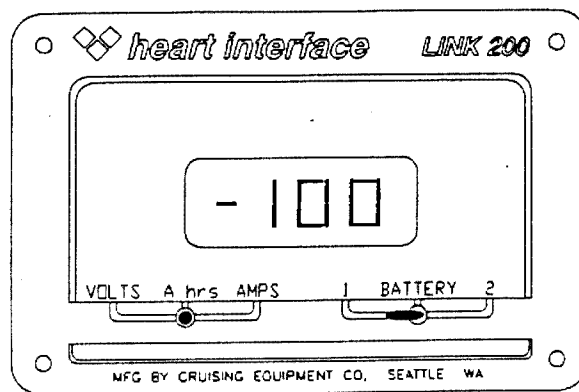
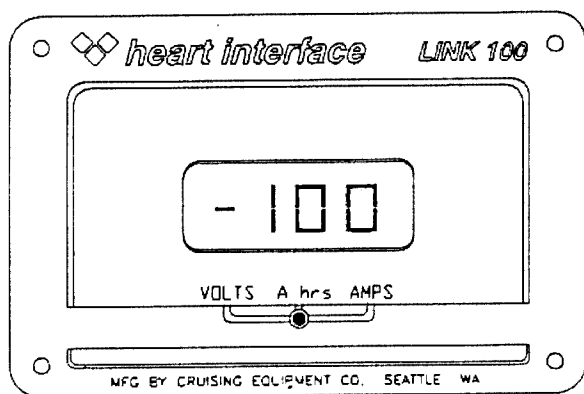


INSTALLATION MANUAL

LINK 100™ LINK 200™ METER

LINK 100 and **LINK 200** Meters are designed to monitor 12 and 24 Volt battery systems. The **LINK 100** is for use with single battery systems. It measures the number of Amp-hours (Ahr) consumed from a fully charged battery. It also measures the voltage and the current being consumed from or supplied to the battery during discharge and during charging. The **LINK 200** has the same functions but is able to monitor two batteries.



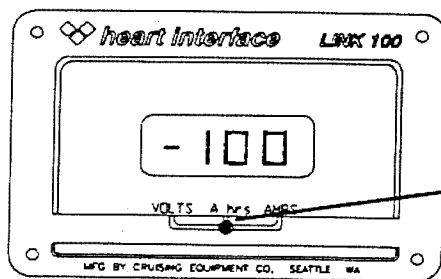
This installation manual is designed to provide you with the information necessary to install and use your **LINK 100** or **LINK 200** Meter. Please read it!

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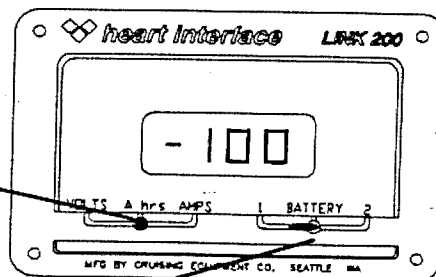
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LINK 100 and **LINK 200** Meters are a joint venture of two Valley Forge Companies. Installation and operation questions should be directed to Heart Interface. Warranty issues should be directed to Cruising Equipment Co.. See warranty page for details.

DESCRIPTION OF THE FRONT PANEL SWITCHES



Display Function Switch
Chooses what is displayed:
Volts, Amps, or Amp-Hours



Battery Monitor Select Switch
Chooses which battery to display

DISPLAY FUNCTION SWITCH

There is only one switch on the **LINK 100** Meter. It chooses the type of information to be displayed and selects the function to be "Set up" during the setup procedure. The setup procedure is discussed in detail on Page 8. Each of the display functions is described below.

VOLTS FUNCTION

When the Display Function switch is in the **VOLTS** position the battery voltage is displayed as a positive number with 0.01 volt resolution. The range is from 9.5V to 18V for 12V systems and 19.5V to 36V for 24V systems.

AMPS FUNCTION

When the Display Function switch is in the **AMPS** position, current being consumed from the battery is displayed as a negative number. If current is being supplied to the battery it is displayed as a positive number (no sign displayed). The current is displayed with 0.1 amp resolution. The range is from -255.0A to 255.0A. Over-range is indicated by OL.

AMP-HOUR FUNCTION

AMP-HOURS CONSUMED: When the Display Function switch is in the **AMP-HOURS** position, the number of Ahrs consumed from the battery is displayed as a negative number. During discharge the negative number will grow as Ahrs are consumed and the meter counts down. During charging the number of Ahrs consumed will decrease as the meter counts back up toward zero. The range is $\pm 9,999$ Ahrs.

CHARGE EFFICIENCY FACTOR: The rate the meter counts back up during charging automatically compensates for the charging inefficiency of the battery. The Charge Efficiency Factor (CEF) has a factory default value of 87%. That means that you must return 1.15 Ahrs to store 1.0 Ahr in the battery.

To insure that the CEF is correct for the particular system, the **LINK** automatically adjusts the CEF after each recharge cycle, if the battery has been discharged more than 10% of the declared battery capacity. The new CEF is based on the charged parameters selected in the setup procedure. At least 100% of the Ahrs removed must be returned and the charged parameters for voltage and current must both be met for 5 minutes before a new CEF is computed. (Time is reduced to 1 minute if Modes Switch #2 is on, see Modes Switch.) Setting up the charged parameters is discussed later. Note also the special feature of the **LINK 200**, detailed later, which allows display of the CEF.

OVER-CHARGE AMP-HOURS: If the battery continues to be charged after the meter counts back up to zero, overcharge Ahrs are accumulated and displayed as a positive number.

AUTOMATIC RESET TO ZERO: If there is an accumulated positive number in the display when discharging begins, the meter automatically resets to zero and begins counting down. See Over-Charge Amp-hours on page 6.

The meter also automatically resets to zero when there has been a discharge/charge cycle that satisfies the conditions for a recalculation of the CEF. In other words, if the battery is discharged 10% and then recharged until the charged parameters have been met the Amp-hours consumed display is reset to zero.

BATTERY MONITOR SELECT SWITCH

The **LINK 200** Meter has two front panel switches. One switch is the Display Function switch. It operates as described above for the **LINK 100**. The second switch chooses the battery to be monitored. If the Battery Monitor Select Switch is in the #1 position the information that is displayed is for battery #1. Similarly for battery #2.

SPECIAL FEATURES:

CHARGE EFFICIENCY FACTOR DISPLAY

The **LINK 200** Battery Monitor Select Switch has a center position that allows the display of the CEF (Charge Efficiency Factor). The left most two digits are the CEF for Battery #1 and the right most two digits are the CEF for battery #2. For example: The default CEF of 87% for Battery #1 and #2 would be displayed as 8787.

This is the first meter that shows this kind of information. We expect the CEF to stabilize after the first half dozen discharge/recharge cycles. Unless the charging system changes, the CEF should remain stable for a long time. Toward the end of the batteries' life we expect to see a rapid decrease in the CEF. Please consider the CEF as a tool to indicate changes in long term system performance.

SPECIAL ALTERNATIVE ENERGY MONITOR FEATURES

The **LINK 200** can be used as Battery/Source monitor for Alternative Energy systems. Mode Switch #2 turns on a set of special features. With this option the Voltage, Amperage, and Amp-Hour functions displayed in the Battery #2 position are for the alternative energy source. The PV panels, Wind, or Micro-Hydro output is supplied through the Battery #2 shunt and then to the batteries. The voltage can be measured right at the source. See Mode Switch Function section of this manual.

The Amp-Hours display shows the cumulative total, up to 9,999 Ahrs, after which it rolls over to 0 and continues totaling. This option allows site evaluation, system performance, and tracking of solar insolation.

The Battery #1 position displays the same information as in the normal operation of the **LINK 200**.

Note 1: With this option the CEF for the Battery #2 input is fixed at 100%. The CEF for Battery #2 will be displayed as --. For example: The default values in the CEF display would be: 87--

Note 2: When using a **LINK 100** in an Alternative Energy system you should switch Modes Switch #2 to the on position. The rules for meeting the charged parameters are more appropriate for cyclic charge controllers and large battery systems.

LOW BATTERY ALARM

The word "LOBAT" flashes in the upper left hand corner of the display when 50% of the declared battery capacity of Battery #1 or Battery #2 has been consumed. See Modes Switch for how to change the Low Battery Alarm setpoint. This function is active with all Link Meters and does not require Mode Switch #5 to be on to be enabled.

