



**victron energy**

**USER MANUAL  
GEBRUIKSAANWIJZING  
MODE D'EMPLOI  
BEDIENUNGSANLEITUNG**

Phoenix 12/220

Phoenix 24/220

Phoenix 48/220



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# INTRODUCTION

Victron Energy has established an international reputation as a leading designer and manufacturer of energy systems. Our R&D department is the driving force behind this reputation. It is continually seeking new ways of incorporating the latest technology in our products. Each step forward results in value-added technical and economical features.

Our proven philosophy has resulted in a full range of state-of-the-art equipment for the supply of electrical power. All our equipment meets the most stringent requirements.

Victron Energy energy systems provide you with high quality AC supplies at places where there are no permanent sources of mains power.

An automatic stand-alone power system can be created with a configuration comprising of a Victron Energy inverter, battery charger and last but not least, batteries with sufficient capacity.

Our equipment is suitable for countless situations in the field, on ships or other places where a mains supply is indispensable.

Victron Energy has the ideal power source for all kinds of electrical appliances used for household, technical and industrial purposes, including instruments susceptible to interference. All of these applications require a high quality power supply in order to function properly.

## **Victron Energy Phoenix sinewave inverter**

This manual contains instructions for installing the Phoenix 12/220, Phoenix 24/220 and Phoenix 48/220 sinewave inverters. It describes the functionality and operation of the Phoenix inverter, including its protective devices and other technical features.

Note: where the abbreviation 'Ph' is used please read 'Phoenix' instead.

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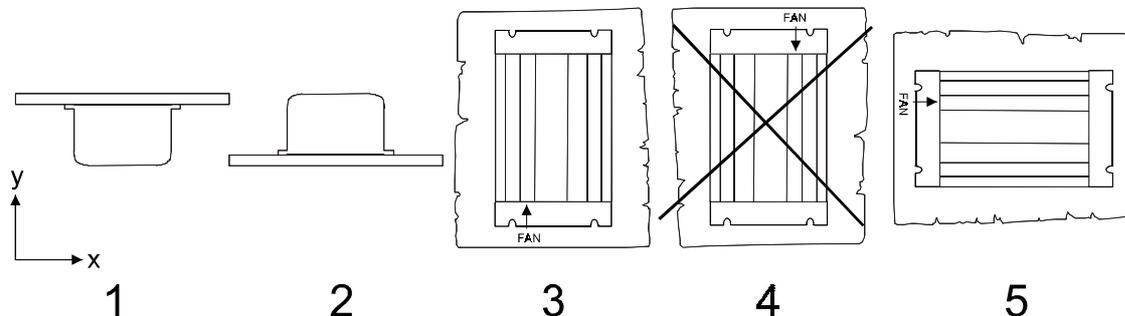
# 1. PRECAUTION STATEMENTS

 WARNING	 CAUTION
<p>This unit produces high voltages during operation. Do not open the inverter. Use the enclosed IEC320 connector to connect the load.</p> <p>Do not connect any other AC generators, like the public grid, to the inverter. Immediate inverter destruction will occur.</p> <p>Apply correct polarity of the battery wires to the inverter (Red to '+' and Black to '-'). Reverse polarity connection will blow an internal fuse so that the inverter has to be returned for service.</p> <p>Avoid any contact with water on the inverter. Do not expose the inverter to rain or moisture.</p> <p>Never use the inverter at locations where there is gas or explosion danger. Like for example directly on top of batteries.</p> <p>If the inverter jumped into an error mode due to an overload or short circuit, it automatically restarts after about 18 seconds. In case of a high temperature error, automatic restart will occur after the inverter has cooled down to an acceptable temperature. Never service the AC connections when the inverter is still running in an error mode or when the inverter is still connected with a DC supply/battery/battery charger.</p>	<p>Opening the inverter, making changes / modifications to the inverter and improper installation of the inverter, will directly void the warranty and manufacturer's responsibility.</p> <p>Do not obstruct the airflow around the inverter. Leave at least 10 cm clearance around the inverter. Do not place items on or over the inverter and do not expose the inverter to high temperature environments. Ambient temperature should be between 0 °C and 40 °C (humidity &lt;95% non condensing). Note that in some extreme situations the inverter's case temperature can exceed 70 °C.</p> <p>Do not expose the inverter to dusty environments.</p> <p>The inverter's case is directly connected to the outlet earth terminal. The DC input wires are not directly connected to the inverter's case.</p> <p>For optimum safety we recommend to install a GFI (Ground Fault Interruptor) on the inverter output.</p> <p>Follow the installation guideline of chapter 2 when installing this inverter.</p> <p>Do not install directly above the batteries, sulphur fumes from the batteries will damage (corrode) the electronic components.</p>

