victron energy

# USER MANUAL
# GEBRUIKSAANWIJZING

## Battery monitor BMV-501
## Batterij monitor BMV-501

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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 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 Energy batterymonitor**
This manual describes the functionality and operation of the BMV-501, including its protective devices and other technical features.

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# 1. BATTERY MONITOR BASICS

## 1.1 Why should I monitor my battery?

Batteries are used in a wide variety of applications, mostly to store energy for later use. But how do you know how much energy is stored in your battery? No one can tell by just looking at it. Battery technology is often oversimplified, but some basic battery knowledge and good monitoring is essential if you want to enjoy maximum life from your expensive batteries. The life time of batteries is dependent on many factors. Battery life reduces by under-charging, over-charging, excessively deep discharge, too fast a discharge and too high an ambient temperature. By monitoring your battery with an advanced battery monitor like the BMV-501, important feedback is given to the user so that remedial measures can be taken when necessary. This way, by extending battery life, the BMV-501 will quickly pay for itself.

## 1.2 How does the BMV-501 work?

The capacity of a battery is rated in Amphours (Ah). For example a battery that can deliver a current of 5Amps for a period of 20hours is rated at 100Ah (5 * 20 = 100). The BMV-501 continuously measures the nett current flow in or out of the battery so it can calculate the amount of energy removed from or added to the battery. But since battery age, discharge current and temperature all influence the battery's capacity, you can't rely simply on an Amp-hours reading. When the same 100Ah battery is discharged completely in two hours, it will give you only 56Ah. (because of the higher rate of discharge)
As you can see the battery's capacity is almost halved. This phenomenon is called Peukert efficiency (see also chapter 2.2). Also, when the temperature of the battery is low, its capacity is decreased even more. This is why simple Amphour counters or Voltmeters give you far from an accurate state-of-charge indication.

The BMV-501 can display both Amphours removed (not compensated) and actual state-of-charge (compensated by Peukert efficiency, charge efficiency and temperature). Reading state-of-charge is the best way to read your battery. This parameter is given in percent, where 100.0% represents a fully charged battery and 0.0% a completely flat battery. You can compare this with a fuel-gauge in a car.

The BMV-501 also makes an estimation of the time the battery can support the present load (time-to-go readout). This is actually the time left till the battery needs to be charged again. If the battery load is fluctuating heavily it’s best not to rely on this reading too much since it is a momentary readout and must be used as a guide only. We always encourage the use of the state-of-charge readout for accurate battery monitoring.

Besides the main function of the BMV-501, displaying the actual battery status, this monitor offers many other features. The readout of actual battery voltage, current and temperature (with optional temperature sensor), the ability to store historic data, the PC computer-link and the Super-lock function are just a few features of the BMV-501. These features are more specifically explained in the corresponding chapters of this manual.

## 2. SETTING UP THE BMV-501

***Before proceeding with this chapter, please make sure your BMV-501 is fully installed in accordance with to the enclosed installation guide.***

When your BMV-501 is installed it is time to adjust the battery monitor to your battery system. But before discussing the functions in the setup menu, four important items are explained first in the following chapters. It is important that as a user of the BMV-501 you have having some insight into these four items. The actual setup menu functions are explained in chapter 2.5 ‘Function overview’.

### 2.1 Precautions when working with batteries

CAUTION

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.

## 2.2 Charge Efficiency Factor (CEF)

Not all energy transferred into the battery during battery charging, is available during discharge of the battery. The charge efficiency of a brand new battery is approximately 90%, meaning that 10Ah must be transferred to the battery to get 9Ah actually stored in the battery. This efficiency figure is called Charge-Efficiency-Factor (CEF) and will decrease with battery age. The BMV-501 can automatically calculate the CEF of the battery.