*FOOTNOTE: BASIC BATTERY FACTS

1) An Amp-hour is 1 Amp for one hour, or 2 Amps for 1/2 hour, or 4 Amps for 1/4 hour, etc. 2) Batteries for cycling service are normally rated on a 20 hour discharge rate which means a 100 Ahr battery will sustain 5 amps for 20 hours. 3) Our Mid-Capacity Rule says that discharge below 50% shortens life and charging more than 85% takes too long with an engine driven charging system. So 35% of the battery capacity is all that is normally available.

SYNCHRONIZING LINK 100 AND 200 Meters TO A CHARGED BATTERY

A charged battery has zero Ahrs removed. Synchronizing your LINK Meter to read zero when the battery is charged insures that you always know the net number of Ahrs removed. The following charged parameters indicate when a charging system has put as much energy into a battery as it normally can. Your LINK must be synchronized to the battery according to these parameters.

CHARGED PARAMETERS

MULTIPLE STAGE CHARGING SYSTEMS

If you are using one of the increasingly common Multiple Stage Charging systems, the battery is charged when the system switches to the Float cycle. Examples of this type of charging system include: our Quad-Cycle Regulator, our Ideal Regulator, and our In-Charge Regulator, and the chargers found in Heart inverters. If properly adjusted, or sized, the transition from Acceptance Charging to Float will occur when the charging current, at the Acceptance Voltage (14.2V to 14.4V), drops to about 2%-2.5% of the battery capacity. (See description below of the Ideal Charge Curve.)

CONSTANT VOLTAGE CHARGING SYSTEMS

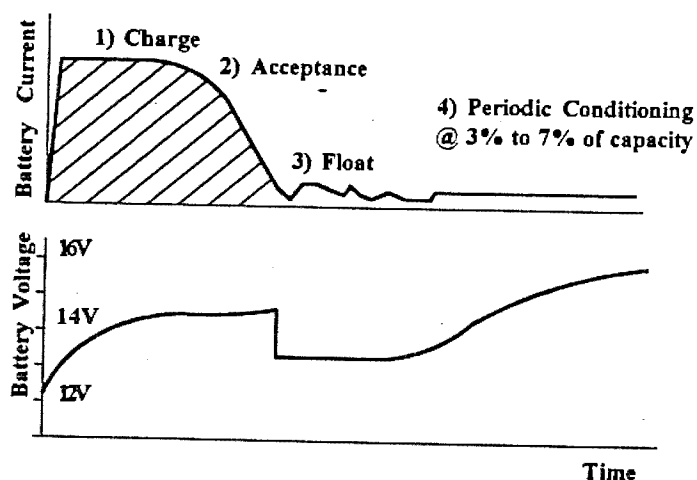
Constant voltage charging systems have restored as much charge to a battery as they can when the voltage reaches the maximum regulation point (typical 12V system is set at 13.8V) and the charging current drops to less than 1% of the battery capacity. It can take more than 8 hours for a battery to reach this state of charge. If you are using an engine driven charging system and trying to limit engine running, you probably will charge only until the current drops to 5% or 10% of capacity. The LINK should be synchronized to which ever of these charge levels is reached in normal operation.

USING SPECIFIC GRAVITY

Accurate battery current measurement is necessary to determine the charged parameters in the two previous methods. Specific gravity of the battery can also be used to determine the charge level of a battery. Regardless of the charging system a battery is charged when the specific gravity shows no increase for three hours, when measured at half hour intervals.

ABOUT CRUISING EQUIPMENT'S IDEAL CHARGING METHOD

THE IDEAL CHARGE CURVE



The CHARGE CYCLE supplies a bulk current to the batteries at a rate limited by alternator capacity or battery capacity. The CHARGE CYCLE continues until the battery reaches 14.2 to 14.4 volts. ACCEPTANCE CHARGING now begins as the battery accepts whatever current it can, until it is accepting only a small current (2% of capacity). At this point the battery is charged and the FLOAT cycle begins, maintaining the batteries safely at about 13.2 volts without water consumption. The CONDITION cycle allows for periodic constant current "equalization" of the batteries. To maximize capacity and life, batteries should be CONDITIONED every 30 days, particularly during deep cycling service.

Time

TWO WAYS TO SYNCHRONIZE

There are two ways to synchronize your LINK to a battery that has met the charged parameters:

- 1) If the LINK is installed on a charged battery, it is in sync as soon as it is turned on.
- 2) If the LINK is installed on a partially charged battery, simply charge until the charged parameters are met. The LINK will begin counting up and will display charging Ahrs as positive. When the battery is charged, turn off the charging source. As soon as discharging begins the Ahr display resets to zero, begins counting down, and is in sync.

If the LINK should ever get out of sync with the battery state of charge it may be resynchronized by either of the above methods. If you want to manually reset your LINK to zero you may do so by turning off the 12V supply. This is easily accomplished by briefly removing the 2 Amp fuse in the Red Wire shown in the wiring diagram. Remember you will have to go through setup again if other than the default values are desired.

If you have a two battery system you should have both batteries fully charged before resynchronizing by de-powering. You may resynchronize each battery separately by charging until the Amp-Hours position shows a positive number and the charged parameters are met.

Occasional controlled overcharging insures that the LINK is in sync with the batteries' state of charge.

HOW TO USE LINK METERS

MANAGEMENT PHILOSOPHY:

Recharge When the Battery is 50% Discharged!

LINK Meters are a guide to the battery's state of charge. The Mid-Capacity Rule says you should begin charging when your **LINK** shows that 50% of the battery capacity has been used. If the battery is normally charged only to the 85% level, then only 35% is actually available for use. This is the most common case for Marine and RV installations that are trying to minimize charging time with an engine driven alternator. The Mid-Capacity rule is a very conservative approach to battery use. Occasionally discharging a battery more deeply is perfectly acceptable. The Mid-Capacity rule is intended as a design and operating guideline to insure long battery life, not a law which must be obeyed without exception.

We recommend synchronizing your **LINK Meter** to the 100% charged level of the battery. You should begin recharging when 50% of your battery capacity has been consumed. When recharging from an engine driven alternator or generator supplied battery charger you do not have to charge until all of the Amp-hours consumed have been returned to the battery. You may cease charging when the **LINK** is still displaying 15% of the battery capacity. When you plug back into shore power, or when your Alternative Energy production exceeds demand, the remaining Amp-hours consumed will be replaced. Periodic Conditioning or equalization should be used to remove any negative Amp-hours that are not replaced during normal charging

EXAMPLES:

MANAGING A SINGLE 200 AMP-HOUR BATTERY

If the battery is normally charged to 100% you may discharge until -100 appears in the display. When you recharge you do not need to charge until the meter reads 0 unless it is convenient. To recharge to the 85% level you may stop charging when the meter displays -30.

MANAGING A TWO BATTERY SYSTEM

With a two battery system we recommend using the **LINK 200**. Use battery #1 until you consume 50% of its capacity, then switch to battery #2 and use 50% of it. When both batteries are 50% discharged it is time to charge.

Suppose you have two 200 Ahr batteries for a total system capacity of 400 Ahrs and you have synchronized the **LINK 200** to 100% charged batteries. You would use battery #1 until the **LINK 200** showed that you had used 50% (-100Ahrs). You would then use battery #2 until you had used 50% of it (-100Ahrs). At this point charge both batteries up to about the 85% level (-30 Ahrs on each). If you have other reasons to continue running the engine or plug back into shore power you may continue charging until the meter reads zero.

OVER-CHARGE AMP-HOURS

If the battery is 100% charged, and the **LINK** is in sync, over-charge Ahrs are displayed as positive. Some accumulation of over-charge Ahrs is normal with systems continuously connected to a charger. A system that maintains a 100 Ahr battery at the Float voltage, will probably have less than .1 A flowing into the battery. This means that 2.4 Ahrs of over-charge would accumulate in a 24 hour period. If the charging system is a constant voltage type set at 14.2 volts, as much as an Amp of current may be flowing all the time after the battery has reached the charged parameters. The battery will be gassing and you will see an accumulation of a large number of Ahrs each day. This is a clear indication that you are destroying your battery by over-charging. Check your **LINK Meter** before turning off a charging source to see that you have not accumulated too many over-charge Ahrs. When discharging begins over-charge Ahrs are erased and the Amp-hour display is reset to zero.