## 2. INSTALLATION

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### 2.1 Location of the inverter



- |   |  |  |
|---|--|--|
| 1 | Ceiling mounting (inverted).           | <b>OK</b>  |
| 2 | Base mounting.                         | <b>OK</b>  |
| 3 | Vertical wall mounting, fan at bottom. | <b>OK</b> (beware of small objects falling through the ventilation openings on top). |
| 4 | Vertical wall mounting, fan on top.    | <u>Not recommended</u>   |
| 5 | Horizontal wall mounting.              | <b>OK</b>  |

### 2.2 Connection to the battery

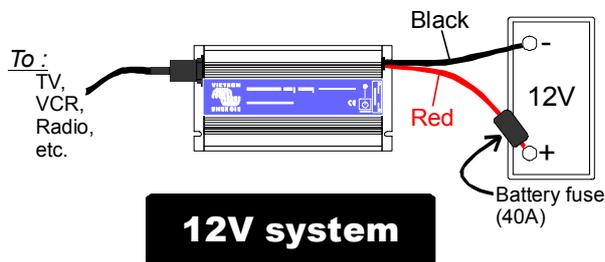
The Ph 12/220 is equipped with two 4mm<sup>2</sup> wires, and the Ph 24/220 and Ph 48/220 are equipped with two 2.5mm<sup>2</sup> wires with a length of 1.25 meters. If it is unavoidable to extend these wires, use a wire gauge of at least 1.5 times larger than the ones supplied with the inverter. Maximum recommended battery wire length is approx. 3 meters.

Please follow the step by step installation guideline below. Make sure you are aware of your local electrical regulations when installing this inverter.

- 1) Unpack the inverter and check for any physical damage. If the unit has any physical damage inform your dealer within 3 days after receipt. Installing a damaged unit is not advisable.
- 2) Check the inverter's top and bottom stickers to confirm if the input and output voltages are according to your requirements. For example, connecting a 12V unit to a 24V or 48V battery will immediately destroy the inverter.

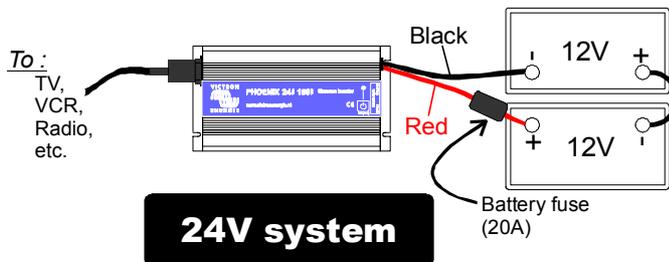
- 3) The inverter must be placed on a flat surface and can be mounted in the position as mentioned in section 2.1. The environment in which the inverter will be installed, must meet the Precaution statements mentioned on chapter 1. The inverter can be mounted with four (Ø 4.5mm max) screws using the outside U-holes.
- 4) Battery connection. Before you connect the battery make sure the AC outlet is safely connected to the load (TV, VCR, radio etc.), or that nothing at all is connected to the output. In any case make sure that no loose wires are connected to the inverter's AC output in some way. **Note that the inverter immediately starts after battery connection!**

For 12V systems connect the inverter as follows:



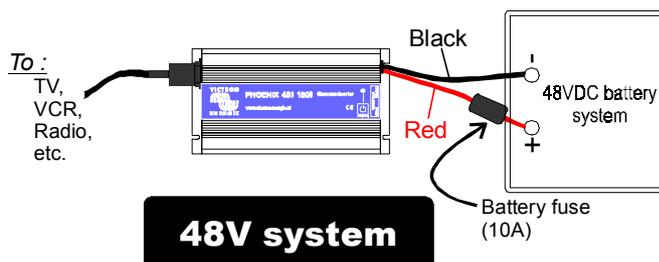
Minimum battery capacity should be 50Ah. Make sure you connect the RED wire to the positive (+) terminal of the battery and the BLACK wire to the negative (-) terminal.

