victron energy

USER MANUAL
GEBRUIKSAANWIJZING
MODE D'EMPLOI
BEDIENUNGSANLEITUNG

Phoenix 12/220
Phoenix 24/220
Phoenix 48/220
Phoenix 12/300
Phoenix 24/350

CE

VICTRON ENERGY B.V. MAKES NO WARRANTY, EITHER EXPRESSED OR IMPLIED, INCLUDING BUT NOT LIMITED TO ANY IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE, REGARDING THESE VICTRON ENERGY PRODUCTS AND MAKES SUCH VICTRON ENERGY PRODUCTS AVAILABLE SOLELY ON AN "AS-IS" BASIS.

IN NO EVENT SHALL VICTRON ENERGY B.V. BE LIABLE TO ANYONE FOR SPECIAL, COLLATERAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES IN CONNECTION WITH OR ARISING OUT OF PURCHASE OR USE OF THESE VICTRON ENERGY PRODUCTS. THE SOLE AND EXCLUSIVE LIABILITY TO VICTRON ENERGY B.V., REGARDLESS OF THE FORM OF ACTION, SHALL NOT EXCEED THE PURCHASE PRICE OF THE VICTRON ENERGY PRODUCTS DESCRIBED HERE IN.

For conditions of use and permission to use this manual for publication in other than the English, Dutch, French or German language, contact Victron Energy B.V.

Victron Energy B.V. reserves the right to revise and improve its products as it sees fit. This publication describes the state of this product at the time of its publication and may not reflect the product at all times in the future.

SECTIONS Page

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 mobile 230 or 115 $Volt_{AC}$ power 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.

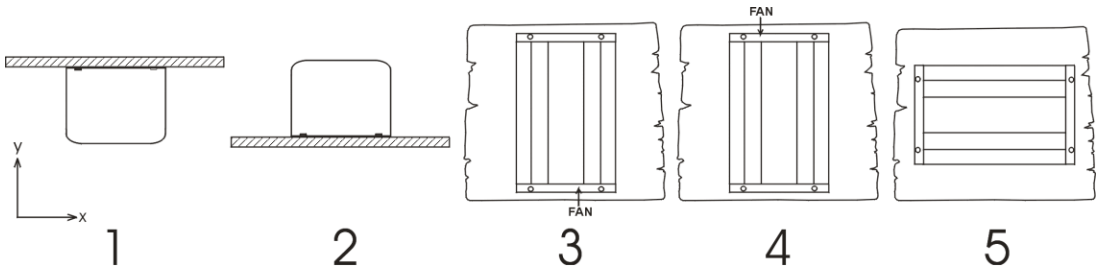
Victron Energy Phoenix sinewave inverter
This manual contains instructions for installing the Ph 12/220, Ph 24/220, Ph 48/220, Ph 12/300 and Ph 24/350 sinewave inverters. It describes the functionality and operation of the Phoenix inverter, including its protective devices and other technical features.

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

CONTENTS

1. INSTALLATION

1.1 Location of the inverter



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

For best operating results, the inverter should be placed on a flat surface. To ensure a trouble free operation of the inverter, it must be used in locations that meet the following requirements:

a) Avoid any contact with water. Do not expose the inverter to rain or moisture.
b) Do not place the unit in direct sunlight. Ambient air temperature should be between 0 °C and 40 °C (humidity < 95% non condensing). Note that in extreme situations the inverter's case temperature can exceed 70 °C.
c) Do not obstruct the airflow around the inverter. Leave at least 10 centimetres clearance around the inverter. When the inverter is running too hot, it will shut down. When the inverter has reached a safe temperature level the unit will automatically restart again.

1.2 Battery requirements

For correct operation, the battery voltage should be between 0.92xVnom and 1.25xVnom where Vnom is 12V or 24V depending on the model, and must be able to supply sufficient current to your inverter. The following table displays the recommended battery capacity per inverter type :

Inverter type :	Iin at Pnom :	Recommended battery capacity:
Ph 12/220	18 Adc	≥ 50Ah
Ph 24/220	9 Adc	≥ 30Ah
Ph 48/220	4 Adc	≥ 20Ah
Ph 12/300	26 Adc	≥ 100Ah
Ph 24/350	15 Adc	≥ 60Ah

The inverter shuts down when the battery voltage is below 0.88xVnom or above 1.3xVnom. In a low or high battery situation the inverter generates one beep per second.

THE Ph 12/220 and Ph 12/300 MUST BE CONNECTED ONLY TO A 12V BATTERY.
The inverter will not operate from a 6V battery. The inverter will be damaged when the battery voltage is higher than 24V.