Systems that have a conditioning or equalization cycle will accumulate a few over-charge Ahrs during those cycles. This is normal and insures that the meter stays in sync with the battery state of charge.

HOW TO USE LINK METERS

BATTERY CAPACITY TESTING

Your **LINK 100** or **200 Meter** can be used to conduct periodic capacity tests that tell you the actual amount of energy your batteries can store. A capacity test should start with a battery that has been properly charged and conditioned. The objective is to find the maximum available capacity.

Deep cycle battery capacity is usually stated as a 20 hour discharge rate. A 100 Ahr battery will provide 5 amps for 20 hours. At discharge rates above 5 amps, the battery will not supply 100 Ahr. For example: If you are drawing 100 amps out of the battery it will last less than one half hour. Listed below are approximate capacities at different discharge rates.

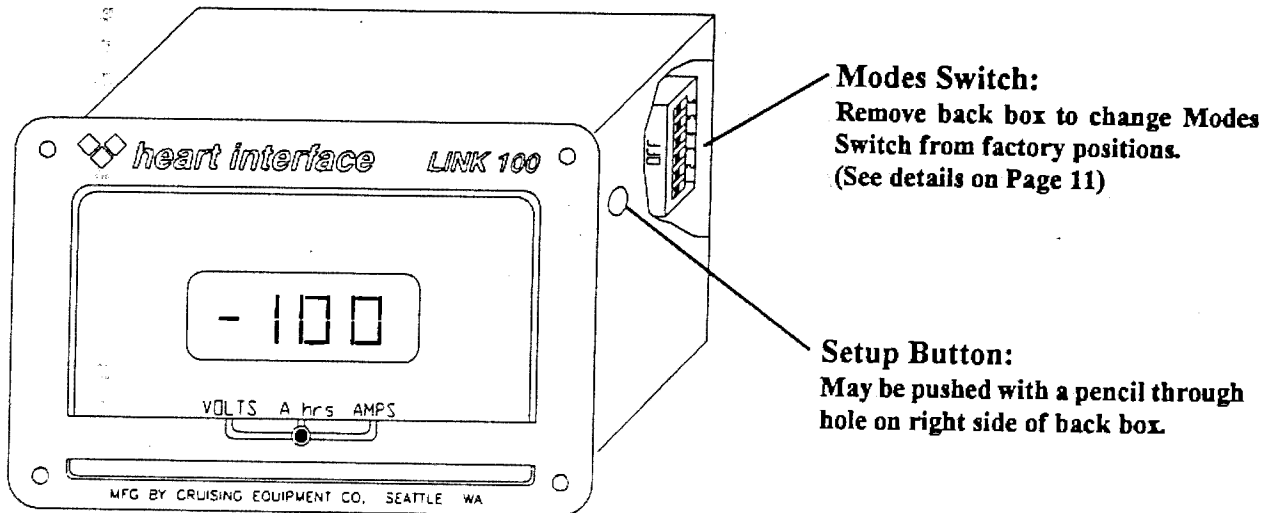
CAPACITY AT VARIOUS DISCHARGE RATES (percentage of 20 hour rate)

| Hours to Discharge | Capacity (percent of rating) |
|--------------------|-------------------------------|
| 20 | 100% |
| 10 | 89% |
| 5 | 78% |
| 3 | 66% |
| 1 | 45% |

To test battery capacity, turn on a load that draws approximately 5% of the declared battery capacity. Measure the current with an ammeter. The load should be constant, such as incandescent lighting. When the battery voltage reaches 10.5 volts, hopefully about 20 hours later, turn off the load and look at your **LINK**. The number displayed is the capacity at the test current. If less than 20 hours passed before the battery voltage fell to 10.5V you can still determine the capacity with some arithmetic. For example: Assume a battery rated at 100 Ahr. Apply a 5 amp load. Suppose it only took 10 hours for the voltage to reach 10.50 volts. The **LINK** would display -50 Ahr. This is the 10 hour capacity. Dividing 50 by 89% (10 hour rate) from the table above, you determine that actual 20 hour capacity is 56 Amp-hours. You could repeat the test at 5% of the tested capacity (2.8A) to verify the actual capacity.

DESCRIPTION OF AUXILIARY SWITCHES

LINK 100 and LINK 200 Meters have two switches located on the right side of the meter that allow the setup of various functions. The Setup Button is a push button that allows the selection of the battery capacity and charged parameters. The Modes Switch is a DIP switch located inside the meter that selects various options. The following is a description of the operation of those two switches.



DESCRIPTION OF SETUP BUTTON OPERATION

LINK 100 and LINK 200 Meters have a Setup Button accessible through a hole in the right side of the case that allows the user to input the battery capacity and set the voltage and current parameters which determine when a battery is fully charged. These inputs are necessary in order to define when the battery has met the charged parameters. Being able to set up specific charged parameters means that the meter can be used with any charging system or any battery, including gelled, lead-acid, and NiCads. See next page for details.

THE DEFAULT VALUES FROM THE FACTORY ARE:

| | |
|--------------------------------|--|
| Battery Capacity | = 200 Ahrs |
| Charged Voltage | = 13.2 Volts for 12 Volt systems (13.8V prior to Serial #250) = 26.4 Volts for 24 Volt systems (27.6V prior to Serial #250) |
| Charged Current % | = 2% (of battery capacity) |
| CEF (Charge Efficiency Factor) | = 87% for Liquid Acid (83% prior to Serial #250) = 90% for Gelled Acid |

The factory default values are initialized when the meter is first powered up. If the meter is de-powered, the factory default values once again become the values used by the meter. The default values have been chosen to work with most systems. If you have a charging system that cannot satisfy the default values, the CEF will not be recalculated and the meter will use the default CEF of 87%. This will work fine in most systems. You may notice an accumulation of negative Ahrs, if so set up appropriate charged parameters or resynchronize periodically.

Link 200 Setup Trick: When setting up two similar batteries, first, setup the desired value for one battery. Wait until the display reverts back to the monitor function. Check the value just setup by pressing the setup button again. While the value is still in the display switch the Battery Monitor Select Switch to the opposite battery. Wait until the display reverts back to monitoring. Press the setup button again to check the value. Repeat for all parameters.

USING THE SETUP BUTTON

The Setup functions described below are the same for the LINK 200 Meter.
The displayed values are for the battery selected with the Battery Monitor Select Switch.

HOW THE BUTTON WORKS

When the setup button is pressed the default value, or the value previously set up, will appear in the display. If the button is held down, 3 seconds later the display will increase incrementally, at 1 second intervals, until it reaches the maximum allowed value. It will then roll over to the minimum allowed value and continue to increase. When the value desired appears, release the setup button. The new value will remain in the display for 5 seconds, before it reverts back to the function currently selected. If the Setup button is pressed during the 5 second period, the display will again start increasing. If the Setup button is pressed after the 5 second period, a new setup cycle will begin.

CHANGING CHARGED VOLTAGE

To change the Charged Voltage place the Display Function switch on Volts and press the Setup button.

Default Value = 13.2 (For 12V systems)

Maximum Allowed Value= 16.0 (For 12V systems)

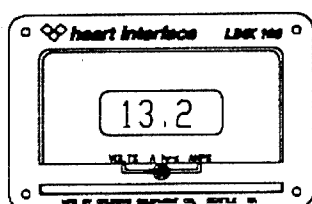
= 26.4 (For 24V systems)

= 32.0 (For 24V systems)

Increments = .1 Volts

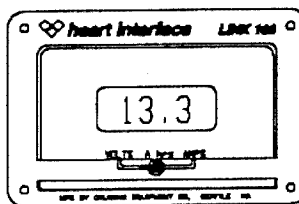
Minimum Allowed Value= 13.0 (For 12V systems)

= 26.0 (For 24V systems)



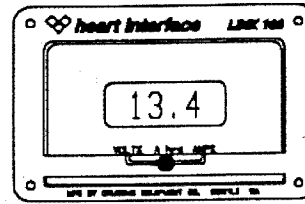
Press Button & Hold

Pencil



After 3 Seconds

Pencil



After 1 More Second

CHANGING BATTERY CAPACITY

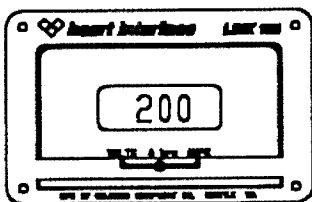
To change the Battery Capacity place the Display Function switch on Amp-Hours and press the Setup button.