For 24V systems connect the inverter as follows:



Minimum battery capacity should be 30Ah. Make sure you connect the RED wire to the positive (+) terminal of the battery and the BLACK wire to the negative (-) terminal.

For 48V systems connect the inverter as follows:



Minimum battery capacity should be 20Ah. Make sure you connect the RED wire to the positive (+) terminal of the battery and the BLACK wire to the negative (-) terminal.

When you want to attach a 12V universal car plug to the Phoenix12/220 battery wires make sure that you use the correct polarity. Usually the plug's tip is positive (+) and the sleeve is negative (-), but this still has to be checked before connecting it.

It is not advisable to extend the battery wires. Extending these wires may cause additional losses and/or inverter malfunctioning. If it is unavoidable to extend these wires, use a wire gauge of at least 1.5 times larger than the standard wire gauge. Maximum recommended battery wire length is approx. 3 meters.

When the battery is connected to the inverter, the output voltage will be present on the AC outlet and the red indicator light is on.

## **2.3 General precautions when working with batteries**

1. Working in vicinity of a lead acid battery is dangerous. Batteries can generate explosive gases during operation. Never smoke or allow a spark or flame in the vicinity of a battery. Provide sufficient ventilation around the battery.
2. Wear eye and clothing protection. Avoid touching eyes while working near batteries. Wash your hands when done.
3. If battery acid contacts skin or clothing, wash immediately with soap and water. If acid enters eye, immediately flood eye with running cold water for at least 15 minutes and get medical attention immediately.
4. Be careful when using metal tools in vicinity of batteries. Dropping a metal tool onto a battery might cause a short-circuited battery and, possibly an explosion.
5. Remove personal metal items such as rings, bracelets, necklaces, and watches when working with a battery. A battery can produce a short-circuit current high enough to melt a ring or the like to metal, causing severe burns.

## 3. INVERTER OPERATION DETAILS

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### 3.1 Connecting the load

Before you connect your appliance(s) to the inverter output, always check if the total power consumption does not exceed 175W. The Phoenix 220VA inverters are able to supply more than 175W for a limited amount of time, with a maximum peak power of approx. 400W. Some equipment like compressors or pumps are needing much more power at start-up than  $P_{nom}$ . Using equipment with a bad power factor (or  $\cos \phi$ ), like most Personal Computers, reduces the inverters maximum output power somewhat.

At higher ambient temperatures ( $>25\text{ }^{\circ}\text{C}$ ) the overload capacity of the inverter is reducing.

Never connect the inverter's output to the AC distribution grid, like your household AC wall outlet. This will damage the inverter.

### 3.2 The multi function on/off/economy switch

The Phoenix inverters are equipped with a multi function on/off/economy switch indicated by the symbol . The main function of this switch is to activate or deactivate the inverter. When the inverter is activated, the red indicator LED is on. When you are not using the inverter, it is advisable to deactivate it in order to save energy from your batteries.

These inverters are equipped with a “stand-by” switch instead of an on/off switch, which disconnect the supply voltage to the control circuit. The internal micro-processor goes into a “sleepmode” when the switch is pressed. This means that there will allways flow a small current to the inverter when it is switched “off”.

It is advisable to disconnect the inverter from it's dc-supply when it is switched off for a longer time.

The on/off/economy switch can also be used to set the inverter in the so-called “economy” mode. To activate this mode make sure the inverter and the AC load are turned off. Then press the on/off/economy switch for 3 seconds until the red indicator LED starts flashing.

When you want to go back to a normal operating mode, just deactivate and activate the inverter again by pushing the on/off/economy switch twice. For further details about the economy mode read chapter 3.3.

### 3.3 The economy mode

To save battery energy when the inverter is running without any load, the Phoenix 220VA inverters are equipped with an economy mode. By activating this mode, the inverter will generate a test pulse once per second to see if there's a load connected or not. Between these testpulses the inverter is sleeping, which drastically reduces it's own power consumption.

