 (OFF)
- Ensure that the BATTERY SWITCH is set to 0 (OFF)
- Ensure correct polarity of all connections
- Control fastening of all connectors
- Switch on the external DC supply by setting the fuse(s) to 1 (ON) position
- Switch on the external AC supply (mains) by setting the fuse to 1 (ON) Position

3.12.2 Operation with external commercial power line (mains)

Caution:
The inverter's AC output carries voltage as soon as the external AC supply is connected to the AC input of the inverter – even if no DC input is connected.

When the inverter is only supplied by the commercial power line (mains), the internal bypass switch stays in the operation mode "Mains supply/OFF-Line operation". This function guarantees a load supply, until the DC supply is connected, i.e. later planning of a battery backup.

When both sources (commercial power line and DC supply) are connected to the inverter, the user can choose the mode of operation (ON-Line/OFF-Line). See chapter 3.10.3 Alteration of parameters for setting the bypass operation mode required.

3.12.3 Bypass switching characteristics

The switch over time of the bypass switch is typical 4ms. If the inverter is set to ON-LINE mode operation (preferred load supply by the inverter) and e.g. a DC failure occurs, the bypass switch turns over to mains supply in less than typical 4ms. After reaching a steady DC supply, the bypass switches back to inverter operation mode. The bypass needs about 10 seconds to switch back. During that time the bypass checks the stability of the supply.

If the inverter is set to OFF-LINE mode operation (preferred load supply by the mains) and a mains failure occurs, the bypass switch turns over to inverter supply in <4ms. After reaching a steady mains supply again, the bypass switches back to mains operation mode after about 10 seconds.

4 Setup

Caution:
The setup mode changes the parameters of the inverter. The factory defaults comply with standard conditions and/or the parameters ordered by the customer. Alteration by qualified personnel only!
Damage to the inverter or connected devices or financial losses due to down times are on sole responsibility of the customer.

4.1 Enabling setup mode

To make changes in the inverter setup, it is necessary to shut down the entire inverter. The DC input and the AC output supply must be switched OFF to enter the setup menu. The connected load is not being supplied during these activities.

1. Disconnect the device from the external AC supply (mains).
2. Make sure the BATTERY SWITCH is set to 0 position (OFF).
3. Push and hold the push button and set the BATTERY SWITCH to I (ON).
4. The inverter is in setup mode now.

The output frequency, normal mode and AC tolerances may me adjusted via the setup mode.

The factory default for the output frequency of the inverter is 50Hz. For special needs, the frequency can be set to 60Hz.

To modify these settings,

- by using the control push button single load LEDs can be chosen, holding the push button for a while, the power LED will be activated (or deactivated). The corresponding activated/ deactivated function in listed in the following tables 7,8 and 9.

Finish the setup mode after altering all desired values by setting the battery main switch to 0 (OFF). The changes are saved for operation of the inverter(s).

LOAD LED	POWER LED activated	POWER LED deactivated
LOAD LED 6 (red)	UVP Bit 0	-
LOAD LED 5 (red)	UVP Bit 1	-
LOAD LED 4 (green)	OVP Bit 0	-
LOAD LED 3 (green)	OVP Bit 1	-
LOAD LED 2 (green)	Mode NORMAL INVERTER	Mode NORMAL MAINS
LOAD LED 1 (green)	60 Hz (115V, 2kVA)	50 Hz (230V, 4kVA)