Default Value = 200 Amp-hours (20 hr. rate)

Maximum Allowed Value= 2000 Amp-hours (20 hr. rate)

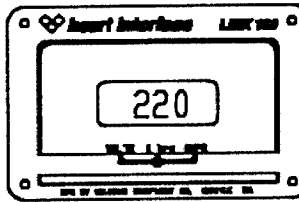
Increments = 20 Amp-hours

Minimum Allowed Value= 20 Amp-hours



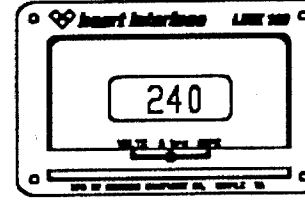
Press Button & Hold

Pencil



After 3 Seconds

Pencil



After 1 More Second

CHANGING CHARGED CURRENT%

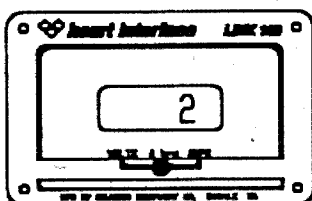
To change the Charged Current % place the Display Function switch on Amps and press the Setup button.

Default Value = 2%

Maximum Allowed Value= 7%

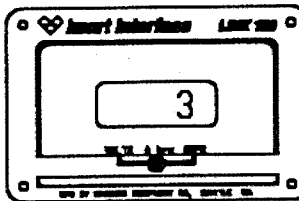
Increments = 1%

Minimum Allowed Value= 1%



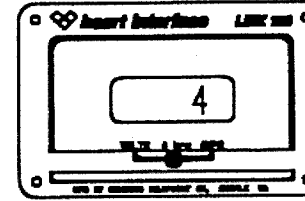
Press Button & Hold

Pencil



After 3 Seconds

Pencil



After 1 More Second

HOW TO SELECT THE CORRECT CHARGED PARAMETERS

LINK 100 & LINK 200 Meters allow the set up of specific charged parameters. The factory default values have been carefully chosen to work on most systems, including constant voltage and multiple step charging systems. The factory Charged Parameters are 13.2Volts and 4Amps (2% of the default battery capacity of 200A hr). **This means when the battery is above 13.2 Volts and the current falls below 4 Amps, for five minutes, the meter considers the battery full.**

The meter learns the Charge Efficiency Factor (CEF) of the battery based on the Charged Parameters. A CEF of greater than 100% is not allowed. To trigger a recalculation of the CEF, the battery must be discharged at least 10% of declared capacity. After this discharge, at least 100% of the energy (kilowatt-hours) removed must be returned, and both the Charged Voltage and Charged Current % parameters must be met for 5 minutes for a recalculation of the CEF to occur. **Amp-hours consumed are automatically reset to zero after a re-calculation of the CEF.** The new CEF is used during the next recharge cycle to determine the rate that the meter counts back up toward zero.

The battery must go through several cycles for the meter to learn the CEF. It will take at least six cycles for the displayed CEF to reflect the actual CEF of the battery.

SHOULD YOU CHANGE THE CHARGED PARAMETERS?

The factory Charged Parameters have been carefully chosen to work for most systems using liquid or gelled lead acid chemistry. Please consider changing only the battery capacity unless your system falls into one of the following categories:

1) Battery chemistry other than lead acid.

If you are using NiCad or other types of batteries you should change your Charged Parameters to the factory specification. NiCad systems would normally use 15.5 to 15.7 as the Charged Voltage. The Charged Current % can probably stay at 2% of declared battery capacity.

2) Charging normally ends before the charging current drops below 2% of battery capacity.

If the charging system is normally shut down before the charging current drops below 2%, the factory Charged Current % will have to be changed. Examples might include: Large solar arrays with controllers that shut off the array at a particular voltage and turn it back on at a lower voltage. Engine driven alternator or AC generators running large inverter/chargers that are normally shut down before the charging current falls below 2% of capacity.

Remember if charging is normally terminated while the current is still a fairly high percentage of battery capacity, the battery is probably not being charged as thoroughly as it should be. If the meter gradually accumulates negative Ahrs it is letting you know that you must periodically remove them by a complete charge.

CHARGED PARAMETER SELECTION RULES

If you must change the Charged Parameters please use the following rules.

- 1) The Charged Voltage MUST be at least .1V BELOW the charging system voltage.
- 2) The Charged Current % times declared Battery Capacity MUST be GREATER than the minimum current the charging system maintains the battery at, or that it quits charging at.

If the charged parameters are not correctly selected, the LINK Meter will never recalculate the CEF. For example:

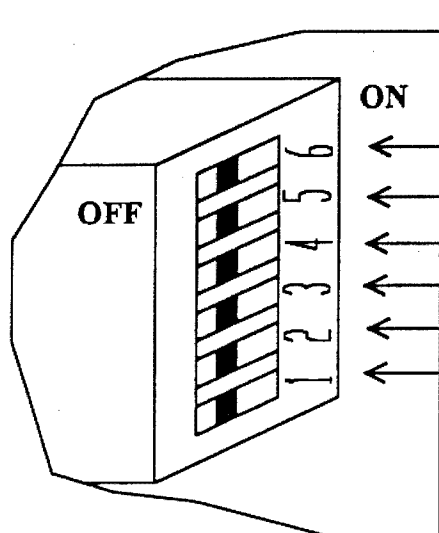
(1) If your charging system only reaches 13.8Volts, a Charged Voltage of 14.0 Volts will not work. Lower the Charged Voltage

(2) If the Charged Current % times the Battery Capacity is less than the current at which the charging system switches off, the Charged Current cannot be met. If the charging system shuts off when the current is 10 Amps, using the factory default value of 4 Amps (2% of 200 Ahrs), will not work. Changing the Charged Current % to 6% would give a Charger Current of 12 Amps which would work fine.

Footnote 1: Prior to Serial #250 the Charged Voltage was 13.8V and the default CEF was 83%

MODES SWITCH FUNCTION

The Modes Switch is a DIP switch on the side of LINK Meters that allows the setup and selection of the following special functions. To access the Modes Switch, remove the two screws that hold the back box to the front panel. The front panel and circuit boards can then be removed from the box. The Modes Switch can be seen on the right side of the back circuit board. The switches are OFF in the up position and ON in the down position.



SUMMARY OF FUNCTIONS

OFF (UP) (Default)

Disable Full Bat. Out
 Disable Low Bat. Out
 Normal Temp.
 Liquid Batteries
 Two Batteries
 Amp-Hours Consumed

ON (DOWN)

Enable Full Bat. Out
 Enable Low Bat. Out
 Warm Temp.
 Gelled Batteries
 Battery/Source
 %Charged

Carefully read the following instructions before attempting to change the Mode Switch functions. Unless otherwise requested, all DIP switches come from the factory in the OFF position.

DIP SWITCH #1 OFF = NORMAL AMP-HOURS CONSUMED FUNCTION
 ON = % CHARGED BASED ON DECLARED CAPACITY

The #1 switch selects the % Charged mode. When the AMP-HOURS position is selected the batteries' % of charge will be displayed. The % of charge will be calculated based on the declared capacity during Setup. A full battery will be displayed as 100 and a 70% charged battery will be displayed as 70.

Please note that the default battery capacity is 200 Ahrs and that the default values are active on powering up the meter. If the meter is de-powered the value selected during Setup is lost. When the LINK 100 Meter is used in the Amp-hours consumed mode the actual number of Amp-hours consumed from the battery is displayed. This number will be accurate even if the Setup parameters are lost, but if the meter is used in the % charged mode the % charged will be in error unless the battery capacity happens to be 200 Ahrs.

Caution! If the % Charged mode is selected it is important that the meter is not de-powered. If it is, the correct battery size must be set up again as soon as power is restored.

NOTE: The % Charged option is not available when the Link meter is used as a Battery/Source monitor. See below.