When a load is detected (for example by turning on your TV) the inverter will automatically jump to a normal mode and will supply continuous power to the load. If you turn off or disconnect the load again, the inverter will jump back to economy mode after about four seconds (red indicator LED is flashing).

For correct operation of the economy mode make sure the load to be detected is at least 15W. Smaller loads (<10W at 12V and <15W at 24V or 48V) cannot be detected so that normal mode is advised.

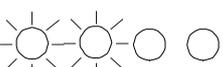
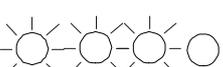
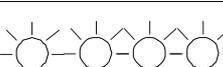
## 4. TROUBLESHOOTING

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### 4.1 The flash sequence table

Your Phoenix inverter is equipped with a self-diagnosis system, to inform you about the cause of inverter shut down. To make this visible the red error/power LED on the front panel of the inverter, can flash in four different sequences. The duration, or time period, of this sequence is about 1 second. During this time period, the red LED can flash four times in a row at most. The number of flashes in this time period indicates the cause of inverter shut down.

In the table below, you can find out what kind of flashing sequence belongs to which error.

Time period ↔	ERROR/ALARM TYPE
	Battery voltage too low or too high ( One flash per second )
	Overloaded or shorted output ( Two flashes per second )
	Inverter temperature too high. Cooling down ( Three flashes per second )
	Inverter in economy mode ( Flashes continuously )

Red LED conditions:

-  =LED flashing
-  =LED ON
-  =LED OFF

All Phoenix 220VA models:  
 → ON, inverter in normal operation

All Phoenix 220VA models:  
 → OFF, inverter in standby mode

## 4.2 The indicator modes

To get optimal feedback from your inverter, the red indicator LED has six different modes of operation:

*Off:* Inverter is turned off, no AC present on the output.

*On:* Inverter is activated, 230V (or 115V) AC is present on the output.

*One flash per second: (battery error)* Inverter turned off due to a too low or too high battery voltage. No AC present on the output. Inverter restarts automatically when the battery voltage reaches a normal level.

*Two flashes per second: (overload error)* Inverter turned off due to an overload or short circuit on the output. No AC present on the output. Inverter tries to restart after approx. 18 seconds!

*Three flashes per second: (high temperature error)* Inverter turned off due to a too high temperature of the unit. No AC present on the output. Inverter automatically restarts after it is cooled down sufficiently.

*Continuous flashing: (economy mode)* Inverter operates in economy mode and is seeking for a load by generating a test pulse every second. AC periodically present on the output.

**Do not service the AC output when the inverter operating in any mode (normal, error or economy)! AC lines may only be serviced when the battery is fully disconnected from the inverter!**

## 4.3 Troubleshooting guidelines

<b>PROBLEM : Inverter is not working (red indicator LED OFF)</b>	
<b><i>Possible cause :</i></b>	<b><i>Remedy :</i></b>
Poor contact between the inverter's battery wires and the battery terminals.	Clean battery terminals or inverter wire contacts. Tighten battery terminal screws.
Blown inverter fuse.	The Ph 12/220, Ph 24/220 and Ph 48/220 has to be returned for service.
Very poor battery condition.	Replace battery.

**PROBLEM : ‘Battery voltage too low or too high’ error keeps on appearing**

<i>Possible cause :</i>	<i>Remedy :</i>
Poor battery condition.	Replace battery or charge it first.
Poor connection or inadequate wiring between battery and inverter, resulting in too much voltage drop.	When extending the battery wires of the inverter make sure you use the correct wire gauge ( $\geq 1.5$ times larger than the fixed battery wires). It is not advisable to extend the battery wires to more than 3 meters.
General failure in your electrical system (in case of no direct battery connection).	Check your electrical system or consult an electrical engineer to check it for you.