## 2.3 Peukert's exponent

As mentioned earlier in chapter 1.2 the Peukert efficiency describes how if you discharge a battery faster than the 20hr rating, it's Amphour capacity decreases. The amount of battery capacity reduction is called 'Peukert exponent' and can be adjusted from *1.00* to *1.50* in Function F10. The higher the Peukert exponent the faster the battery size shrinks with increasing discharge rate. An ideal (theoretical) battery has a Peukert Exponent of 1.00 and doesn't care how big the discharge current is. Of course such batteries do not exist, and an F10 setting of *1.00* is only implemented to bypass Peukert compensation in the BMV-501.

The default setting for the Peukert exponent is 1.25, and is an acceptable average value for most lead acid type of batteries. However for precise battery monitoring, entering the right Peukert exponent is essential. If the Peukert exponent is not provided with your battery, you can calculate it by using other specifications which must be provided with your battery. The Peukert equation is stated below :

$Cp = I^n \cdot t$ where Peukert exponent 'n' = $\dfrac{\log t2 - \log t1}{\log I1 - \log I2}$

The battery specifications needed for calculation of the Peukert exponent, are the rated battery capacity (usually the 20hr discharge rate[(1)] ) and for example a 5hr discharge rate[(2)]. See the calculation example below to define the Peukert exponent using these two specifications :

5hr rating, C5 = 75Ah
$\rightarrow$ t1 = 5hr
$\rightarrow$ I1 = 75Ah/5hr = 15A

20hr rating, C20 = 100Ah (rated capacity)
$\rightarrow$ t2 = 20hr
$\rightarrow$ I2 = 100Ah/20hr = 5A

Peukert exponent n = $\frac{\log 20 - \log 5}{\log 15 - \log 5}$ = **1,26**

(1) Please note that the rated battery capacity can also be defined as the 10hr or even 5hr discharge rate.
(2) The 5hr discharge rate in this example is just arbitrary. Make sure that besides the C20 rating (low discharge current) you choose a second rating with a substantially higher discharge current.

When no ratings are given at all, you can measure your battery using a 'constant load bank'. In this way a second rating can be obtained, besides the 20hr rating which represents the rated battery capacity in most cases(1). This second rating can be defined by discharging a fully charged battery with a constant current, until the battery reaches 1.75V per cell (is 10.5V for a 12V battery or 21V for a 24V battery). a calculation example is shown below :

A 200Ah battery is discharged with a constant current of 20A and after 8.5 hours 1.75V/cell is reached.

So, $\rightarrow$ t1 = 8.5hr
$\rightarrow$ I1 = 20A

20hr rating, C20 = 200Ah
$\rightarrow$ t2 = 20hr
$\rightarrow$ I2 = 200Ah/20hr = 10A

Peukert exponent n = $\frac{\log 20 - \log 8.5}{\log 20 - \log 10}$ = **1,23**

To calculate the Peukert exponent with the specifications above, you can also use the Peukert calculator which can be downloaded from our website at www.victronenergy.com, or is part of the optional PC-link interface kit software. (see page 23 for article number)

## 2.4 Charged-parameters

Based on increasing charge voltage and decreasing charge current, a decision can be made whether the battery is fully charged or not. When the battery voltage is above a certain level during a predefined period while the charge current is below a certain level for the same period, the battery can be considered fully charged. These voltage and current levels, as well as the predefined period are called ‘charged-parameters’. In general for a 12V lead acid battery, the voltage-charged-parameter is 13.2V and the current-charged-parameter is 2.0% of the total battery capacity (e.g. 4A with a 200Ah battery). A charged-parameter-time of 4 minutes is sufficient for most battery systems. Please note that these parameters are very important for correct operation of your BMV-501, and must be set appropriately in the corresponding Functions.

## 2.5 Synchronizing the BMV-501

For a reliable readout of the state of charge of the battery, the battery monitor has to be synchronized regularly with battery and charger. This is accomplished by fully charging the battery. When the charger is operating in the ‘float’ stage, the charger considers the battery full. At this moment the BMV-501 must reckon the battery as full too, so that the Amphour counting can be reset to zero and the state-of-charge reading set to *100.0%*. By precisely adjusting the charged-parameters in the BMV-501, the battery monitor can automatically synchronize with the charger when the ‘float’ stage is reached. The range of the charged-parameters is wide enough to adjust the BMV-501 to most battery charging methods.