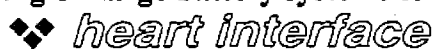
DIP SWITCH #2 OFF = NORMAL BATTERY MONITORING
 ON = BATTERY/SOURCE MONITORING (For LINK 200 Meters only)

Turn this switch on with all LINK 100 and LINK 200 Meters used in Alternative Energy Systems.

The #2 switch selects between the two battery mode and the battery/source mode of the LINK 200 Meter. When the switch is OFF the meter works as a two battery Ahr meter as described previously. When the switch is ON, the Battery #1 position works normally, but the Battery #2 position becomes a cumulative Ahr meter for the energy sources in the system. The Amps position displays current supplied by the source. The Volts position displays the voltage of the source.

The Battery #2 position displays the total number of Ahrs that have been supplied since the meter was powered up. The display will count up to 9,999 and then roll over to 0 and continue to count up. The CEF is set at 100% and is displayed as --. The #2 position may also be used to monitor the specific consumption of a particular device.

This switch also changes the default, Battery Capacity to 800 Ahrs, the Charged Current % to 4%, the default Charged Voltage to 13.5V, and reduces the time necessary to satisfy the charged parameters from 5 minutes to 1 minute. These changes help cyclic PV controllers operating on large battery systems to be able to satisfy the charged parameters.



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MODES SWITCH FUNCTION

DIP SWITCH #3 OFF = LIQUID BATTERIES CEF = 87%
 ON = GELLED BATTERIES CEF = 90%

The #3 switch selects between standard liquid electrolyte battery or gelled electrolyte battery operation. It sets the appropriate CEF. Our experience with Gelled batteries indicate they are slightly more efficient than standard liquid electrolyte batteries. The **LINK 100 Meter** will still learn the actual CEF of the system. Beginning with a higher default CEF means fewer charge/discharge cycles will be needed to find the actual CEF.

NOTE: If you have the Ideal Regulator option, see it's Installation Manual for other functions of this switch.

DIP SWITCH #4 (NORMAL/WARM TEMPERATURE SWITCH)

USED WITH IDEAL REGULATOR OPTION ONLY. SEE REGULATOR INSTALLATION MANUAL.

NOTE: PRIOR TO SERIAL #1200 THIS SWITCH HAD A DIFFERENT FUNCTION AND WAS SET AT THE FACTORY FOR 12V OR 24V OPERATION. DO NOT CHANGE FROM THE FACTORY SETTING.

USED WITH FULL/LOW BATTERY OPTION

THE FULL/LOW BATTERY OUTPUT OPTION REQUIRES AN EXTERNAL RELAY CIRCUIT BOARD. PLEASE IGNORE THE FOLLOWING UNLESS YOU HAVE THIS OPTION.

| |
|--|
| <p align="center">"LO BAT" Flashes in the upper right of the display when Low Battery is true.</p> |
|--|

DIP SWITCH #5 OFF = LOW BATTERY OUTPUT DISABLED
 ON = LOW BATTERY OUTPUT ENABLED
 DEFAULT VALUE 50% (50% OF AMP-HOURS CONSUMED)

The #5 switch enables and allows setup of the Low Battery output signal. If DIP Switch #5 is in the off position the Low Battery output signal is disabled. When the DIP Switch is turned on the default value, or the presently selected value will be displayed for 10 seconds. If the Setup Button is pressed during that 10 seconds the default value will increase in 5% increments until it reaches 85%. If the Setup Button remains depressed the display will roll to 5% below the Full Battery value and again increase in 5% increments. When the desired Low Battery % is displayed release the Setup Button. The newly selected value will remain in the display for 10 seconds and then the display will revert back to the normal. If the Setup button is pressed during the 10 second period the display will again begin counting down. If a new setup cycle of the Low Battery Output is needed turn the DIP switch off and then back on. For Example: Setting up a value of 75% would mean the Low Battery relay would be turned on when the battery was 75% discharged.

The "LOW BAT" annunciation in the display is always active. Dip Switch #5 does not have to be on to enable the display. Switch #5 may be used, as described above, to change the set point to a value other than 50%.

NOTE: For **LINK 200 Meters** the Low Battery Output set-point is the same for both batteries. There is a separate Low Battery Output for each battery, but they are both set at the same % of capacity.

DIP SWITCH #6

OFF = FULL BATTERY OUTPUT DISABLED
 ON = FULL BATTERY OUTPUT ENABLED
 DEFAULT VALUE 0% (0% OF AMP-HOURS CONSUMED)

The #6 switch enables and allows setup of the Full Battery output signal if the relay option has been chosen. If DIP Switch #6 is in the off position, the Full Battery output signal is disabled. When the DIP Switch is turned on, the default value, or the presently selected value, will be displayed for 10 seconds. If the Setup Button is pressed during that 10 seconds the default value will increase in 5% increments until the display reaches 20%. If the Setup Button remains depressed the display will roll back over to 0% and again increase in 5% increments. When the desired Full Battery % is displayed release the Setup Button. The newly selected value will remain in the display for 10 seconds and then the display will revert back to the normal display. If the Setup button is pressed during the 10 second period the display will again begin counting down. If a new setup cycle of the Full Battery Output is needed, turn the DIP switch off and then back on. Example: Setting the Full Battery output at 5% enables the Full Battery relay when the battery is 5% discharged.

NOTE: For **LINK 200 Meters** the Full Battery Output set-point is the same for both batteries. There is a separate Full Battery Output for each battery, but they are both set at the same % of capacity.

REQUIRED READING !!!!!

**LINK METERS COME IN 12V AND 24V MODELS
YOU MUST USE THE CORRECT MODEL TO MATCH YOUR SYSTEM VOLTAGE**

**Before wiring the LINK 100 or LINK 200 Meters, install the shunts as indicated.
All wiring should be done before installing the fuse.**

GENERAL NOTES

- 1) All wiring to the LINK should be #18 AWG. (Larger is OK but not necessary)
- 2) Shunt Sense Leads should be a twisted pair. Leads up to 1,000 feet long may be used if they are not run along with other noise producing conductors. Offset error should be less than 0.2 Amps.
Note: You may make your own twisted pair wire by chucking up two wires in an electric drill motor and twisting them by running the drill motor until there is a twist every inch. A wrap of tape every 16" will keep the wires together and make them easier to pull through the raceway.
- 3) If your starter draws more than 500 amps please see #2 Tips and Tricks below.

LINK INSTALLATION TIPS AND TRICKS

1) Battery current is sensed with a shunt which is a very precise, small, resistance which is inserted in series (in line) in the wire whose current flow you wish to measure. The current is measured by sensing the voltage drop across this resistance. LINK Meters uses a 50 mV, 500 Amp shunt. When 500 Amps flows through the shunt, there is a 50 mV drop across it. Thus 10 Amps equals 1 mV or 1 Amp equals .1mV The display is scaled to read amps.

CAUTION!!!!

The output voltage of the shunt is very small. It is critical that all of the connections for the shunt sense leads have the highest possible integrity. Every effort must be made to prevent corrosion that might affect the sense leads.

2) Note for Marine and RV installations: If starter current exceeds 500 amps, the starter negative must be connected to the battery side (BSHB) of the battery shunt so that starter current does not flow through it. The problem with this is that if the alternator is of the grounded case type its current will not be flowing through the shunt. The alternator ground must be isolated from the engine and run to the load side (BSHG) of the battery shunt to be able to measure the current going into the battery from the alternator. Isolated negative output alternators are available and we strongly recommend them. With isolated negative output alternators, remember that instrumentation and other loads grounded directly to the engine block will not be measured unless their negatives are relocated to the load side of the Battery Shunt. Special high current shunts are also a solution and may be ordered from us. A separate engine starting battery whose negative is connected directly to the engine also solves the problem.

3) We have shown several wires connected to the load side of the battery shunt in the wiring diagram. If more than a few wires need to be connected here, it is best to use a 2/0 jumper from the shunt to a good negative bus. We recommend that the only connections actually made on the shunt, besides the sense leads, are the two batteries, the negative for the engine, and the feed to the negative bus. The negative bus should be a solid copper or brass bar with many threaded screws under which the negatives for all of the loads may be secured. It should be fed with a conductor of sufficient size so that there is no appreciable voltage drop even under full load.