**PROBLEM : ‘Overloaded or shorted output’ error keeps on appearing**

<i>Possible cause :</i>	<i>Remedy :</i>
Inverter is overloaded.	Make sure that the total power rating of the connected equipment is lower than the nominal inverter power rating.
Connected equipment features a bad power factor ( $\cos \varphi$ at sinusoidal currents).	Reduce the required power consumption of the load. Please note that, for example, a computer load features a bad power factor, which causes a reduction of the maximum output power of the inverter by approx. 20%.
Connected equipment causes a short circuit at the inverter’s output.	Make sure that the connected equipment is not broken or malfunctioning. Check if the AC power cord between the inverter and the connected equipment is OK. Any physical damage on the power cord can produce a short circuit. <i>Be careful in these situations!</i>

**PROBLEM: 'Inverter temperature too high. Cooling down' error keeps on appearing**

<i>Possible cause :</i>	<i>Remedy :</i>
Airflow around the inverter is obstructed.	Make sure there is at least 10 centimetres of clearance around the inverter. Remove any items placed on or over the inverter. Keep the inverter away from direct sunlight or heat producing equipment.
Too high ambient temperature.	Move the inverter to a cooler place or provide additional cooling by an external fan.

*Note: Don't turn-off the inverter when it's operating in an 'Inverter temperature too high. Cooling down' error. The inverter needs this error time to cool down.*

If none of the above remedies helps to solve the problem you encounter, contact your local Victron Energy distributor for further help and/or possible repair of your inverter. Do not open the inverter yourself, there are dangerous high voltages present inside. Opening the inverter will directly void your 12 months warranty period.



## 5. TECHNICAL DATA

### 5.1 Phoenix 12/220, 24/220 and 48/220

<b>TECHNICAL DATA</b>			
	Ph 12/220	Ph 24/220	Ph 48/220
Cont. output at 25°C <sup>4)</sup>	220VA	220VA	220VA
Cont. output power at 25°C <sup>1)</sup>	175W	175W	175W
Cont. output power at 40°C <sup>1)</sup>	150W	150W	150W
Peak power	350W	400W	400W
Output voltage	230Vac ± 2% [or 115Vac ± 2% ]		
Output frequency	50Hz ± 0.05% [or 60Hz ± 0.05%]		
Output waveform	True sinewave		
Total harmonic distortion	Maximum 5% <sup>3)</sup>		
Admissible cos φ of load	0.6 - 1		
Input voltage :			
Nominal	12Vdc	24Vdc	48Vdc
Range	10.5 <sup>2)</sup> - 15.5Vdc	21 <sup>2)</sup> - 31Vdc	41 <sup>2)</sup> - 59.5Vdc
Maximum efficiency	90%	91%	93%
No load power consumption [economy]	< 2.5W [0.5W]	< 3W [0.8W]	< 4W [1.2W]
Operating temperature range (ambient)	0 .. 40 °C		
Protections against	Short circuit, overload, high temperature and low battery voltage		
Indications (through different red indicator LED conditions)	Power on, economy mode, short circuit/overload, high temperature and high/low battery voltage		
economy threshold	Pout = 10W	Pout = 15W	Pout = 15W
DC input connection	Two wires, length 1.25 meters, Ø 2.5mm <sup>2</sup> (12V= Ø 4 mm <sup>2</sup> )		
AC output connection	IEC-320 AC outlet		
Enclosure body size (l x h x w)	187 x 71 x 110 [without mounting brackets]		
Protection class	IP20		
Total weight	2.1 kg	2.1 kg	2.3 kg
The inverter complies with the following standards :	EN50081-1 Generic Emissions Standard EN50082-1 Generic Immunity Standard EN60950 Safety Standard EN60742 Transformer Standard		