When the BMV-501 can’t be adjusted to the charging algorithm of the installed charger, the user can always synchronize the battery monitor manually when the battery is fully charged. This is achieved by pressing both < and > selection keys simultaneously for three seconds. By manually synchronizing the battery monitor, the CEF will not be calculated automatically. **When the supply voltage to the BMV-501 has been interrupted, the battery monitor must always be synchronized in order to operate correctly.**

*Please note that regularly (at least once per month) fully charging your battery not only keeps it in sync with the BMV-501, but also prevent substantial capacity loss of your battery that limits it’s life time.*

## 2.6 Function overview

The BMV-501 factory settings are suitable for an average 12V lead acid battery system of 200Ah. So in most cases when monitoring a 12V system, the only Function which possibly needs to be changed is the battery capacity (F01). When using other types of batteries please ensure that all the relevant specifications are known to properly setup the BMV-501 Functions.

Users can fully adjust their BMV-501 with the help of twenty different settings, called ‘Functions’. Before setting up the BMV-501, the user has to activate the setup-mode first. The setup-mode can be activated by pressing the SETUP key for three seconds. The display will blink to indicate that the setup-mode is active. By repeatedly pressing the SETUP key the desired Function can be selected. The selected Function is represented as *Fxx* where *xx* indicates the Function number. The < and > keys can be used to alter the value of the selected Function. By pressing the SETUP key again, the next Function will be selected. To save the changed settings to the BMV-501 memory, the SETUP key must be pressed for three seconds until the display stops flashing and the battery monitor jumps back to normal operating mode again. If the BMV-501 operates in the setup-mode and no key is pressed for 90 seconds, the monitor will jump back to normal operating mode automatically, without saving any altered settings.

The table below gives an overview of all BMV-501 Functions including a short description. It is recommended not to change the Functions F04, F05, F06, F09, F10, F11, F12, F13, F14, F16, F17 or F20 when in doubt. For most battery systems, only adjusting the values of Functions F01, F02, F03, F07 and F08 should be sufficient.

| | |
|---|---|
| F01 : | Battery capacity in Amphours (Ah). This must be the capacity at a 20h discharge rate and 20 °C.<br><br>*Default : 200Ah*<br>*Range : 20 – 2000Ah*<br>*Stepsize : 1Ah* |
| F02 : | Voltage-charged-parameter. The battery voltage must be above this voltage level to consider the battery as fully charged. Make sure the voltage-charged-parameter is always slightly below the voltage at which the charger finishes charging the battery (usually 0.1V or 0.2V below the 'float' stage voltage of the charger).<br><br>*Default : 13.2V*<br>*Range : 8.0 – 33.0V*<br>*Stepsize : 0.1V* |
| F03 : | Current-charged-parameter. When the charge current value is below this percentage of the battery capacity (see F01), the battery can be considered as fully charged. Make sure the current-charged-parameter is always greater than the minimum current at which the charger maintains the battery, or stops charging.<br><br>*Default : 2.0%*<br>*Range : 0.5 – 10.0%*<br>*Stepsize : 0.5%* |
| F04 : | Charged-parameter-time. This is the time the charged-parameters (as described in F02 and F03) must be met, in order to consider the battery as fully charged.<br><br>*Default : 4 minutes*<br>*Range : 1 – 4 minutes*<br>*Stepsize : 1 minutes* |
| F05 : | Low-battery alarm ON (discharge floor). When the state-of-charge percentage has fallen below this value, the alarm relay will be activated and the *CHARGE BATTERY* indication will flash on the display to indicate the battery must be charged. The time-to-go calculation is also linked to this value. It is recommended to keep this value at or around *50.0%*.<br><br>*Default : 50.0%*<br>*Range : 0.0 – 99.0%*<br>*Stepsize : 1.0%* |