THE Ph 24/220 and Ph 24/350 MUST BE CONNECTED ONLY TO A 24V BATTERY.
The inverter will not operate from a 12V battery. The inverter will be damaged when the battery voltage is higher than 31V.

THE Ph 48/220 MUST BE CONNECTED ONLY TO A 48V BATTERY.
The inverter will not operate from a < 40V battery. The inverter will be damaged when the battery voltage is higher than 60V.

1.3 Connection to the battery

The Ph 12/220, Ph 24/220, Ph 48/220, Ph 12/300 and Ph 24/350 are equipped with two 4 mm² wires with a length of 1.5 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.

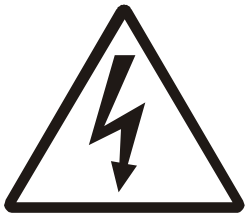
1.3.1 General precautions when working with batteries

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-circuit 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.

THE RED WIRE MUST BE CONNECTED TO THE POSITIVE (+) TERMINAL AND THE BLACK WIRE TO THE NEGATIVE (-) TERMINAL OF THE BATTERY.
Reverse polarity connection of the battery wires can damage the inverter!
Damage caused by reversed polarity is not covered by the warranty. Make sure the power switch is in the OFF ‘0’ position before connecting the battery.

1.4 Connecting the load

Before you connect your appliance(s) to the inverter, always check it's maximum power consumption. Do not connect appliances to the inverter needing more than the nominal power rating of the inverter continuously. Some appliances like motors or pumps, draw large inrush currents in a start-up situation. In such circumstances, it is possible that the start-up current exceeds the overcurrent trip level of the inverter. In this case the output voltage will quickly decrease to limit the output current of the inverter. If the overcurrent trip level is continuously exceeded, the inverter will shut down and restart within 18 seconds. In this case it is advisable to disconnect the appliance from the inverter, since it requires too much power to be driven by this inverter. Note that at higher ambient temperature levels, the overload capacity of the inverter is reduced.



WHEN CONNECTING MORE THAN ONE APPLIANCE TO THE INVERTER, IN COMBINATION WITH A COMPUTER, NOTE THAT IF ONE OF THE APPLIANCES DRAWS A HIGH START CURRENT, IT CAN CAUSE YOUR COMPUTER TO REBOOT DUE TO A SUDDEN VOLTAGE DROP.

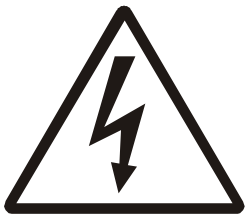
NEVER CONNECT THE INVERTER'S OUTPUT TO THE AC DISTRIBUTION GRID, SUCH AS YOUR HOUSEHOLD AC WALL OUTLET. IT WILL DAMAGE THE INVERTER.

1.5 Turning the inverter on

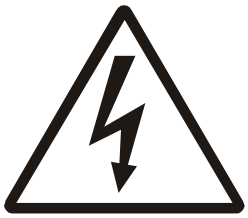
When all the above requirements are checked and satisfied and all connections are made, it's time to turn on your Phoenix inverter by pushing the power switch to the ' **I** ' position (see top label for push direction). After a short two tone beep, indicating that all internal circuits are checked, the sinewave shaped output voltage gently rises until 230V/50Hz ± 2% is reached.

When the inverter is not supplying power to an appliance for a longer time, it's recommended to use the inverter in the "economy" mode to heavily reduce the inverter's own power consumption. In this case the power switch must be pushed in the ' **II** ' position. In the economy mode the inverter will generate a testpulse on it's output once per second, to check that there is a load applied. When the economy mode is activated (by generating a reversed two tone beep), the indicator LED will be continuously on for 4 seconds while the inverter outputs a continuous 230V (or 115V) sinewave. After this 4 seconds the continuous output will change to a pulsed output, indicated by a flashing indicator LED. When a load is connected to the inverter output (or switched on) drawing more than approx. 12W (or 15W depending on model), the inverter jumps to the continuous mode immediately, delivering power to the load. When the load is disconnected again (or switched off), the indicator LED starts flashing again after 4 seconds, and the inverter jumps back to the pulsed output economy mode. This way the inverter automatically jumps to a low power 'sleep' mode when there is no power demand on the output.

Note that some loads like TV/video equipment (with standby mode) and alarm clocks need continuous power so that the ASB mode can not be used.
With some small non compensated loads, it is possible that the inverter jumps from continuous output to pulsed output and vice versa all the time. In this case you have to connect a small additional load to the AC output.