WIRE BY WIRE INSTRUCTIONS

There are five wires in the cable for the **LINK 100 Meter**. Refer to Wiring Diagrams

The **BLACK WIRE (AGND)** is the Analog Ground. It is the reference for measurement. It must be connected on the BSHG (Grounded) side of the shunt. The BSHG side of the shunt is the side opposite of the negative battery terminals. It must have a good connection to the big bolt of the battery shunt.

The **RED WIRE (+12V)** is the +12V supply. (If using a 24V unit, supply with +24V.) Be sure to install the 2 Amp fuse shown in the drawing, as near the battery as possible. If this wire is disconnected the meter will reset and all parameters will revert to the default values.

The **GREEN WIRE (BSHG)** is connected to the **SMALL SCREW ON THE GROUND SIDE, OR LOAD SIDE**, of the battery shunt (BSHG). This wire must be located exactly as described to ensure accuracy of current measurements. The wires that run from the Battery shunt sense terminals to the **GREEN AND ORANGE** wires should be a twisted pair.

The **ORANGE WIRE (BSHB)** is connected to the **SMALL SCREW ON THE BATTERY SIDE** of the battery shunt (BSHB). This wire should be located exactly as described to ensure accuracy in current measurements.

The **WHITE WIRE** supplies the display backlighting. It should be supplied from a switch that controls other instrument lighting. It may be connected to +12 V along with the red wire if you wish the lighting to be on all the time. The backlighting consumes about 8mA (.008A). If left on all the time it would use less than .2Ahrs per day.

There are nine wires in the **LINK 200 Meter** cable. Refer to Wiring Diagrams

NOTE: If only one current input is used, ground both of the other channel's current sense leads.

The **BLACK WIRE (AGND)** SAME AS LINK 100 Meters SEE ABOVE

The **RED WIRE (+12V)** is the +12V supply. (If using a 24V unit, supply with +24V.) The wiring diagram shows two options. The preferred option is to jumper together the RED and BLUE wires as shown. Wired this way, the meter cannot accidentally be reset by being de-powered. It has the disadvantage of always consuming a little bit of power from the #1 Battery. The meter consumes about 20mA (.020A). If left on all the time it would use about .5Ahrs per day.

If the system is left unattended for long periods (more than 30 days) with no charging sources, then you should consider the option shown with the dotted line. In this case the RED wire is not jumped to the BLUE but supplied from the common of the battery switch. (Be sure to install the 2A fuse as near the battery switch as possible.) Whichever battery is selected is the battery that supplies the power. If the switch is turned off the meter is de-powered. You will have to resynchronize and set up your charge parameters each time the system is turned off and back on.

The **GREEN WIRE (B1SHG)** is connected to the **SMALL SCREW ON THE GROUNDED, OR LOAD SIDE**, of the battery #1 shunt (B1SHG). The green and orange wires should be a twisted pair.

The **ORANGE WIRE (B1SHB)** is connected to the **SMALL SCREW ON THE BATTERY SIDE** of the battery #1 shunt (B1SHB).

The **WHITE WIRE (Backlighting)** SAME AS LINK 100 Meters SEE ABOVE

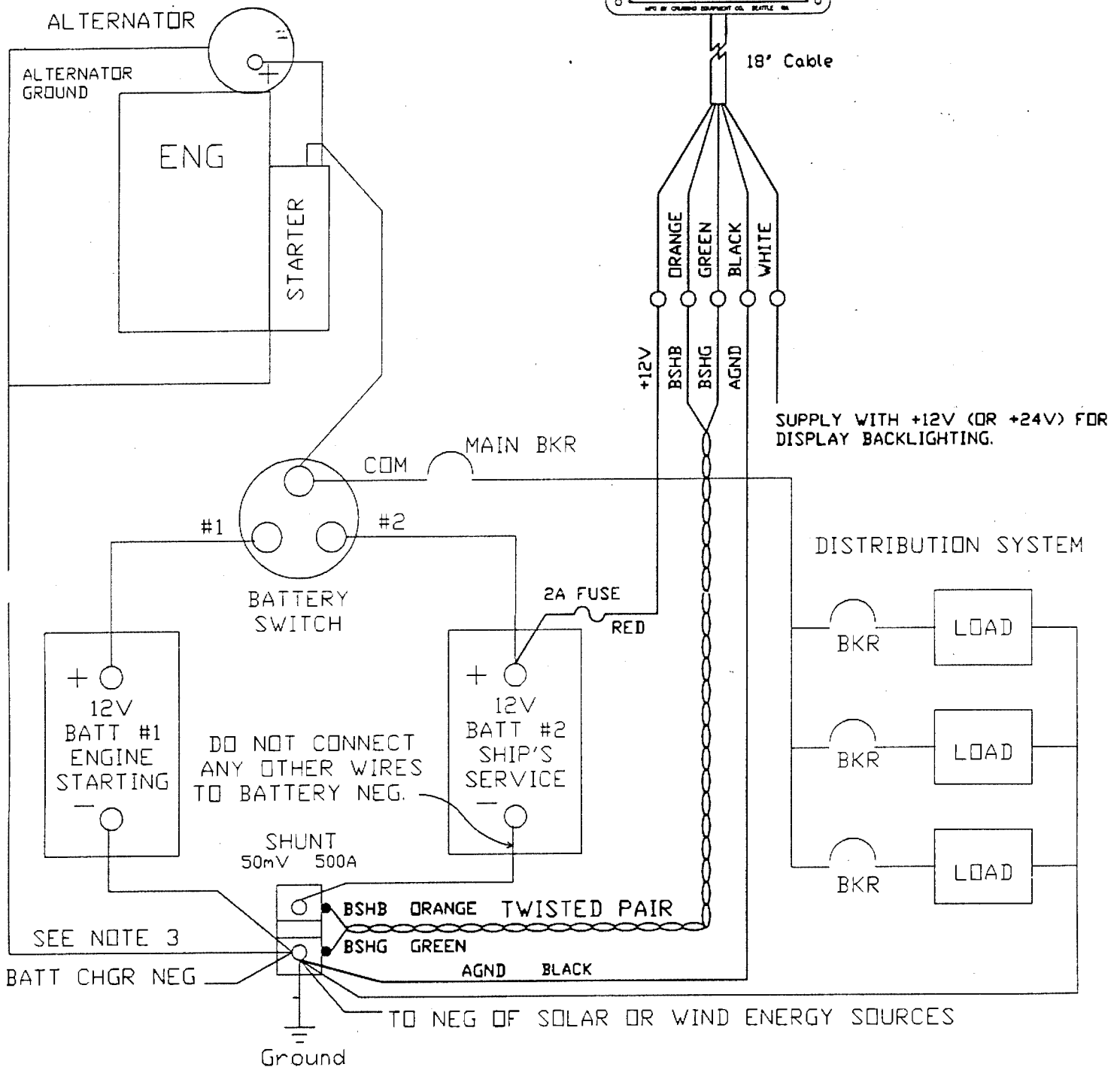
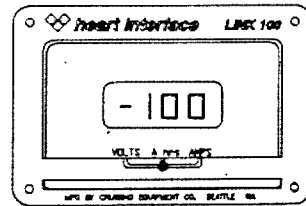
The **BLUE WIRE (B1V)** supplies Battery #1 Voltage for sensing. It should be supplied directly from Battery #1. Be sure to install the 2Amp fuse shown in the drawing as near the battery as possible.

The **VIOLET WIRE** supplies Battery #2 Voltage for sensing. It should be supplied directly from Battery #2. Be sure to install the 2Amp fuse shown in the drawing.

The **YELLOW WIRE (B2SHB)** is connected to the **SMALL SCREW ON THE BATTERY SIDE** of the Battery #2 shunt (B2SHB). The **YELLOW** and **BROWN** wires should be a twisted pair.

The **BROWN WIRE (B2SHG)** is connected to the **SMALL SCREW ON THE GROUNDED, OR LOAD SIDE**, of the Battery #2 shunt (B2SHG).

CAUTION!!! IF THE LINK 100 METER IS TO BE USED IN A 24V SYSTEM BE SURE IT IS A 24V MODEL.



NOTES:

(1) Shunt rated at 500 Amps max.

All LINK 100 METER wiring #18 AWG minimum.
Shunt leads are twisted pair.

