



victron energy

USER MANUAL GEBRUIKSAANWIJZING

Phoenix 12/300

Phoenix 12/500

Phoenix 24/500

Phoenix 24/900



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victron energy

USER MANUAL

Phoenix 12/300

Phoenix 12/500

Phoenix 24/500

Phoenix 24/900



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 adding of 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 a Victron Energy inverter, battery charger, mains manager (if required) 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 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 Phoenix inverter

This manual contains directions for installing the Phoenix inverter. It describes the functionality and operation of the Phoenix inverter, including its protective devices and other technical features.

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1. DESCRIPTION

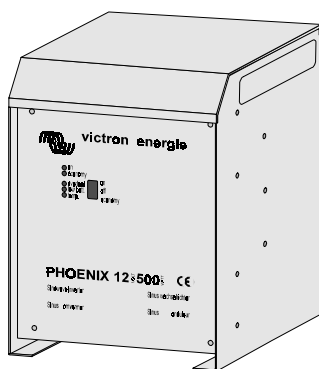
1.1 GENERAL

All Victron Phoenix inverters are tested to ensure correct functioning before leaving the factory. They are packed first in shock-absorbing polystyrene and then in sturdy cardboard boxes for secure transportation.

The Victron Phoenix is housed in a robust aluminum cabinet (IP21) suitable for floor or wall mounting. The AC output terminals, the DC battery terminals and the terminals for a remote control switch (if used) can be reached by opening the front of the cabinet with a screwdriver.

1.2 VICTRON PHOENIX INVERTER

The coding of the Phoenix inverter model is composed as follows:



For example Phoenix 12/500:
'12' = 12 V_{DC} = battery voltage
'500' = 500 W = continuous electrical load

The Victron Phoenix inverter is designed for 12 or 24 V_{DC} battery input voltages and produces a sinusoidal output voltage of 230 V_{AC}, 50 Hz (crystal controlled).

Continuous power can be delivered at all times (see the specifications).

The inverter is developed to serve AC equipment requiring a high quality energy input. That is, when correct functioning is dependent on true sinewave supplies such as: computers, satellite communications equipment, and precision measuring instruments, particularly in mobile applications.

The Phoenix inverter uses high frequency switching techniques in combination with a low frequency transformer resulting in a very high

efficiency for the user. For power consumption in a no-load situation, see section 7.1.

Watt =
unit of power

Volt =
unit of voltage

Volt_{RMS} =
root mean square
(effective value of
alternating wave)

Hertz =
unit of frequency

The power supply of the Phoenix inverter is:

	continuous(1) power	short term (2) power	surge power(3)
Phoenix 12/300	300 W	400 W	1300 W
Phoenix 12/500	500 W	650 W	1350 W
Phoenix 24/500	500 W	750 W	1400 W
Phoenix 24/900	900 W	1000 W	2500 W

- 1. Continuous power: the continuous power at 40°C ambient temperature.
- 2. Short term power: the power during 30 minutes at 40°C ambient temperature.
- 3. Surge power: the power during 3 seconds at 40°C ambient temperature.

2. SAFETY

To protect your equipment and connected loads against internal electronic damage the following built-in safety measures are integrated in the Phoenix inverter.

2.1 SHORT CIRCUIT PROTECTION

*short circuit
current =
current
supplied when
a short-circuit
on the output
occurs.*

The inverter's output is protected against short-circuits. The short-circuit current for the 12V version is $5.5 A_{RMS}$ (approximately). The 24V version have a short circuit current of $11 A_{RMS}$ (approximately).

In this condition the output voltage approaches 0 V. The LED 'overload' will flash for three seconds, after three seconds the LED 'overload' will illuminate

continuously and the inverter switches off. At most 30 seconds after the short-circuit has been removed the inverter resumes normal operation.

2.2 SHORT TERM POWER / SURGE POWER LIMITATION

The Phoenix inverter can deliver a higher short-term power and a surge power for 3 seconds (see section 1.2). This level is electronically limited. When the inverter is overloaded the LED 'overload' will flash. If the overload is too high the inverter will switch off and the LED 'overload' will illuminate continuously.