*Note: the given specifications are subject to change without notice*

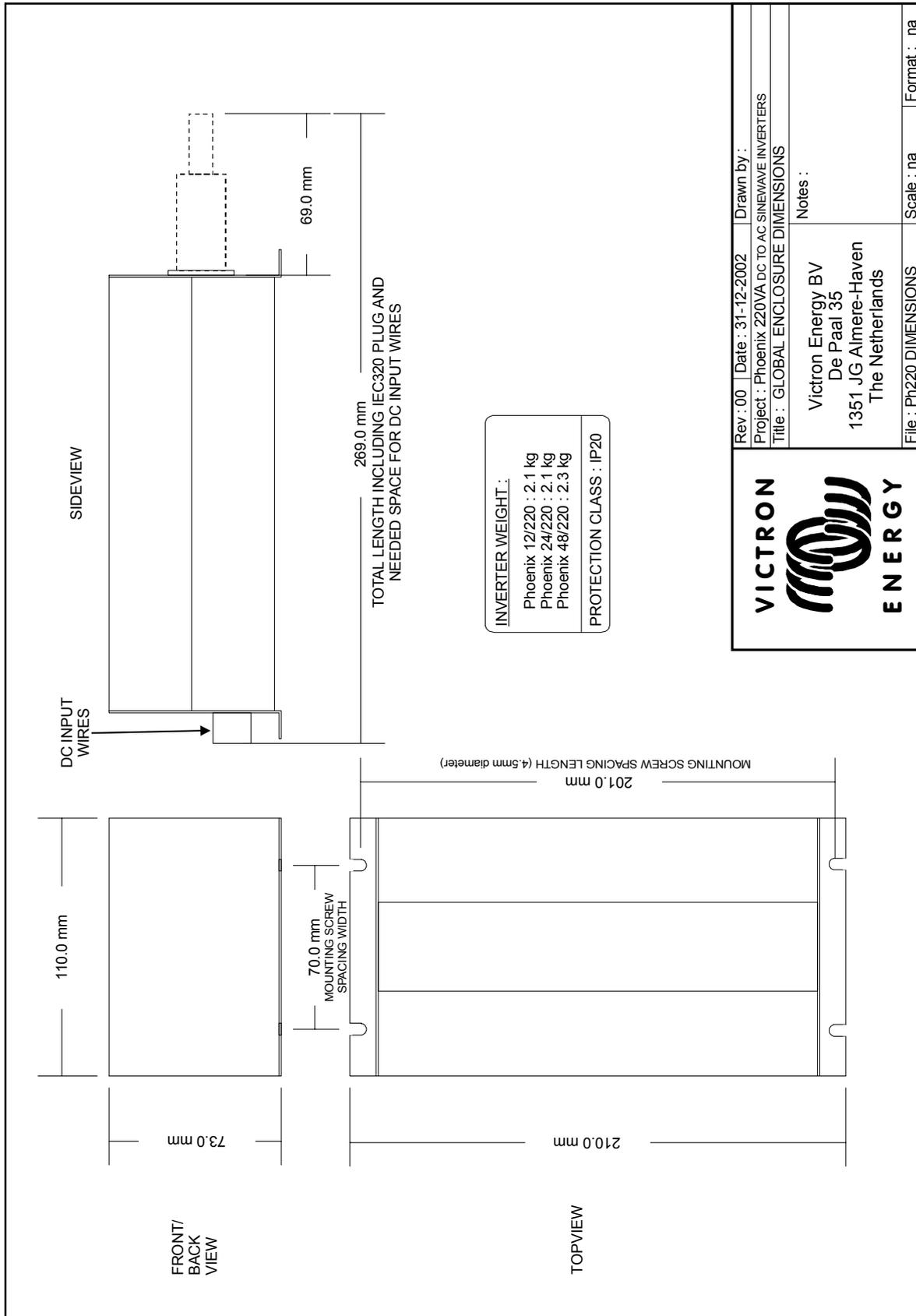
<sup>1)</sup> Measured with resistive load

<sup>2)</sup> Undervoltage limit is dynamic. This limit decreases with increasing load to compensate the voltage drop across cables and connections.

<sup>3)</sup> Measured with nominal load Ta=25°C and by nominal input and output voltage.

<sup>4)</sup> Non linear load, crest factor 3:1.

## 5.2 Global enclosure dimensions



## 6. BATTERY CAPACITY

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### 6.1 Calculation of the minimum required battery capacity

If the power ratings of the equipment to be powered by the Phoenix inverter and the duration that the inverter is expected to power the equipment are known, the minimum battery capacity can be calculated.

Make a list of all equipment to be powered by the Phoenix inverter and sum up each single power consumption multiplied by the duration of time in hours, during which power will be consumed (Watt-hours). Add the internal loss of the Phoenix inverter.

The calculation on the internal loss is a two step process. First we calculate the loss when the inverter is supplying power to a load. The efficiency of the inverter in this state is 85%, adding roughly 15% to the power consumption. When the inverter is not supplying power to a load, power consumption is approximately 4.5 W.

Determine the number of Ah by dividing the power consumption by the nominal battery voltage (for example 24 Vdc). The result is the total battery capacity-consumption in Ah's. Multiply this value with a safety factor of 1.7 and the result is the recommended minimum battery capacity.