IF THE INVERTER SWITCHES TO AN 'ERROR MODE' (SEE CHAPTER 2.1) DUE TO AN OVERLOAD OR SHORT CIRCUIT, THE INVERTER WILL AUTOMATICALLY RESTART AFTER ABOUT 18 SECONDS.
In case of an over-temperature error, the inverter will automatically restart after it has reached an acceptable temperature. Just before the inverter restarts, it will warn you with a short beep.
NEVER TOUCH THE AC CONNECTIONS WHEN THE INVERTER IS STILL RUNNING IN AN ERROR MODE!



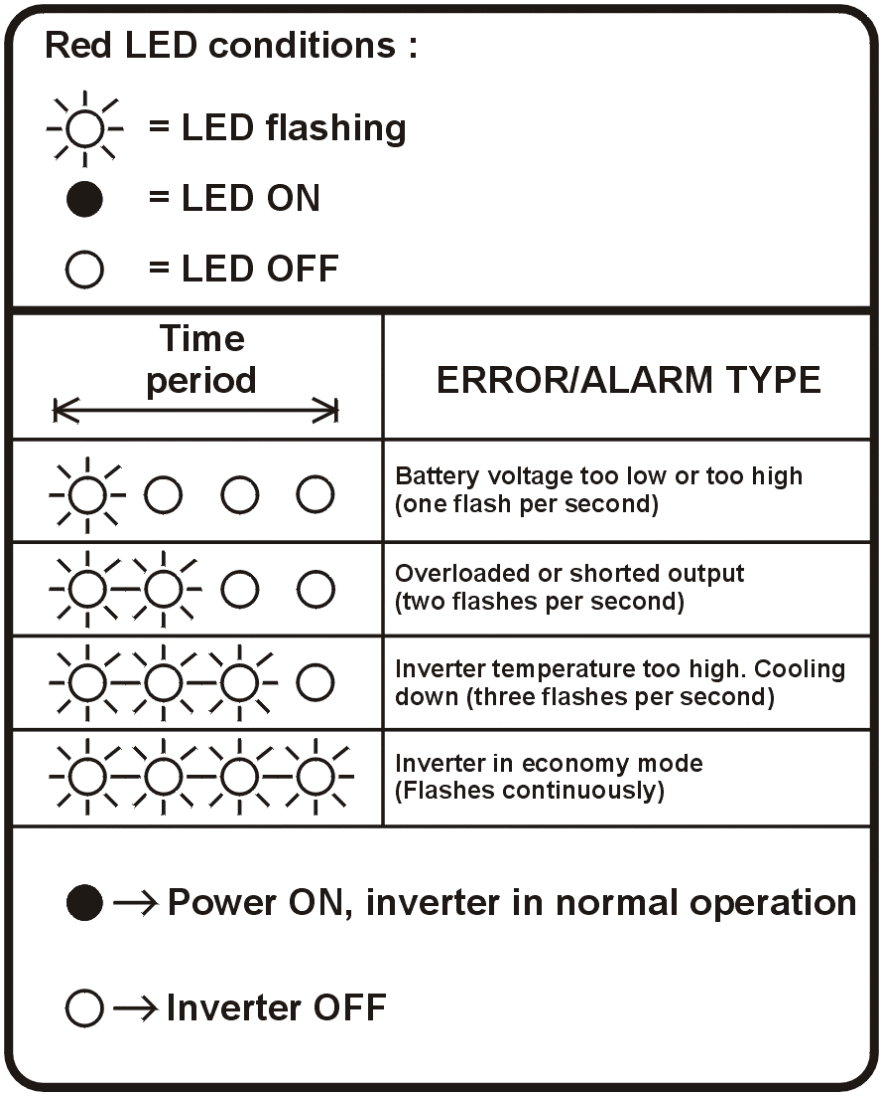
THE BUILT IN LARGE ELECTROLYTIC CAPACITORS CAN HOLD SIGNIFICANT DC VOLTAGE WHEN THE BATTERIES ARE DISCONNECTED.
To avoid sparks or short inverter operation, it is advisable to switch on the inverter for 10 seconds after battery disconnection, before you transport the inverter.

2. TROUBLESHOOTING

2.1 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 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.



2.2 Acoustic messages

The inverter is equipped with an acoustic alarm.
There are three kinds of acoustic messages depending on the possible cause of inverter shutdown. These messages are related to the red LED flashing sequences mentioned previously.

Message 1: **One beep per second.** The battery voltage has reached too low or too high a level.

Message 2: **Two beeps per second.** The inverter will shut down soon due to an overloaded output. Note that with very heavy overloads the alarm will not sound due to fast inverter shut down.