2.3 TEMPERATURE PROTECTION

The temperature of the electronics is continuously monitored. The inverter switches off before the temperature reaches an unacceptable high level due to output short-circuit, overload or excessive ambient temperatures. The LED 'temp' will flash to indicate that critical temperature is almost reached. If the internal temperature is too high the LED 'temp' will illuminate and the inverter switches off. The inverter restarts automatically once the temperature has dropped to an acceptable level.

2.4 LOW INPUT VOLTAGE PROTECTION

2.4.1 12 Volt_{DC} battery

The inverter switches off if the input voltage drops below 9.6 V_{DC} and restarts once the input voltage has risen above approximately 11.0 V_{DC}.

2.4.2 24 Volt_{DC} battery

The inverter switches off if the input voltage drops below 19.5 V_{DC} and restarts once the input voltage has risen above approximately 22.0 V_{DC}.

2.4.3 Alarm indication 'low batt.'

If the battery voltage is low the LED 'low batt.' will flash. When the battery voltage is too low the inverter will switch off and the LED 'low batt.' will illuminate continuously.

2.5 HIGH INPUT VOLTAGE PROTECTION

2.5.1 12 Volt_{DC} battery

The inverter switches off if the input voltage rises above 17.0 V_{DC} and restarts once the input voltage has dropped below approximately 16.5 V_{DC}.

2.5.2 24 Volt_{DC} battery

The inverter switches off if the input voltage rises above 32.5 V_{DC} and restarts once the input voltage has dropped below approximately 31.0 V_{DC}.

2.6 REVERSED POLARITY

The Victron Energy Phoenix 12/300, 12/500, 24/500 and 24/900 are electronically protected against reverse polarity. Reversing the polarity at the input of these inverters does not damage the inverter in any way. After connecting the battery cables switch the inverter ON. If the inverter does not work, switch it OFF and change the polarity of the battery cables.

2.7 RIPPLE VOLTAGE PROTECTION

The Victron Energy Phoenix 12/300, 12/500, 24/500 and 24/900 are protected against too high ripple voltage at the input. If the rms value of the input voltage-ripple exceeds 10% of the nominal DC input voltage, the inverter will state an alarm; the LED 'low batt.' and the LED 'overload' will flash. If the previous alarm situation is on for a period of over 21 minutes, the inverter will switch off and the following alarm indication can be seen; the LED 'low batt.' and the LED 'overload' illuminate.

The inverter has to be resetted before it will continue operation. Resetting can be done by means of switching the inverter off and on again.

3. INSTALLATION AND CONNECTION

3.1 LOCATION

Install the inverter in a dry area with good ventilation.

NOTE:

High ambient temperatures will impair efficiency and shorten working life or will completely shut the inverter off (see section 7 ‘Specifications’).

There are holes in the bottom and rear of the cabinet enabling floor or wall mounting. For dimensions see section 8 (‘Dimensions’).

Except for the Phoenix 12/300 and the Phoenix 24/500, the inverter has a built in fan. The Phoenix without fan has to be mounted in a vertical position due to natural convection. The Phoenix with fan can be mounted in any position, although it is recommended to mount the unit in a vertical position for optimal cooling. Make sure you will have easy access to the inside of the unit after installation.

Keep the distance between the Phoenix inverter and the battery as short as possible to minimize the losses in the cables.

3.2 INSTALLATION REQUIREMENTS

The Victron Phoenix inverter should be installed with the help of the following equipment:

3.2.1 Installation equipment

- two battery cables (max. length 6 meters, with clamps)
- one spanner or wrench (10 mm or M6), to connect the battery cables.
- one screw driver (no. 1), to connect the 230 V_{AC} cables

3.2.2 Battery cables

The cross sections of the battery cables are suitable for continuous loads and peak loads.

	length 0 - 1.5 meters	length 1.5 - 6 meters
Phoenix 12/300	6 mm ²	10 mm ²
Phoenix 12/500	10 mm ²	16 mm ²
Phoenix 24/500	6 mm ²	10 mm ²
Phoenix 24/900	6 mm ²	10 mm ²

Avoid contact resistances by tightening all connections.