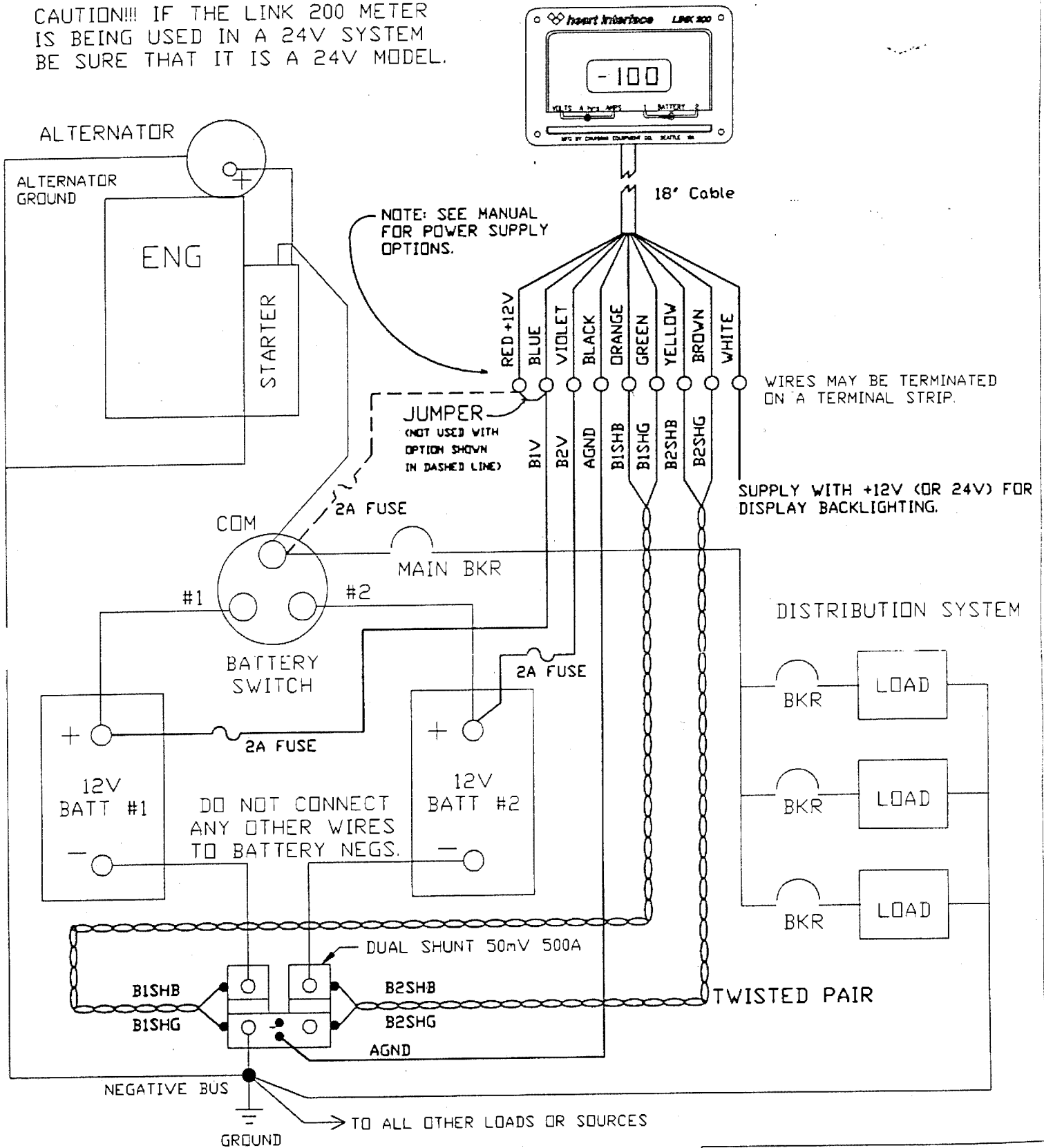
3) Engine battery connected to engine ground.
Wired as shown the LINK 100 METER only measures the Amps and Amp-Hours of the ship's service battery. If monitoring of both batteries is required please use the LINK 200 Meter.

DWG: LINK 100 METER FOR TWO BATTERIES WITH ENGINE ALTERNATOR CHARGING SYSTEM

NO: LIWIRE.DWG REV: 5/18/94

CRUISING EQUIPMENT CO.

CAUTION!!! IF THE LINK 200 METER IS BEING USED IN A 24V SYSTEM BE SURE THAT IT IS A 24V MODEL.



NOTES:

- (1) Shunt rated at 500 Amps max.
- (2) All LINK 200 Meter wiring #18 AWG minimum. Shunt leads are twisted pair.

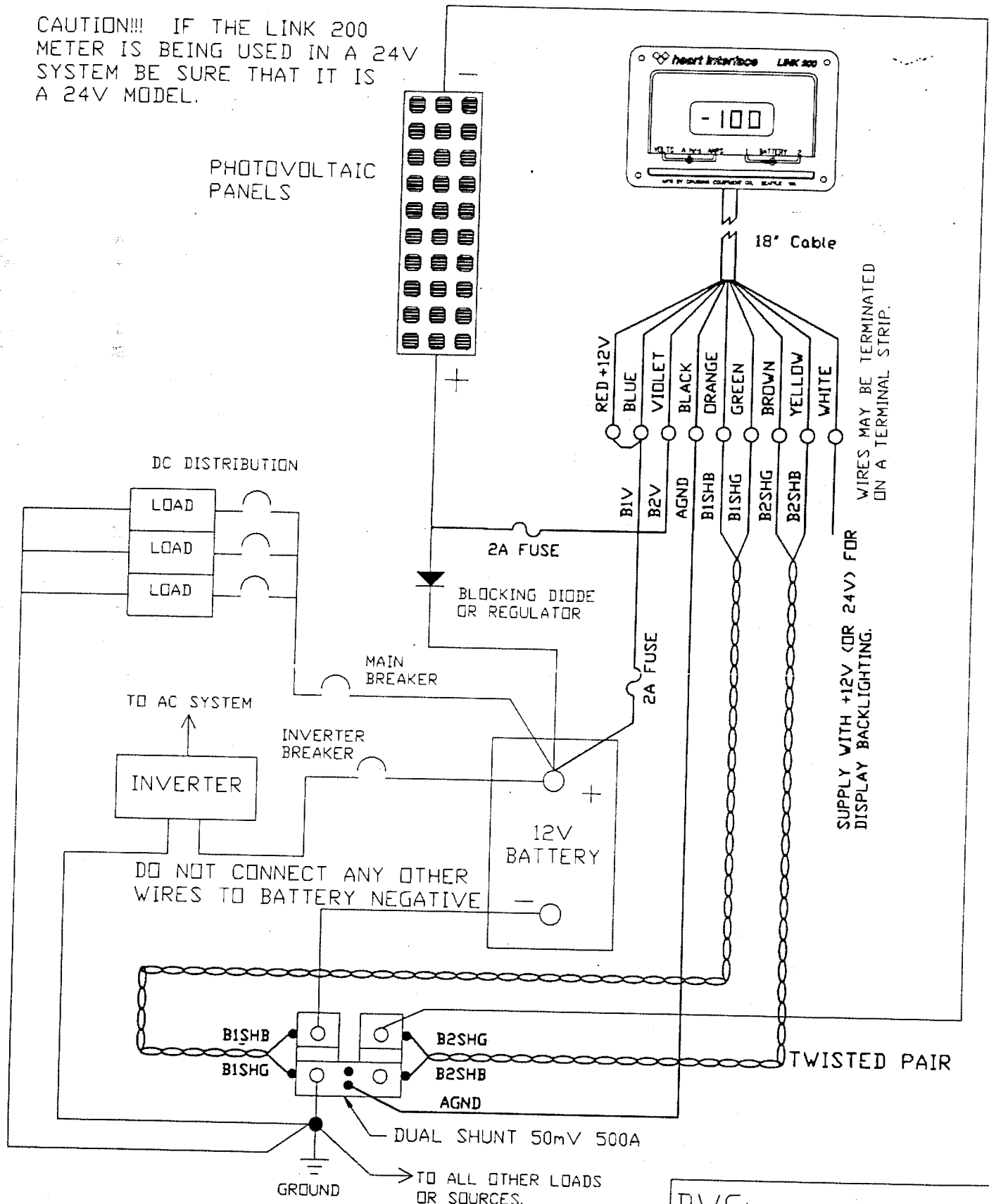
DWG: LINK 200 METER FOR TWO BATTERIES WITH ENGINE ALTERNATOR CHARGING SYSTEM

NO: L2WIRE.DWG REV: 9/28/93

CRUISING EQUIPMENT CO.