| | |
|---|---|
| F06 : | Low-battery alarm OFF. When the state-of-charge percentage has risen above this value and the alarm relay is activated, the alarm relay will be deactivated again. When *FULL* is selected the alarm relay is deactivated when the charged-parameters are met.<br><br>*Default : 80.0%*<br>*Range : 0.0 – 100.0% / FULL*<br>*Stepsize : 1.0%* |
| F07 : | Undervoltage alarm. When the battery voltage falls below this value, after 10 seconds the message *Lo* shall appear on the display and the alarm relay will be activated.<br><br>*Default : 10.5V*<br>*Range : OFF / 8.0 – 33.0V*<br>*Stepsize : 0.1V* |
| F08 : | Overvoltage alarm. When the battery voltage rises above this value, after 5 seconds the message *Hi* shall appear on the display and the alarm relay will be activated.<br><br>*Default : 16.0V*<br>*Range : OFF / 10.0 – 35.0V*<br>*Stepsize : 0.1V* |
| F09 : | Charge-efficiency-factor (CEF). It is recommended to keep this value at *AU* (automatic calculation). The value *A90* resets the automatic calculation to 90%. A manual setting is represented by *Uxx* where *xx* is the charge-efficiency. (see chapter 2.1 for more info about CEF)<br><br>*Default : AU*<br>*Range : U50 – U99 / AU / A90*<br>*Stepsize : 1%* |
| F10 : | Peukert exponent (discharge efficiency). When unknown it is recommended to keep this value at *1.25*. A value of *1.00* disables the Peukert compensation. See chapter 2.2 for more information and a calculation example to calculate your battery's Peukert exponent.<br><br>*Default : 1.25*<br>*Range : 1.00 – 1.50*<br>*Stepsize : 0.01* |

| | |
|---|---|
| F11 : | Battery temperature. In this Function the average battery temperature can be adjusted. The value *AU* enables the automatic temperature measurement provided that an external temperature sensor is connected to the BMV-501. Also the temperature readout in normal mode is enabled. When *AU* is selected and the connection with the temperature sensor is lost, four dashes (- - - -) are displayed and the internal temperature compensation calculations are made using the default *20 ° C* value.<br><br>*Default : 20* °C<br>*Range : 0 – 50 / AU*<br>*Stepsize : 1* °C |
| F12 : | Temperature coefficient. This is the percentage the battery capacity changes with temperature. The unit of this value is '%cap/°C' or percent capacity per degree Celsius. The default setting is *0.5* %cap/°C, typical for most batteries. The setting *OFF* disables temperature compensation.<br><br>*Default : 0.5 %cap/° C*<br>*Range : OFF / 0.05 – 0.95 %cap/° C*<br>*Stepsize : 0.05 %cap/° C* |
| F13 : | Time-to-go averaging period. Specifies the time window in minutes that the moving averaging filter works with. Selecting the right time depends on your installation. A value of *0* disables the filter and gives you instantaneous (real-time) readout, however the displayed values may fluctuate heavily. Selecting the highest time (*12* minutes) ensures that long term load fluctuations are included in the time-to-go calculations.<br><br>*Default : 3 minutes*<br>*Range : 0 / 3 / 6 / 9 / 12 minutes* |
| F14 : | Current threshold. When the current measured falls below this value it will be considered as zero Amps. With this function it is possible to cancel out very small currents that can negatively affect long term state-of-charge readout in noisy environments. For example if an actual long term current is +0.05A and due to injected noise or small offsets the battery monitor measures –0.05A, on the long term the BMV-501 can incorrectly indicate that the battery needs recharging. When in this case Function 14 is set to *0.1*, the BMV-501 calculates |

