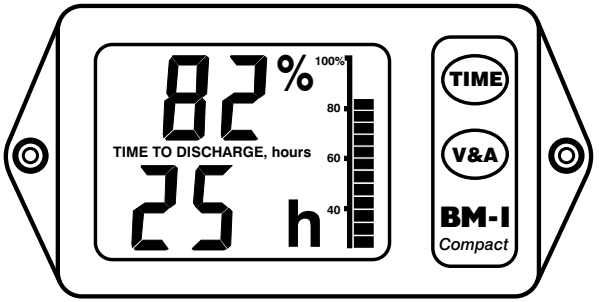
DESIGNED AND MANUFACTURED IN ENGLAND



NASA

BATTERY MONITOR BM-1 *Compact*

RoHS ✔
2002/95/EC

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READ THIS FIRST!

Before installing the BM-1 Compact,
CAREFULLY READ THE FOLLOWING INSTRUCTIONS,
ESPECIALLY THE SAFETY NOTES AND WARRANTY CONDITIONS.

INTRODUCTION

The NASA BM-1 *Compact* is supplied complete with display unit, current shunt (standard 50mV), and connecting cables. It is intended for operation on 12V Lead-Acid batteries with capacities between 5 and 600 Ampere-hours (Ah). Its own current consumption is less than 1.5mA, which is about 1 Ah per month, less than the self-discharge rate of most Lead-Acid batteries.
The NASA BM-1 *Compact* monitors the battery voltage, the current into and out of the battery, and predicts the time to achieve full charge (during charging) or the time to full discharge (during discharging). A visual indication of the state of the battery charge is always available, and an alarm is used as an alert when the battery voltage falls to a preset level.

INSTALLING THE DISPLAY

Safety notes - <u>IMPORTANT</u>

Lead-acid batteries can emit hydrogen when in operation. Hydrogen and air forms a potentially explosive mixture. Accordingly, ensure that the area around the batteries is well-ventilated, and douse all naked flames and prevent sparks. Short-circuiting a battery with a metal tool or piece of jewellery can cause catastrophic currents to flow. Before installing any of the BM-1 Compact units, remove all jewellery (such as rings or metal necklaces). Ensure that no metal tool can cause a short circuit. If you are not sufficiently skilled to undertake any part of this installation safely, you must seek the assistance of a suitably qualified person.

INSTALLATION OF THE DISPLAY UNIT

The installation should be performed in the order specified in the following sections.

1. Select a convenient position for the display. The area should be flat and remain dry at all times.
2. Drill two 2mm holes to accommodate the stainless steel self-tapping screws supplied. If desired, also drill a 5mm hole to allow the cable to pass through the panel. Alternatively, the cable can be folded so as to exit the unit vertically against the panel face.
3. Screw the unit to the panel and connect the wires to the terminal block provided. Connect the shunt cable to the display unit as shown on Figure 1, above, using the terminal block supplied. Be careful to connect the wires exactly as shown, noting that the black and white wires are joined at the shunt connection, and are connected separately at the instrument end of the cable.
4. It is good practice to run the cables vertically downwards from the unit, even if they later have to rise to connect to the vessel's supplies. Doing so prevents any water that might get onto the cables from running back along the cables and into the unit.

5.