3.3 CONNECTIONS

The connections are an important issue. The connections are situated inside the unit on the PCB (Illustration 1). The battery connections are coded and indicate the positive ('+') and the negative ('-') connections.

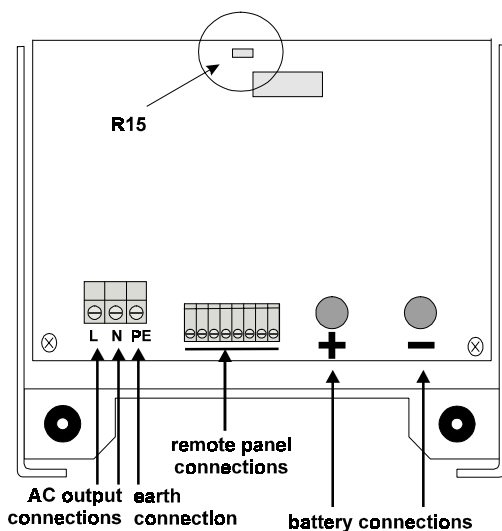
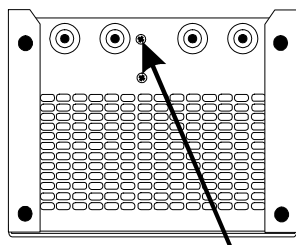


Illustration 1.

Earth connection



Earth connection

Illustration 2.

The ground connection (earth protection conductor) from the mains is located on the AC-terminal block (Illustration 1). The circuit is functional only if the cabinet is connected to earth. A M4 earth screw is fitted in the bottom of the cabinet. Connect the cabinet earth terminal to earth (Illustration 2).

The earth for vessels is the hull or earth plate; for motor vehicles it is the chassis.

3.4 CONNECTING THE BATTERY CABLES

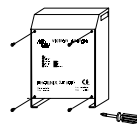
To take full advantage of the Phoenix inverter, particularly under peak/surge load conditions, the inverter should be connected to the battery with special battery cables. See section 3.2.2.

Connection procedure battery cables

The following procedure is to be carried out carefully.

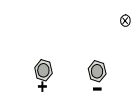
step 1.

Unscrew the four screws of the front panel.



step 2.

Connect the battery cables: the '+' (red) to the left and the '-' (black) to the right.



step 3.

If the DC-input cables to the inverter are connected in reverse polarity (+ on - and - on +), the inverter will not work.

step 4.

If the inverter does not work disconnect the cables and re-connect them correctly.

step 5.

Make sure that the connections are screwed tight; (use a 10 mm or M6 spanner or wrench).

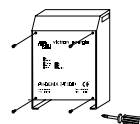
3.5 CONNECTING THE 230 V_{AC} CABLES

The terminal block is located on the PCB (see Illustration 1). The 230 V_{AC} external equipment must be connected to the inverter by means of a three-wire cable. Use a cable with a flexible core and a cross section of 2.5 mm².

Connection procedure 230 V_{AC} cables

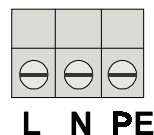
step 1.

Unscrew the four screws of the front panel .



step 2.

The 230 V_{AC} equipment may be directly connected to the connector block on the left side of the PCB, with a three-wire cable. The connections are clearly coded and from left to right they are: 'L', 'N', and 'PE'. The AC output is automatically current limited in the event of a short circuit on the output (see section 2.1).



The inverter will be seriously damaged if an external voltage is connected to the inverter's AC-block. This damage will occur regardless of the switch position of the inverter is 'ON' or 'OFF'.

step 3.

Replace the front panel with the four screws.