| | |
|---|---|
| | with 0.0A so that errors are eliminated. A setting of *0.0* disables this Function.<br><br>*Default : 0.0A*<br>*Range : 0.0 – 2.0A*<br>*Stepsize : 0.1A* |
| F15 : | Reserved.<br><br>*Default : ---* |
| F16 : | Voltage prescaler. This Function is only important when an optional prescaler is installed in the battery voltage sense input of the BMV-501. The voltage-charged-parameter, undervoltage- and overvoltage alarm settings are linked with this Function. Don't change this value if you are not using a prescaler!<br><br>*Default : 1-1*<br>*Range : 1-1 / 1-5 / 1-10* |
| F17 : | Display (backlight) mode. Duration of backlight activation in seconds after pressing a key on the BMV-501. Furthermore settings can be made to leave the backlight always *ON* or always *OFF*. In the setting *AU* the backlight will be activated automatically when the charge/discharge current exceeds 1A or when a key is pressed.<br><br>*Default : 30 seconds*<br>*Range : OFF / 10 – 60 / ON / AU*<br>*Stepsize : 10 seconds* |
| F18 : | Reserved.<br><br>*Default : ---* |
| F19 : | Firmware version. Displays the firmware version of the BMV-501. No alterations can be made.<br>*Default : 1.00* |
| F20 : | Setup lock. When this Function is *ON*, all functions (except this one) are locked and can't be altered.<br><br>*Default : OFF*<br>*Range : OFF / ON* |

When all the necessary changes are made and double checked in the setup-mode, it is time to jump back to the normal operating mode by pressing the SETUP key for three seconds. Your BMV-501 is now ready for use!

## 3. GENERAL OPERATION

In normal operating mode the BMV-501 can display the six most important parameters of your DC system. Use the < and > selection keys to select the desired parameter.


Battery voltage (V). This readout is useful to make a rough estimation of the battery's state-of-charge. A 12V battery is considered empty when it can't maintain a voltage of *10.5V* under load conditions.


Current (A) represents the actual current flowing in or out of the battery. A discharge current is indicated as a negative value (current flowing out of the battery). If for example a DC to AC inverter draws 5Amps from the battery, it will be displayed as *–5.0A*.


Consumed Amphours (Ah) displays the amount of Amphours consumed from the battery. A fully charged battery sets this readout to *0.0Ah* (synchronized system). When for three hours a current of 12Amps is drawn from the battery, this readout gives *–36.0Ah*.


State-of-charge (%). This is the best way to monitor the actual state of the battery. This readout represents the current amount of energy left in the battery. A fully charged battery sets this readout to *100.0%* while a fully discharged battery is represented as *0.0%*.


Time-to-go (h) is an estimation of how long the battery can support the present load, before it needs recharging. This time will be represented in hours (above 100h) or in hh.mm format (under 100h). A time-to-go of 15 hours and 45 minutes will be represented as *15.45h*.


Temperature (°C) displays the present battery temperature. This readout is automatically activated when Function F11 is set to *AU* and the optional temperature sensor is connected to the BMV-501. When connection with the temperature sensor is lost, the display will return four dashes (- - - -).

The BMV-501 also indicates when the battery needs to be recharged again or when the battery is fully charged. These indications are made using the CHARGE BATTERY FULL indicators at the bottom of the display. In the table below the three possible combinations of these indicators are explained.


*CHARGE BATTERY* (flashing). The state-of-charge of the battery has dropped below the adjusted ‘discharge floor’ (see Function F05). The battery needs to be recharged as soon as possible.


*BATTERY FULL* (flashing). The battery is fully charged and the battery charger is probably operates in the ‘float’ stage. The charger may be turned off. The monitor is synchronized with the battery!


*CHARGE BATTERY FULL* (flashing). Charge the battery completely full! This indication will arise when the BMV-501 decides that the monitor needs to be synchronized with the battery (for example after a number of charge/discharge cycles, after a reset or immediately after power-up).

# 4. ADVANCED FEATURES

Besides the general functionality described in chapter 3, the BMV-501 offers additional advanced features too. These features are reviewed in the next three chapters.