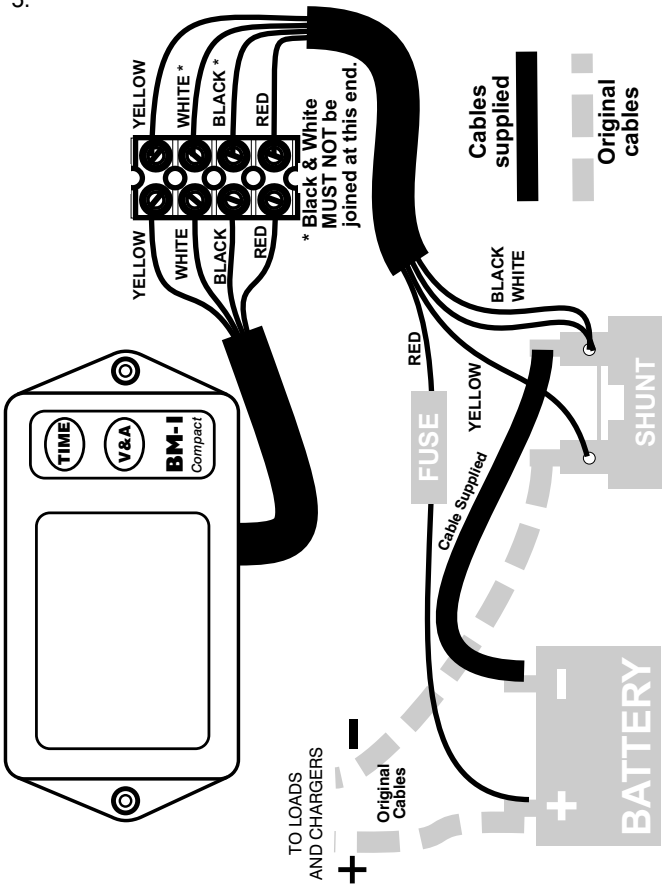

Figure 1 - Wiring Installation

6. Ensure that all loads and generators are switched off
7. Disconnect the NEGATIVE terminal from the battery and connect it to the shunt as shown in Figure 1.
8. Connect the Black and White wires and Yellow wire to the shunt as shown on Figure 1.
9. Connect the short link cable to the shunt and then to the negative terminal of the battery, as shown on Figure 1. Ensure it is positioned where it cannot come into electrical contact with other parts, and ensure it will remain dry and free from contaminants. Also note that the shunt can get warm when heavy currents flow, so ensure it is secured in a position where its heat cannot affect other parts. TAKE CARE TO AVOID OVER-TIGHTENING THE CONNECTIONS TO THE SHUNT..
10. Finally, connect the red wire to the POSITIVE terminal of the battery to complete the electrical installation. The BM-1 Compact will now begin assessing the battery state, using its factory default values. The default values must be set to the values appropriate to the new installation as discussed in SETTING UP, below.
11. Do NOT put the battery on charge immediately.
12. Apply a load to the battery by switching on lights or instruments and wait for a few minutes for the BM-1 Compact to “learn” the battery's characteristics and to show a steady reading before starting charging.
13. It is necessary to set the battery capacity to the correct value, and may be necessary to calibrate the zero current setting, as described in SETTING UP, below.

NORMAL OPERATION

The BM-1 *Compact* offers two normal modes of operation:

- Time to go.
- Volts and Amps;

The battery charge state is always displayed on the scale on the right of the display. If the battery voltage falls below the preset alarm level representing dangerous discharge, the alarm bell symbol is flashed.

SWITCHING THE BACKLIGHT

Pressing either key switches the backlight on for approximately two minutes, after which it switches off to reduce the battery discharge.

SHOWING THE TIME TO GO.

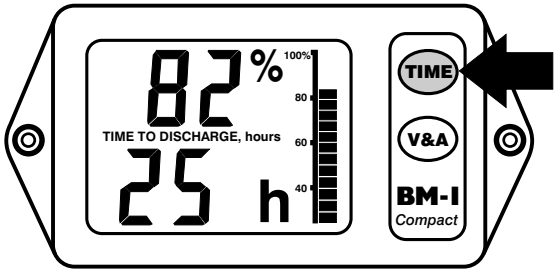

Figure 2 - Percentage & Time to Go

Figure 2 shows the display when the TIME key is pressed. The remaining battery capacity in digits as a percentage and analogue “thermometer” displays, and the up-to-date estimate of how long it will take to charge or discharge the battery fully, are shown. If the current changes, the estimate of the time updates continuously, reflecting the best estimate of time to be fully charged or fully discharged. Times in excess of 199 hours are shown as 199 hr.

SHOWING THE VOLTAGE AND CURRENT

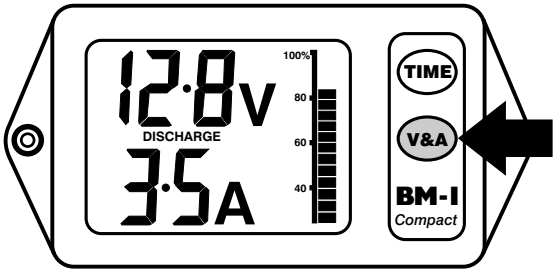

Figure 3 - Voltage and Current

Figure 3 shows the display when the V&A key is pressed. The present battery voltage and battery current, as well as the estimate of the state of the battery's charge are shown. The maximum current measurement is 102 Amps.