Message 3: **Three beeps per second.** The inverter will shut down when its temperature has risen another three degrees Celsius.

2.3 Troubleshooting guidelines

PROBLEM : Inverter is not working (red LED OFF)	
Possible cause :	***Remedy :***
Power switch in OFF (0) position.	Push the power switch to the ON (I) position.
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 inverter has to be returned for service.
Very poor battery condition.	Replace battery.

PROBLEM : 'Battery voltage too low or too high' error keeps on appearing	
Possible cause :	***Remedy :***
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 (≥ 1.5 times larger than the fixed battery wires). It's 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	
Possible cause :	***Remedy :***
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 (cosφ 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. *Be careful!*.

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

PROBLEM : Inverter jumps between continuous mode and economy mode all the time	
Possible cause :	***Remedy :***
Connected load is not compensated or the ratio between inrush current and continuous current is too large.	Connect an additional load to the output.

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.

3. TECHNICAL DATA

3.1 Phoenix xx/220

TECHNICAL DATA			
	Ph 12/220	Ph 24/220	Ph 48/220
Cont. output at 25°C [4]	220VA	220VA	220VA
Cont. output power at 25°C [1]	175W	175W	175W
Cont. output power at 40°C [1]	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% [3]		
Admissible cos φ of load	0.6 – 1		
Input voltage :			
Nominal	12Vdc	24Vdc	48Vdc
Range	10.5[2] – 16Vdc	21[2] – 31Vdc	41[2] – 60Vdc
Maximum efficiency	90%	91%	93%
No load power consumption at nominal input voltage [economy]	< 2.8W [0.6W]	< 3W [0.8W]	< 4W [1.2W]
Operating temperature range (ambient)	0 - 40 °C		
Economy threshold	Pout = 12W	Pout = 15W	Pout = 15W
Protections against	Short circuit, overload, high temperature and low battery voltage		
Indications (by pre-programmed flashing sequences of the power LED)	Power on, short circuit/overload, high temperature, high/low battery voltage and economy mode		
DC input connection	Two wires, length 1.5 meters, ∅ 4mm²		
AC output connection	IEC-320 AC outlet		
Enclosure body size (l x h x w)	154 x 98 x 130 (without mounting brackets)		
Protection class	IP20		
Total weight	2.3 kg	2.3 kg	2.4 kg
The inverter complies with the following standards :	EN50081-1 Generic Emissions Standard EN50082-1 Generic Immunity Standard EN60335-2 Safety Standard		

3.2 Phoenix 12/300 and Phoenix 24/350

TECHNICAL DATA		
	Phoenix 12/300	Phoenix 24/350
Cont. output at 25°C [4]	300VA	350VA
Cont. output power at 25°C [1]	250W	300W
Cont. output power at 40°C [1]	230W	275W
Peak power	700W	800W
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% [3]	
Admissible cos φ of load	0.6 – 1	
Input voltage :		
Nominal	12Vdc	24Vdc
Range	10.5[2] – 16Vdc	21[2] – 31Vdc
Maximum efficiency	91%	93%
No load power consumption at nominal input voltage [economy]	< 3W [0.7W]	< 3.5W [0.8W]
Operating temperature range (ambient)	0 - 40 °C	
Economy threshold	Pout = 12W	Pout = 15W
Protections against	Short circuit, overload, high temperature and low battery voltage	
Indications (by pre-programmed flashing sequences of the power LED)	Power on, short circuit/overload, high temperature, high/low battery voltage and economy mode	
DC input connection	Two wires, length 1.5 meters, ∅ 4mm²	
AC output connection	IEC-320 AC outlet	
Enclosure body size (l x h x w)	184 x 98 x 130 (without mounting brackets)	
Protection class	IP20	
Total weight	3.5 kg	3.5 kg
The inverter complies with the following standards :	EN50081-1 Generic Emissions Standard EN50082-1 Generic Immunity Standard EN60335-2 Safety Standard	

Note : the given specifications are subject to change without notice

1) Measured with resistive load.
2) Undervoltage limit is dynamic. This limit decreases with increasing load to compensate the voltage drop across cables and connections.
3) Measured with nominal load at Ta=25ºC and at nominal input and outputvoltage.
4) Non linear load, crest factor 3:1

3.3 Enclosure dimensions Ph xx/220, Ph 12/300 and Ph 24/350

See page 71.