Table 7

OVP

Bit 1	Bit 0	Valve
0	0	+10%
0	1	+15%
1	0	+20%
1	1	+25%

Table 8

UVP

Bit 1	Bit 0	Valve
0	0	-10%
0	1	-15%
1	0	-20%
1	1	-25%

Table 9

Factory defaults

5 Mechanical dimensions

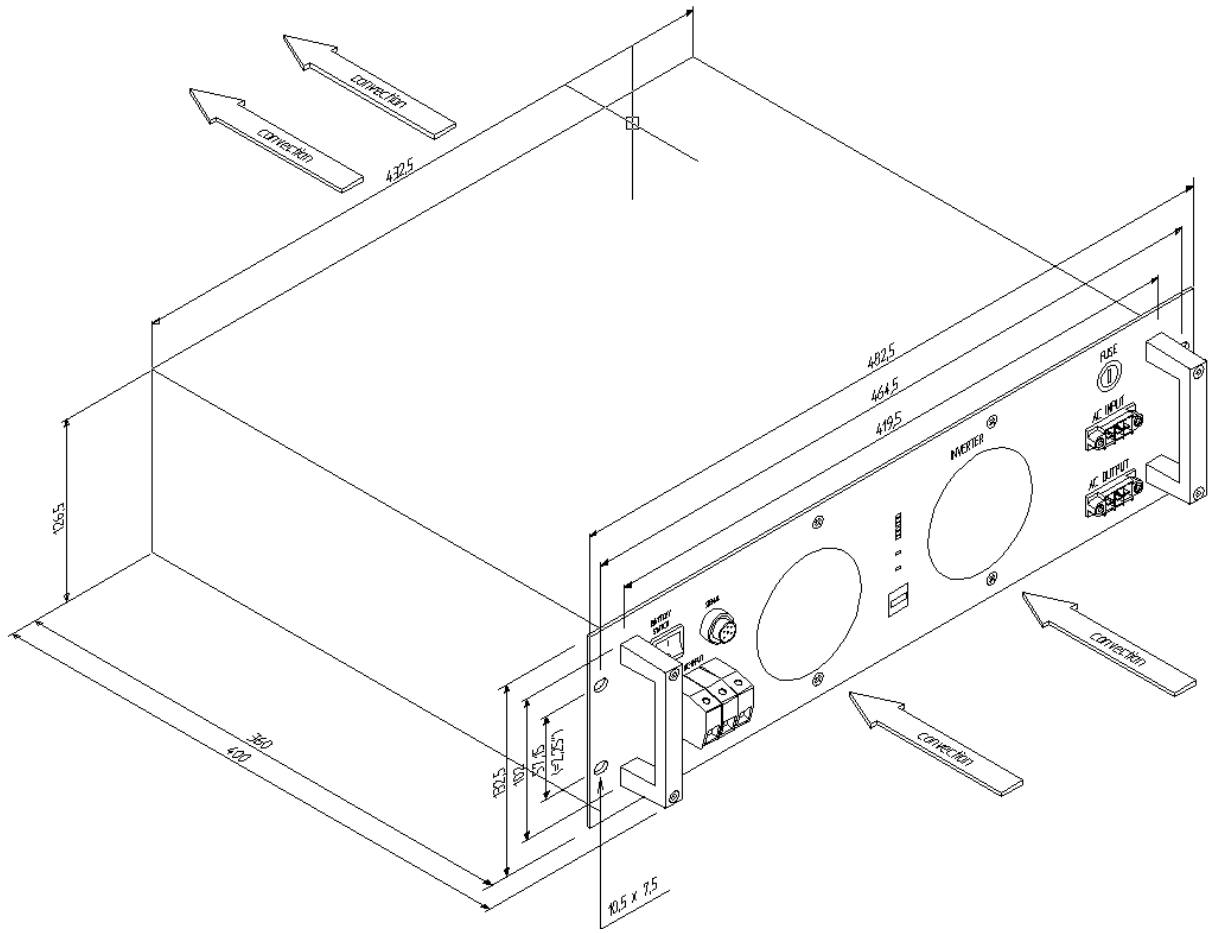


Figure 8

6 Exhibit

Technical data, additional information and handling advices for this product series are listed in the attachment of this manual.

A. Conversion table AWG to millimeter

AWG	ø mm	mm²
7	3,665	10,5510
8	3,268	8,3870
9	2,906	6,3200
10	2,588	5,2620
11	2,304	4,1680
12	2,052	3,3080
13	1,829	2,6270
14	1,628	2,0867
15	1,450	1,6513
16	1,290	1,3070
17	1,151	1,0387
18	1,024	0,8171
19	0,912	0,6504
20	0,813	0,5153
21	0,724	0,3959
22	0,643	0,3217
23	0,574	0,2624
24	0,511	0,2043
25	0,455	0,1590
26	0,404	0,1257
27	0,363	0,1018
28	0,320	0,0804

Table 9 AWG: American Wire Gauge

B. Declaration of conformity

We, **Power Innovation Stromversorgungstechnik GmbH**,

Address: Rehland 2
28832 Achim
Germany

hereby certify in sole responsibility that the products listed below:

Inverter INVB-Series

comply with the standards of electrical safety EN 60950 (VDE 0805). We hereby certify that all important interference tests have been performed. All products have passed High Voltage and Protective Earth tests before delivery. The compliance with EMC standards has been tested in-house.

The products are labelled with a CE marking.

Technical documentation for products listed above is kept at

Power Innovation Stromversorgungstechnik GmbH
Rehland 2
28832 Achim
Germany

C. Technical data

INVB4000 4000VA/3200W
INVB2000 2000VA/1600W

General	
Electrical safety	EN 60950, VDE 0805
Efficiency	> 88% at nominal load
Galvanic isolation	3.75kV$_{DC}$
EMC (emission)	EN 50081-1, Curve EN 55022A
EMC (immunity)	EN 50082-2
Operating temperature	-5 to +50°C, non condensing +50 to +70°C, 2%/K derating
Input DC voltage ranges	
INVB4000/INVB2000-48/60	48/60 (38-72) V$_{DC}$
INVB4000/INVB2000-110	110 (88-132) V$_{DC}$
INVB4000/INVB2000-220	220 (176-264) V$_{DC}$
Output AC	
Voltage INVB4000	230V$_{AC}$, failure tolerance +/-5%
Voltage INVB2000	115V$_{AC}$, failure tolerance +/-5%
Frequency	50 Hz (60 Hz), sine wave processor controlled
Power factor	0.8
Load range	0-100%
Crest factor	> 2.5
Harmonic distortion	< 2%
Bypass Switching time	typical 4ms
Signals	
Visual	LED bar graph 2+6
Signal output 1	general alarm, voltage free turn over contact, 1 pole
Signal output 2	bypass status, voltage free turn over contact, 1 pole
Operation	control push button, BATTERY MAIN SWITCH
Warranty	24 months
Housing	19"-rack mounting case
Size	3U, 360mm depth
Weight	app. 15kg
Classification	IP 20
Ventilation	internal fan
Electrical connections	front
DC input	3 terminal blocks, 16 mm^2
AC input	Phoenix Power CombiCon, 4mm^2
AC output	Phoenix Power CombiCon, 4mm^2
Signal	Binder round connector, 250V$_{DC}$/0,1A; 100V$_{DC}$/0,2 A; 250V$_{AC}$/3A

We reserve the right to modify technical specifications without notice.