3.6 REMOTE CONTROL CONNECTION

Phoenix inverters can be switched ‘on’, ‘off’ and ‘economy’ by remote control. In addition all five indicator LED’s can also be remotely connected. Illustration 3 illustrates how to make the connections. Alternatively a complete remote control panel, incorporating the indicator LED’s and ‘on/off/economy’ switch is available from Victron Energy.

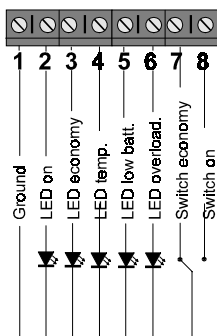
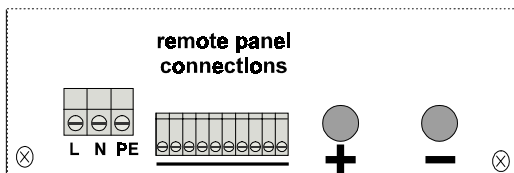


Illustration 3.

3.7 VARIOUS POINTS OF ATTENTION

The rms value of the ripple voltage at the input should be limited to maximum 10% of the DC input voltage.

Never use a battery charger as a power supply for these Victron Energy inverters, unless batteries or a suitable ripple suppressor are connected.

4. OPERATION

4.1 LED INDICATIONS

The switch and LED's are located on the front of the Phoenix inverter (see Illustration 4).

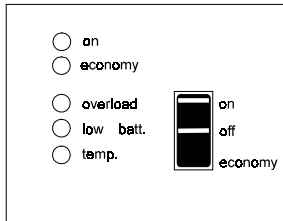


Illustration 4.

LED's:

On = indication when unit is 'ON'.

Economy = indication when unit is in 'economy' mode.

Overload = indication for overload condition.

low batt. = indication for low battery condition.

Temp. = indication for high temperature condition.

4.2 ON/OFF/ECONOMY SWITCH

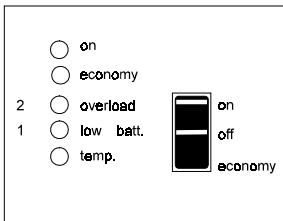


Illustration 5. When switching to 'economy' the led 'economy' will flash. If the load is high enough the inverter will switch on and the led 'economy' and the led 'on' will illuminate. (see section 4.7).

With the 'on/off/economy' switch the inverter switches on, off or in economy mode, (see Illustration 5). When switching to 'ON', the following startup procedure takes place

1. The LED 'low batt' will illuminate for one second;
2. The LED 'on' will illuminate.

4.3 OVERLOAD INDICATION

When the inverter is overloaded, the 'overload' LED will flash. If the overload is too high the inverter will switch off automatically, in this case the LED 'overload' will illuminate continuously. The Phoenix inverter will automatically switch on again after 25 seconds.

4.4 LOW BATTERY INDICATION

The LED 'low batt.' will illuminate and the inverter will switch off, if the input voltage to the inverter is too low due to:

- A discharged battery;
- A relatively low battery capacity with respect to the high loads by which the input voltage is significantly reduced;
- Battery cables are too thin and / or too long.
- Insufficient battery capacity for the high output power of the inverter;
- Poor battery condition.

The inverter will switch 'ON' as the input voltage is increased to within specifications.

4.5 TEMPERATURE INDICATION

The LED 'temp.' will illuminate in the event of high ambient temperatures and when heavily overloaded. The Phoenix inverter will then switch off. As the temperature has dropped to a sufficiently low level, the inverter will automatically switch on again.

4.6 ADJUSTMENTS

To adjust output voltage, open the Phoenix inverter cabinet, by loosening the four screws on the front, and removing the front panel (see Illustration 6).

It will be necessary to remove the dripshield and top plate to gain access to the adjustment potentiometers.

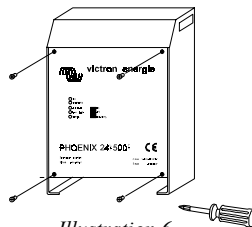


Illustration 6.