If the BM-1 Compact is left for long periods registering little or no charge or discharge current, the estimate of capacity may become unreliable. It is important to switch some load onto the battery for a few minutes so a reliable estimate can be calculated, and its value settles, before starting charging.

SETTING UP

Setting up can be done after applying power to the unit while one of the keys is pressed. This procedure prevents inadvertent changes being made by an unfamiliar user. Applying power is usually most easily achieved by removing the fuse for a few seconds, and then re-inserting it. When the setting is finished, removing the power again returns the unit to normal operation when power is re-applied with no key pressed.

SETTING THE BATTERY CAPACITY

1. Turn off the unit.
2. With the V&A key pressed, re-apply the power.
3. Release the key. CAP is briefly displayed to show that the capacity is to be changed.
   The TIME key increases the setting, and the V&A key reduces it. Keyboard repeat allows quick changes if the keys are kept pressed. The maximum capacity is 600 A-hr, and the minimum is 5 A-hr.
4. When the correct value has been set, turn off the power to the unit to save the setting.
5. Turn the power back on for normal operation.

SETTING THE ZERO-CURRENT

If no current is flowing into or out of the battery, and yet a small residual current is shown on the display, the reading can be adjusted to zero.

1. Ensure that no current is flowing into or out of the battery.
2. Turn off the unit.
3. With the TIME key pressed, re-apply the power.
4. Release the key. SET A is briefly displayed to show that the zero current is to be changed. The TIME key increases the setting, and the V&A key reduces it
5. Adjust the setting until the value is shown as zero discharge. (Note: several presses of the key are needed to change the setting by 0.1).
6. When the correct value has been set, turn off the power to the unit to save the setting.
7. Turn the power back on for normal operation.

BATTERY MANAGEMENT BASICS

After Voltage and Current, the most useful measurement available from a battery condition monitor is the state of charge of the battery. However, estimation of the state of charge of lead-acid batteries is never exact. The problem of making accurate estimates results from the characteristics of the cells, the electrolyte, and the history of currents drawn from (discharge) and supplied to (charge) the battery. The basis for the best capacity estimates is that the starting condition is known. The only well-established “known” state of a battery is when it is fully charged after a long period of trickle or float charging, usually on a shore or regulated alternator-driven charging system. Discharging a fully-charged new battery at a current 1/20 of the manufacturer's stated capacity will discharge it fully in 20 hours. This current is known as the “20-hour rate”.

So, for example, if a battery has a stated capacity of 100 Ah, then the 20-hour rate for that battery is 5 Amps (because 100/20 = 5). Likewise, a 40 Ah battery would have a 20-hour rate of 2 Amps (because 40/20 = 2).

If higher currents than the 20-hour rate are drawn from the battery, the available capacity is reduced. For example, if it is steadily discharged at 10 times the 20-hour rate (50 Amps from a 100Ah battery), the available capacity falls to about half of the stated capacity. The battery will be flat after about 1 hour instead of the expected 2 hours. (However, if the battery is left to recover with the heavy load removed, most of its *remaining* capacity will return after perhaps 20 hours' resting or at a discharge rate close to the 20-hour rate.) The BM-1 *Compact* makes due allowance for these effects when estimating the battery's state of charge and the expected time to discharge the battery fully.

When the battery is being charged, the voltage is no longer a reliable estimate of the state of charge, and so the BM-1 *Compact* integrates the Ampere hours added to the last known capacity to estimate the battery's state of charge on a continuous basis. Allowance for charge efficiency (not all charging current results in useful charge in the battery) is also computed.

The effects of cell deterioration on the available capacity are significant. If the battery is charged for long periods, gassing takes place. The gases are Hydrogen and Oxygen, derived from the water in the battery acid. Loss of this water needs to be made up by topping up the cells if possible, or by avoiding lengthy overcharges in sealed cells.

Other irretrievable effects include sulphation (encouraged by leaving the battery flat for long periods), and deterioration of the cells' plates. If the battery voltage falls below 10.7 Volts (for a nominally 12 Volt battery), and charging is not started, sulphation of the plates can begin. The BM-1 *Compact* has an alarm which flashes the bell symbol when the voltage falls below 10.7 Volts. If the alarm is triggered, it is important to reduce the current being drawn immediately and, if possible, place the battery on charge, to avoid permanent damage to the cells. If the alarm is ignored, the total number of charge/discharge cycles which the battery will survive before it loses a substantial fraction of its nominal capacity may be substantially reduced.