D. Fields of application

The galvanic isolation of the inverters in- and output is built with a transformer. Because of the high-frequent switching we have achieved a small light weight design. The inverters of the INVB Series have very low output impedance and are therefore suitable for non-linear loads (i.e. switching power supplies). Even considerable peak currents only bring slight deformation of the sine wave. The inverters have a robust IGBT-fullbridge stage at the AC-output.

The inverters' contruction is designed for resistance to shock or vibration which also facilitates mobile applications.

E. Applications

- Industrial DC-supply networks
- Power plants
- Telecom applications
- Solar energy applications
- Off-shore-applications/DC-networks on board of vessels, trains and other vehicles

F. Shipping and storage

The inverters are packed individually for shipping and storage purposes. Handle with care. In case of reshipment use the original packing. Make sure that the filling material of the packaging does not enter into the convection area. The standard device box is not save enough for transport. An additional transport box or pallets are necessary for shipping.

The recommended temperature for shipping and storage of the inverters is:
-20°C to + 60°C non condensing

Attention!
If the inverters are not installed on arrival, please store in original packaging.

Protect the inverters against moisture and weather influence.

G. Terms of warranty

Dear customer,

Thank you for choosing Power Innovation, the manufacturer of modern power supplies. In case your Power Innovation product needs guarantee service, please contact your distributor, or Power Innovation. In order to avoid any unnecessary inconvenience, we suggest reading the user and installation manual carefully before contacting us.

Your guarantee
Power Innovation guarantees the product to be free of defects in material and workmanship for a period of **two years** from the time of its original purchase. If, during this period of guarantee, the product proves defective due to improper material or workmanship, the manufacturer will repair or (at manufacturer's discretion) replace the product or its defective parts free of charge, corresponding to terms and conditions set out below. The manufacturer reserves the right (at its sole discretion) to replace spare parts of defective products or to replace low cost products with either new or recycled spare parts or products.

Conditions.

1. This guarantee will be granted only when the original invoice or delivery note (indicating the date of purchase, appliance type, serial number and name of distributor) is presented together with the defective product.
   Power Innovation reserves the right to refuse free-of-charge guarantee service if the above document cannot be presented or if the information contained in it is incomplete or illegible.

2. This guarantee will not reimburse nor cover the damage resulting from adaptations or adjustments which may be made to the product without the prior written consent of Power Innovation in order to conform to the national or local technical or safety standards in force in any country other than the ones for which the product was originally designed and manufactured.

3. This guarantee will not apply if the type or part/serial number on the product has been altered, deleted, removed or made illegible.

4. This guarantee covers none of the following:
   - 4.1. Periodic maintenance and repair or replacement of parts due to normal wear and tear;
   - 4.2. Any adaptation or changes to upgrade the appliance from it's normal purpose as described in the user manual without the prior written consent of Power Innovation;
   - 4.3. Transport costs and all risks of transport relating directly or indirectly to the guarantee of the product;
   - 4.4. Damage resulting from:
     - 4.4.1. Misuse, including but not limited to failure to use the product for it's normal purpose or in accordance with manufacturer's instructions on the proper use and maintenance and installation or use of the product in a manner inconsistent with the technical or safety standards in force in the country where it is used;
     - 4.4.2. Repair done by non-authorized service stations or distributors or the customer himself;
     - 4.4.3. Accidents, lightning, water, fire, improper ventilation or any cause beyond the control of Power Innovation;
     - 4.4.4. Defects in the system to which the product has been connected or into which it has been incorporated.
     - 4.4.5. IN NO EVENT SHALL POWER INNOVATION BE LIABLE FOR ANY CONSE-QUENTIAL DAMAGES OR COLLATERAL DAMAGES OF ANY KIND OR NATURE ALLEGED TO HAVE RESULTED FROM ANY BREACH OF WARRANTY. POWER INNOVATION DOES NOT WARRANT THE MERANTABILITY OF THE PRODUCT(S) OR THEIR/ITS FITNESS FOR ANY PARTICULAR PURPOSE. POWER INNOVATION MAKES NO WARRANTY, EXPRESS OR IMPLIED OTHER THAN THOSE SPECIFICALLY SET FORTH HEREIN.

5. This guarantee does not affect the consumer's statutory rights under applicable national laws in force nor the consumer's rights against the distributor arising from their sales/purchase contract.