4.6.1 Adjusting output level

The output voltage is factory set to approximately 230 V_{AC}. In the event one wishes to change that value it can be adjusted with potentiometer R15 (see Illustration 1 section 3.3), that permits an adjustment of approximately + 5% and – 20%. Refit the top plate, dripshield and front.

4.6.2 Unloaded output voltage

The unloaded output voltage of the Phoenix inverter is approximately 230 V_{AC}.

4.7 ECONOMY MODE

When the inverter is switched in 'economy' mode (bottom position of the switch), the yellow LED 'economy' flashes to indicate that the economy mode has been activated. The inverter starts as soon as the load at the output exceeds 26 Watt. The green LED 'on' lights up and the yellow LED 'economy' will also light up continuously. The inverter switches back to the 'economy' mode as soon as the load drops below 13 Watt. The yellow LED 'economy' flashes again and the green LED 'on' is off.

4.8 MAINTENANCE

Phoenix inverters do not require any specific maintenance other than a yearly inspection of the connections. Keep the unit dry and as clean as possible.

5. BATTERY CAPACITY

If the power ratings are known of the equipment to be powered by the Phoenix inverter and the duration that the inverter is expected to power the equipment for, 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 8.5W in 'on' mode or 2.5W in 'economy' mode.

Determine the number of Ah by dividing the power consumption by the nominal battery voltage (for example 24 V_{DC}). The result is the electrical consumption in Ah's. 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.

Example with a Victron Energy Phoenix 24/500 inverter:

Equipment	Power	Number of hours on	Consumption
Colour TV	100 W	4	400 Wh
VHS-recorder	50 W	4	200 Wh
Hi-fi equipment	50 W	4	200 Wh
Lights	100 W	4	400 Wh
Computer	100 W	3	<u>300 Wh</u>

Consumption: **1500 Wh**

Internal loss of the inverter supplying the load (15% of 1500Wh) 225 Wh

Internal loss of the inverter not supplying a load for 12 hours

(12 hours x 8,5 W) 102 Wh

Total power consumption **1827 Wh**

Total battery capacity-consumption in Ah (1827/24 Volt): **76 Ah**

Daily use safety factor Required in Ah

76 Ah x 1,7 = 129Ah

The result is, with a requirement of 129 Ah; the battery should have a minimum capacity of 130 Ah. This example is suitable for a standard lead-acid battery.

For 'sealed' and 'gel' batteries the recommended safety factor can be as low as 1.3, permitting a smaller battery capacity. Please consult your battery manufacturer's specifications.

6. FAULT TRACING LIST

6.1 GENERAL

This list will facilitate the rapid tracing of the most common types of faults.

Before performing checks on the inverter you must disconnect all other 12V_{DC} or 24 V_{DC} equipment from the batteries.

6.2 TROUBLE SHOOTING

If the fault cannot be solved, consult your Victron Energy dealer.

Problem	Possible cause	Solution
The inverter does not work when switched on:	The input voltage is too high or too low.	Make sure that the input voltage is within the correct values, see section 7 for these values.
	The plus '+' and the minus '-' of the batteries and the inverter do not correspond.	Switch the inverter off and connect the battery correctly.
The LED 'low batt.' flashes:	The battery voltage is low.	Recharge the batteries or check the battery connections.
The LED 'low batt.' illuminates:	The inverter is switched off because the battery voltage was too low.	Recharge the batteries or check the battery connections.
The LED 'overload' flashes:	The load connected to the inverter is higher than the nominal load.	Disconnect a part of the load.
The LED 'overload' illuminates:	The inverter is switched off due to a too high load.	Disconnect a part of the load.