All of these (and other effects) reduce the available charge after fully charging the battery. If the effects are ignored, the BM-1 *Compact* will incorrectly estimate that more capacity is available at any state of discharge than is actually the case. If so, it is wise to alter the nominal capacity stored in the unit to match the reality of the battery's condition.

QUESTIONS AND ANSWERS

Q Why is the screen of my BM-1 Compact blank?

A *Check the wiring is correct and securely terminated. Check the fuse, and check that the battery is not completely flat.*

Q Why does my BM-1 Compact show that the number of hours remaining is high or low when a constant discharge current is flowing?.

A *The actual battery capacity is different from the value you have entered in Engineering. The reasons for this difference have been discussed above. Adjust the battery capacity in Engineering to match the battery.*

Q My battery is made up of a bank of several batteries. Is that a problem?

A *Not as long as the combination produces a nominal 12 volts, and all the current drawn from the bank passes through the shunt.*

Q Can the BM-1 Compact monitor my engine starting battery as well as my service battery?

A *No, it cannot. The service battery is in continuous use, and so needs continuous monitoring. The starter battery, however, is subject only to periodic heavy loads followed by float charging, and so does not need to be monitored.*

Q I have another voltmeter on my vehicle which shows a different value to the BM-1 Compact indication.

A *The BM-1 Compact very accurately measures the voltage directly across the battery terminals. Other voltmeters may read differently owing to volt drops in the wiring.*

Q Why does my BM-1 Compact show a higher capacity immediately after charging than it does after a few minutes' discharging?

A *This is an unavoidable feature of battery chemistry, which varies from battery to battery, and the charging regime used.*

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Q Do I need to disconnect my BM-1 Compact when I leave the vehicle for long periods?

A No. The BM-1 Compact is designed to be permanently connected to the battery. It is independently fused, and draws only 1.5mA from the battery. At such a low current, it would take several years to discharge a typical fully-charged service battery.

Q Why does my battery seem to have less capacity than it says on its label?

A The value on the manufacturer's label is seldom the value achieved in service, because of the deterioration of the cells' plates and many other factors. If it seems to have much lower than its expected capacity, it may need replacement, or you may feel that changing the nominal capacity from the Engineering mode will suffice to let you know well enough the percentage charge remaining.

Q When on heavy load, the time to run is lower than I expect. Is this correct?

A YES. When heavily loaded, a lead-acid battery delivers less energy than expected owing to electrolyte exhaustion and stagnation. When the battery is delivering heavy currents the BM-1 Compact uses Peukert's equation to allow for these effects and so show a better estimate for the time to run.

Q I have a 500W appliance. How do I know what current it will draw?

A Divide the power rating by the nominal supply voltage to find the current. So, for example, your 500W appliance will draw 500W/12V Amps from a nominal 12V battery: i.e. about 42Amps

IMPORTANT READ THIS BEFORE UNPACKING INSTRUMENT

Prior to unpacking this instrument read and fully understand the installation instructions. Only proceed with the installation if you are competent to do so. Nasa Marine Ltd. will not accept any responsibility for injury or damage caused by, during or as a result of the installation of this product. Any piece of equipment can fail due to a number of causes. Do not install this equipment if it is the only source of information and its failure could result in injury or death. Instead return the instrument to your retailer for full credit. Remember this equipment is an aid to navigation and not a substitute for proper seamanship. This instrument is used at your own risk, use it prudently and check its operation from time to time against other data. Inspect the installation from time to time and seek advice if any part thereof is not fully seaworthy.

LIMITED WARRANTY

Nasa Marine Ltd. warrants this instrument to be substantially free of defects in both materials and workmanship for a period of one year from the date of purchase. Nasa Marine Ltd. will at its discretion repair or replace any components which fail in normal use within the warranty period. Such repairs or replacements will be made at no charge to the customer for parts and labour. The customer is however responsible for transport costs. This warranty excludes failures resulting from abuse, misuse, accident or unauthorised modifications or repairs. In no event shall Nasa Marine Ltd. be liable for incidental, special, indirect or consequential damages, whether resulting from the use, misuse, the inability to correctly use the instrument or from defects in the instrument. If any of the above terms are unacceptable to you then return the instrument unopened and unused to your retailer for full credit.

Name _____

Address _____

_____

Dealer Name _____

Address _____

_____

Date of Purchase _____

Proof of purchase may be required for warranty claims.

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