4. BATTERY CAPACITY

4.1 Calculation of the minimum required battery capacity

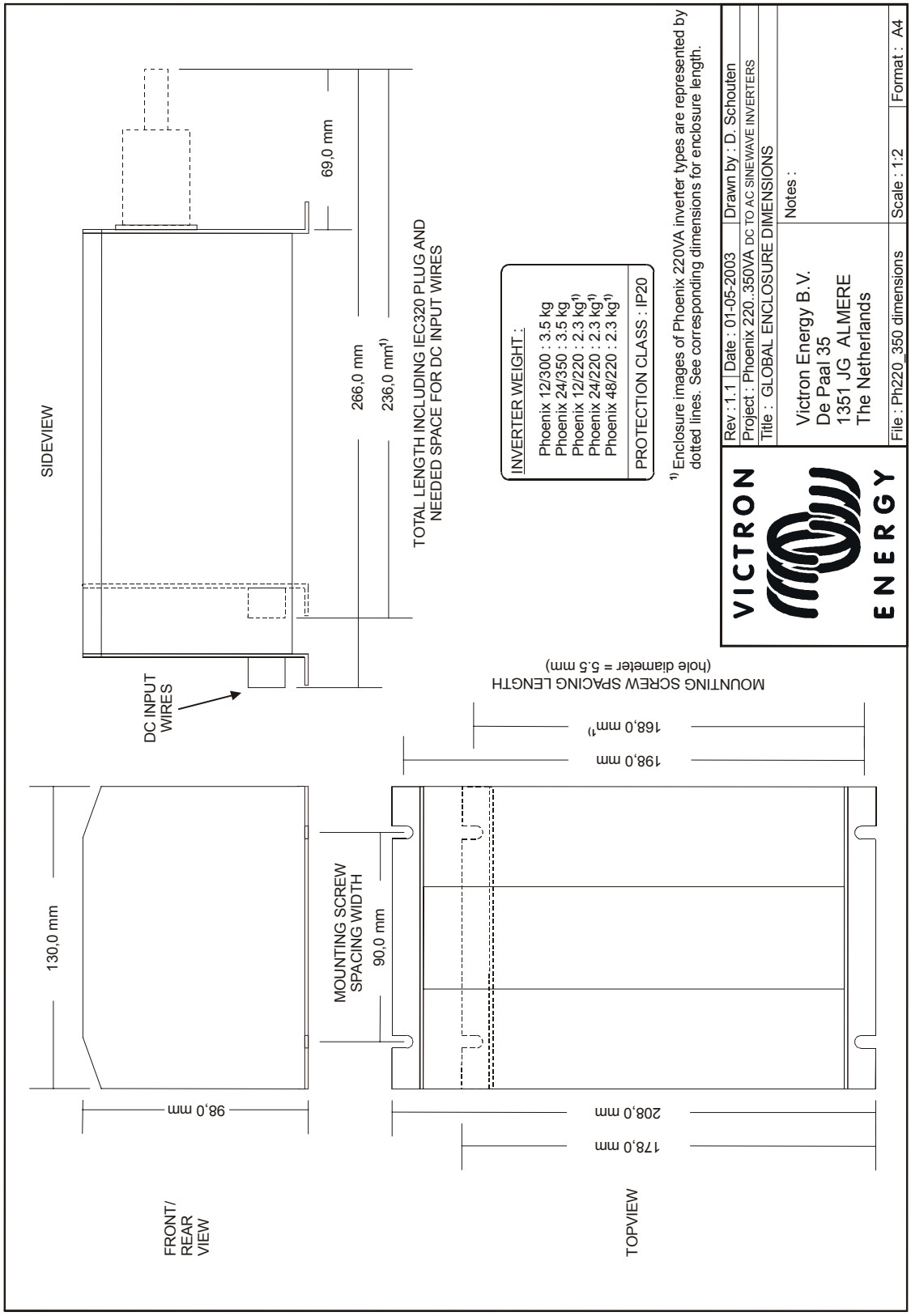
If the power ratings of the equipment to be powered by the Phoenix inverter and the duration that the inverter is expected to power the equipment are known, the minimum battery capacity can be calculated.

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 4W.

Determine the number of Ah by dividing the power consumption by the nominal battery voltage (for example 24 V_{DC}). 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.

3.3 Abmessungen Ph xx/220, Ph 12/300 und Ph 24/350



Stock number:
Dealer:

Victron Energy B.V.
The Netherlands

General phone: +31 - (0)36 - 535 97 00
General and Service fax: +31 - (0)36 - 531 16 66
Sales fax: +31 - (0)36 - 535 97 40

E-mail: sales@victronenergy.com
Internet site: http://www.victronenergy.com

Article Number: ISM010039000
Doc. no. ISM010039000-*-REV00
Version 00
Date 16-06-2003