Problem	Possible cause	Solution
The LED 'temp.' flashes:	The ambient temperature is high, or the temperature of internal components is high or the load is too high.	Place the inverter in a cool well-ventilated place, or disconnect a part of the load.
The LED 'temp.' illuminates:	The inverter is switched off due to a too high ambient or component temperature or the load is too high.	Place the inverter in a cool well-ventilated place, or disconnect a part of the load.
The LED's 'low batt.' and 'overload' are flashing:	Low battery voltage and too high load or the ripple voltage at the input exceeds 10%.	Recharge the batteries, disconnect a part of the load, or place a ripple suppressor and/or batteries with a higher capacity. Mount shorter and/or thicker battery cables.
The LED's 'low batt.' and 'overload' illuminate:	The inverter is switched off due to a too high ripple voltage at the input.	Place a ripple suppressor and/or batteries with a higher capacity. Mount shorter and/or thicker battery cables and reset the inverter (switch OFF and ON again).
One alarm LED is illuminating and the second one is flashing:	The inverter is switched off due to the alarm indicated by the illuminating LED. The flashing LED indicates that the inverter nearly switched off at that alarm.	Check this table to take actions that correspond to the alarm.

6.3 THE AC OUTPUT VOLTAGE IS TOO LOW

The AC output voltage is too low when measured by means of a RMS voltmeter. Turn potentiometer R15 (see section 4.6, ‘Adjustments’), to the right and check whether the voltage returns to the normal value. If not, contact your Victron Energy dealer to have the inverter repaired.

7. SPECIFICATIONS

7.1 INPUT

Nominal input voltage:

Phoenix 12/300	:	12 Volt _{DC}
Phoenix 12/500	:	12 Volt _{DC}
Phoenix 24/500	:	24 Volt _{DC}
Phoenix 24/900	:	24 Volt _{DC}

Input voltage range:

Phoenix 12/300	:	9,6 – 17,0 Volt _{DC}
Phoenix 12/500	:	9,6 – 17,0 Volt _{DC}
Phoenix 24/500	:	19,5 – 32,5 Volt _{DC}
Phoenix 24/900	:	19,5 – 32,5 Volt _{DC}

Switch-on voltage (low):

Phoenix 12/300	:	11,0 Volt _{DC}
Phoenix 12/500	:	11,0 Volt _{DC}
Phoenix 24/500	:	22,0 Volt _{DC}
Phoenix 24/900	:	22,0 Volt _{DC}

Switch-on voltage (high):

Phoenix 12/300	:	16,5 Volt _{DC}
Phoenix 12/500	:	16,5 Volt _{DC}
Phoenix 24/500	:	31,0 Volt _{DC}
Phoenix 24/900	:	31,0 Volt _{DC}

Switch-off voltage (low):

Phoenix 12/300	:	9,6 Volt _{DC}
Phoenix 12/500	:	9,6 Volt _{DC}
Phoenix 24/500	:	19,5 Volt _{DC}
Phoenix 24/900	:	19,5 Volt _{DC}

Switch-off voltage (high):

Phoenix 12/300	:	17,0 Volt _{DC}
Phoenix 12/500	:	17,0 Volt _{DC}
Phoenix 24/500	:	32,5 Volt _{DC}
Phoenix 24/900	:	32,5 Volt _{DC}

Voltage ripple	:	max. 10 % V_{RMS} of nominal DC input voltage.
Nominal input current:		
Phoenix 12/300	:	30 A at 12V/300W
Phoenix 12/500	:	52 A at 12V/500W
Phoenix 24/500	:	25 A at 24V/500W
Phoenix 24/900	:	44 A at 24V/900W
Maximum input current:		
Phoenix 12/300	:	185 A
Phoenix 12/500	:	185 A
Phoenix 24/500	:	90 A
Phoenix 24/900	:	170 A
Power consumption:		
No-load in 'ON' mode:		
The 12V version	:	8,5 W
The 24V version	:	10,6 W
No-load in 'economy' mode:		
All four types	:	2,5 W

7.2 OUTPUT

Output voltage	:	230 V_{AC} +/- 1%
Output voltage range	:	185 V_{AC} – 245 V_{AC}
Frequency	:	50 Hz +/- 0.2% (crystal controlled)
Waveform output voltage	:	sine wave
Total harmonic distortion	:	max. 2,5%
Powerfactor (cos phi)	:	0,2 capacitive to 0,4 inductive
Nominal power:		
Phoenix 12/300	:	300 W
Phoenix 12/500	:	500 W
Phoenix 24/500	:	500 W
Phoenix 24/900	:	900 W
		(cos phi = 1,0) 0°C / +40°C
		At higher ambient temperatures the power is re-adjusted automatically.