## 4.1 Historic data

The BMV-501 is able to store special events as historic data in it's memory. The following events are stored as historic data :

| | |
|---|---|
| H01 : | The charge-efficiency-factor (CEF) automatically calculated. |
| H02 : | The average discharge. This value will be recalculated after each synchronization. |
| H03 : | The deepest discharge in Ah. |
| H04 : | Number of charge/discharge cycles. |
| H05 : | The number of 'equalizations'. This is the number of times the battery is fully charged meeting the charged-parameters condition. |
| H06 : | The number of full discharges (reaching a state-of-charge of 0.0%). |
| H07 : | The number of undervoltage alarms. |
| H08 : | The number of overvoltage alarms. |
| H09 : | reserved |
| H10 : | reserved |

The information stated above can be recalled in the 'history readout'. This readout can be activated by pressing all three keys of the BMV-501 for five seconds. After this five seconds, a flashing '*H01*' shall appear on the display. With the < and > selection keys the value of H01 can be displayed. By pressing the SETUP (next) key the next history event, in this case '*H02*', can be selected. To jump back to normal operating mode, all three BMV-501 keys must be pressed for five seconds again.

## 4.2 PC-link

Each BMV-501 offers the possibility to communicate with a Personal Computer. However, the optional external communications interface kit is required for this feature. This communications interface only needs to be connected when actually communicating with the BMV-501, to avoid unnecessary power consumption. With the dedicated BMV-501 Windows 95/98/ME/2000/XP ® software, the user can simultaneously display all

parameters. The BMV-501 can also be fully programmed via this link, while the complete Function setup can be saved to disk. Furthermore historic data can be readout, the BMV-501 can be tested and the super-lock can be (de-)activated.

### 4.3 Super-lock

With the super-lock feature, the setup menu of the BMV-501 can be completely locked and secured by a password. In super-lock mode the historic data cannot be erased either. The normal operating mode is not affected by the super-lock and the Functions in the setup menu can be reviewed, but not altered. Only the user/installer knowing the password, can unlock the BMV-501 via the PC-link.
The super-lock must not be confused with the setup-lock (Function F20). The big difference between the two is that the setup-lock can be disabled by anybody, even without communication between BMV-501 and PC. The setup-lock is used to avoid accidental alteration of the Function values. The super-lock, however, can only be (de-)activated via the PC-link using a unique password. The super-lock feature is primarily meant for warranty purposes.

## 5. TROUBLESHOOTING GUIDE

| PROBLEM | REMEDY OR SUGGESTION |
|---|---|
| | |
| The monitor doesn't operate (no display) | - Check monitor- and battery connections.<br>- Make sure the inline fuses are installed and not blown.<br>- Check battery voltage. Battery might be flat.<br>Vbatt must be > 8VDC.<br>- Try to restart the monitor by removing/placing the fuses again. |
| Current readout gives wrong polarity (positive current instead of negative when discharging) | - Current sense leads from the shunt are reversed. Check the installation guide. |
| The monitor resets all the time | - Check the wiring for corrosion and/or loose contacts.<br>- Battery might be flat or defective. |

| | |
|---|---|
| No changes can be made in the setup-mode | - Check if the setup-lock is *OFF* (Function F20)<br>- Your BMV-501 might be locked by the super- lock. Ask the installer for the password to unlock the monitor using the PC-link. |
| Not <u>all</u> readouts in normal mode can be selected | - Installer has cancelled some parameter readouts using the administrator software with the PC-link. |
| 'CHARGE BATTERY' or 'CHARGE BATTERY FULL' keeps on flashing | - Charge battery full (equalize/synchronize your battery with the monitor)<br>- Check the charged-parameters in Functions F02, F03 and F04 for possible wrong settings. |
| State-of-charge and/or time-to-go readout not accurate | - Check if all current is flowing through the shunt (the negative terminal of the battery may only contain the wire going to the battery-side of the shunt!).<br>- Current sense leads from the shunt are reversed.<br>- Check battery capacity in Function F01<br>- Check CEF in Function F09<br>- Check Peukert Exponent in Function F10<br>- Check Battery temperature in Function F11<br>- Check Temperature coefficient in Function F12 |
| Display returns '- - - -' in temperature readout | - Connection with temperature sensor is lost. Check for failed connections and/or cable damage. |
| Battery voltage readout is highly inaccurate | - Check prescaler setting in Function F16 |

If none of the above remedies will help to solve the problem you encounter, it's best to contact your local dealer for further help.