Temporary max. power
at 40°C ambient temperature:

	Short term	Surge
Phoenix 12/300	: 400 W	1300 W
Phoenix 12/500	: 650 W	1350 W
Phoenix 24/500	: 750 W	140 W
Phoenix 24/900	: 1000 W	2500 W

Switch-on behavior : The inverter can be switched on under any load conditions.

Efficiency :

Type	12/300	12/500	24/500	24/900
P _{nom}	81%	80 %	84%	82 %
$\frac{1}{2}$ P _{nom}	85 %	85 %	85 %	84 %

Dynamic stability : maximum 10 % short duration surges when switching on and off at 50 % nominal load.

Recovery time : 3 periods

Overload protection : The inverter is protected against overload.

Short circuit protection : The output is short circuit proof. The circuit current is approx. 5,5 A_{RMS} for the 12V version and 11 A_{RMS} for the 24V version.

7.3 ECONOMY MODE

Switch-on load : 26 W

Switch-off load : 13 W

Testvoltage economy : 60 msec. 230V_{RMS} 50Hz, 1 second no voltage.

7.4 GENERAL

Cooling 12/300 and 24/500 : Natural convection

Cooling 12/500 and 24/900 : Forced convection (internal)

Protection against excessive ambient temperatures,

overload and short circuit : The temperature of critical components is measured with sensors (PTC's). The sensors switch the inverter off when maximum component temperature specifications are reached. When temperature returns within limits the inverter switches on automatically.

Relative humidity	:	0-95%
Environment conditions		
Operating temperature	:	0 - 50°C
Storage temperature	:	-25 - +70°C

EMC: Electro-magnetic
compatibility according
Council Directive
89/336 EEC

Emission	:	EN 55014 (1993)
Immunity	:	EN 55104 (1995)
Safety	:	EN 60950 (1991)

7.5 MECHANICAL

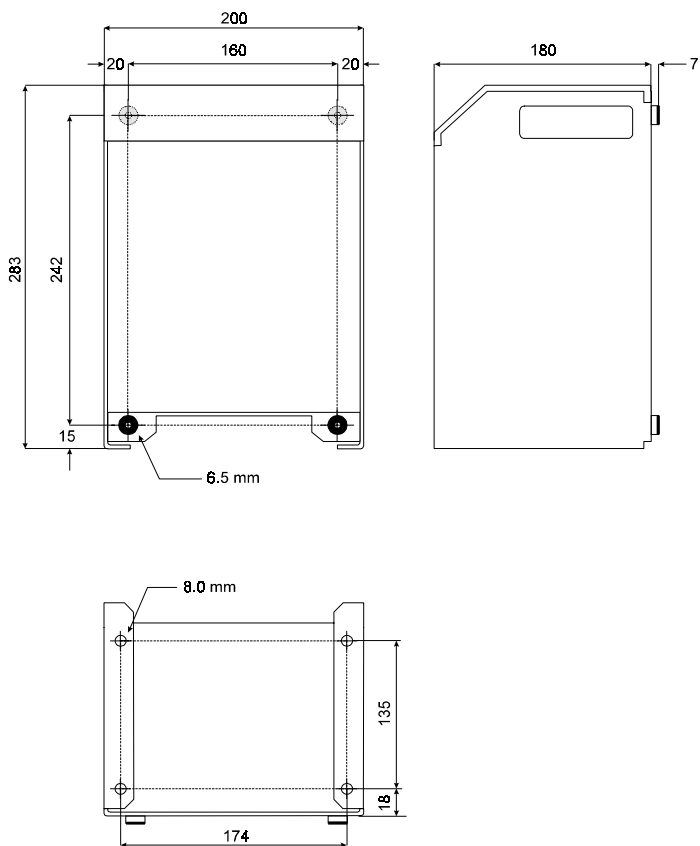
Case	:	Aluminum IP 21
Colour	:	Blue (RAL 5012) epoxy
Dimensions (hwxwd)	:	283 x 200 x 180 mm
Weight	:	8,5 kg
Output 230 V _{AC}	:	Connections on PCB ^{*)} (Connector suitable for 2,5 mm ² wires).
Input 12 or 24 V _{DC}	:	Connections on PCB (M6 bolts)
Remote on/off	:	Connections on PCB (Connector suitable for 1,5 mm ² wires).

^{*)} PCB= Printed Circuit Board

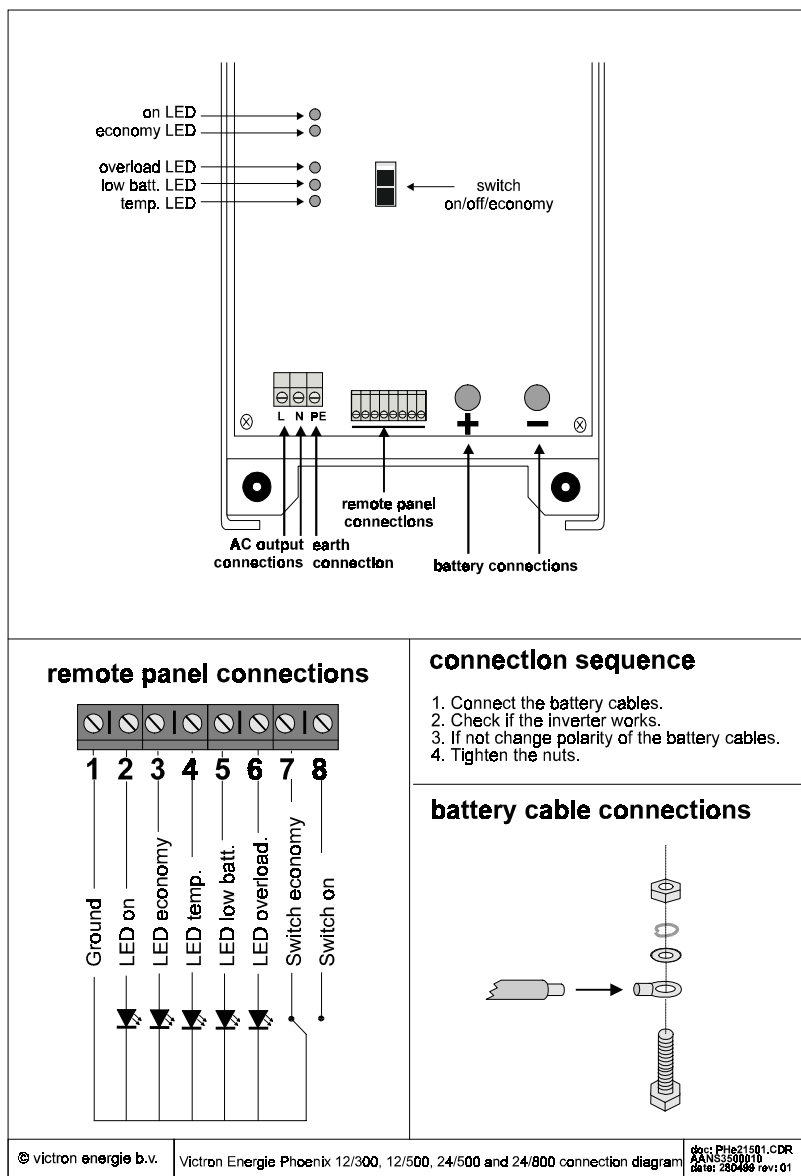
8. DRAWINGS

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8.1 DIMENSIONS



8.2 CONNECTION DIAGRAM





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