## 5.1 Warranty

Victron Energy B.V. warrants this battery monitor free from defects in workmanship or materials for 24 months from the date of purchase. During this period Victron Energy B.V. will repair the defective battery monitor free of charge. Victron Energy B.V. is not responsible for any costs of the transport of this battery monitor.

This warranty is void if the battery monitor has suffered any physical damage or alteration, either internally or externally, and does not cover damage arising from improper use, install or repair by anyone other than Victron Energy B.V. qualified personnel. Victron Energy B.V. is not responsible for any loss, damage or costs arising from improper use, use in an unsuitable environment or improper installing and user setup of the battery monitor.

# 6. TECHNICAL DATA

| BMV-501 TECHNICAL DATA | |
|---|---|
| | |
| Supply voltage range | 9 .. 35VDC |
| Supply current @Vin=24VDC without BL | 6mA |
| @Vin=12VDC without BL | 8mA |
| | |
| Input voltage range | 0 .. 35VDC |
| Input current range | -500 .. +500A |
| Battery capacity range | 20 .. 2000Ah |
| Operating temperature range | 0 .. 50°C |
| | |
| Readout resolution : | |
| voltage (0 .. 35V) | ± 0.01V |
| current (0 .. 200A) | ± 0.1A |
| current (200 .. 500A) | ± 1A |
| Amphours (0 .. 200Ah) | ± 0.1Ah |
| Amphours (200 .. 2000Ah) | ± 1Ah |
| state-of-charge (0 .. 100%) | ± 0.1% |
| time-to-go (0 .. 100hrs) | ± 1minute |
| time-to-go (100 .. 240hrs) | ± 1hr |
| temperature (0 .. 50°C) | ± 1°C |
| Voltage measurement accuracy | ± 0.3% |

| | |
|---|---|
| Current measurement accuracy | ± 0.4% |
| | |
| Dimensions : | |
| Frontpanel | 65 x 65mm |
| Body diameter | ∅ 52mm |
| Overall depth | 72mm |
| Net weight : | |
| BMV-501 | 70 gram |
| Shunt | 315 gram |
| Material : body | ABS |
| sticker | Polyester |
| | |
| Equipped with : | - Potential free, normally open, alarm contact (60V/1A max.) |
| Inclusive : | - BMV-501 battery monitor<br>- Safety and Regulatory information<br>- 500A/50mV current shunt<br>- this user manual<br>- installation guide<br>- self-adhesive drill-mould |
| | |
| Accessories: | - BMV-501 Connection kit<br>art. ASS030077000 (length 10m)<br>art. ASS030078000 (length 15m)<br>art. ASS030079000 (length 20m)<br>art. ASS030080000 (length 30m)<br><br>- BMV-501 temperature sensor<br>art. ASS030081000 (length 10m)<br>art. ASS030082000 (length 20m)<br>art. ASS030083000 (length 30m)<br><br>- BMV-501 communications interface kit<br>art. ASS030084000<br>- BMV-501 Ethernet kit<br>art. ASS030075000<br>- 1:5 voltage prescaler<br>art. ASS030076000 |

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

## 6.1 Declaration of conformity

CE

IMPORTER : Victron Energy B.V.

ADDRESS : De Paal 35
1351 JG Almere
The Netherlands

Declares that the following products :

PRODUCT TYPE : Battery Monitor

BRAND : Victron Energy

MODEL : BMV-501

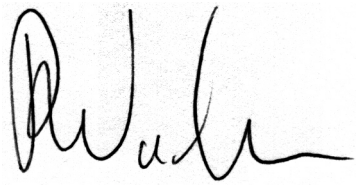
Conforms to the requirements of the following Directive of the European Union :

EMC Directive 89/336/EEC

The above product is in conformity with the following harmonized standards :

- EN50081-1: 1994 EMC - Generic Emissions Standard
- EN50082-1: 1997 EMC - Generic Immunity Standard

Signed : R. Vader



Authority : Managing Director

Date : 12 September 2002