CAUTION!!! IF THE LINK 200 METER IS BEING USED IN A 24V SYSTEM BE SURE THAT IT IS A 24V MODEL.

PHOTOVOLTAIC PANELS



NOTES:

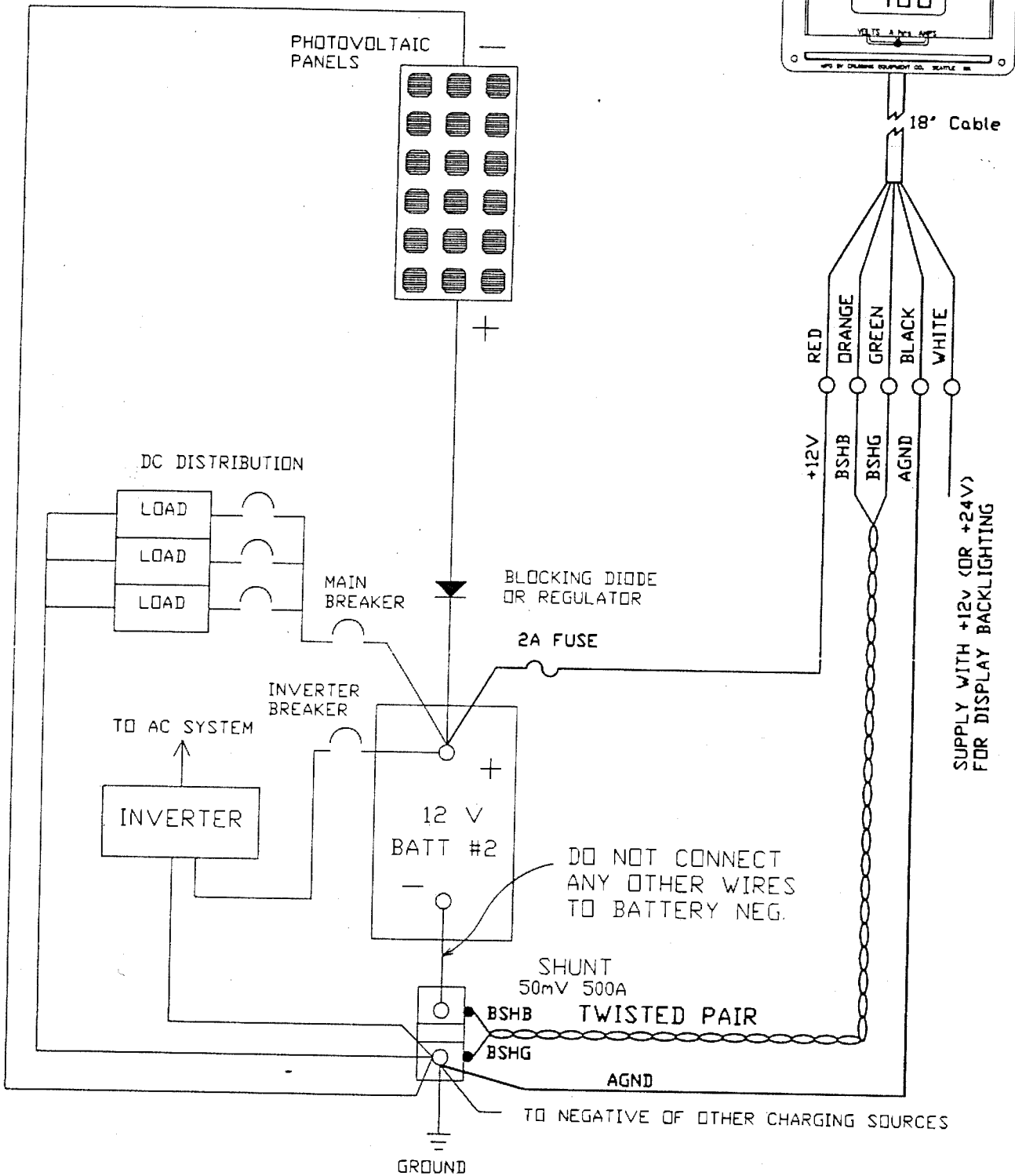
- (1) Shunt rated at 500 Amps max.
- (2) All LINK 200 Meter wiring # 18 AWG minimum. Shunt leads are twisted pair.

DWG: LINK 200 METER
USED AS BATTERY/SOURCE
MONITOR FOR ALTERNATIVE
ENERGY SYSTEM

NO: L2WIREA.DWG REV: 9/28/93

CRUISING EQUIPMENT CO.

CAUTION!!! If the LINK 200 Meter is to be used in a 24V system be sure it is a 24V model.



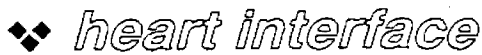
NOTES:

- (1) Shunt rated to 500 Amps max.
- All LINK 200 Meter wiring #18 AWG minimum.
- Shunt leads are twisted pair.

DWG: LINK 100 METER
FOR ONE BATTERY WITH
ALTERNATIVE ENERGY
CHARGING SYSTEM

NO: LIWIREA.DWG REV: 9/28/93

CRUISING EQUIPMENT CO.



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Cruising Equipment Co.

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LINK Meters are a joint venture of two Valley Forge Companies. Installation and operation questions should be directed to Heart Interface. Warranty issues should be directed to Cruising Equipment Co..

LIMITED WARRANTY

DO NOT INSTALL OR ATTEMPT TO USE THIS PRODUCT UNTIL YOU HAVE READ THE OWNER'S MANUAL IN ITS ENTIRETY. IMPROPER INSTALLATION OR USAGE OF THIS DEVICE MAY BE HAZARDOUS AND MAY CAUSE DAMAGE TO OTHER ELECTRICAL EQUIPMENT.

Cruising Equipment Co. (CECO) warrants to the original purchaser only for 18 months from the date of purchase that LINK 100, LINK 200, LINK 200R, LINK 2000, and LINK 2000R Meters (hereafter Meter) will be in good working order when properly installed and operated as described in this Manual.

If your Meter fails to perform or becomes defective under normal use and service, CECO will, without charge, at CECO's place of business, within a reasonable time after delivery, repair, or at CECO's option, replace with a new or factory reconditioned part any part found defective, or at its further option, refund to you the entire purchase price.

In order to avail yourself of the warranty you must:

1. First contact: Heart Interface Corp. at 21440 -68th Ave. S. Kent, WA 98032, (206) 872-7225 or Cruising Equipment Co. at 6315 Seaview Ave. N.W., Seattle, WA 98107, (206) 782-8100;
2. Obtain warranty authorization from CECO or Heart;
3. Ship the Meter, charges prepaid, with proof of purchase within 18 months of its sale to you.

This warranty is void and will not apply if:

1. Your Meter has been modified or repaired without written authorization from CECO;
2. The identification markings on your Meter have been altered or removed;
3. Your Meter has been damaged through abuse, neglect, exposure to sea spray, lighting strikes, high voltage, accident; or
4. Your Meter was not installed and operated according to the owner's manual or was operated under conditions more severe than those specified in the owners manual.

THE FOREGOING WARRANTY IS IN LIEU OF ALL OTHER WARRANTIES, INCLUDING THE WARRANTIES OF FITNESS FOR A PARTICULAR PURPOSE AND MERCHANTABILITY, EXPRESS OR IMPLIED, AND OF ALL OBLIGATIONS OR LIABILITIES ON THE PART OF CECO FOR DAMAGES, INCLUDING, BUT NOT LIMITED TO LOSS OF TIME, INCONVENIENCE, COMMERCIAL LOSS OR CONSEQUENTIAL DAMAGES, WHICH MAY ARISE OUT OF OR IN CONNECTION WITH THE USE OR PERFORMANCE OF THE METER.

Some states do not allow the exclusion or limitation of incidental or consequential damages, and some states do not allow limitations on how long and implied warranty lasts, so if the law of that state applies, the above limitation or exclusion may not apply to you. This warranty gives you specific legal rights and you may also have others which vary from state to state.

Warranty Registration

Cruising Equipment Co. periodically updates installation manuals, programs, & products, or offers product enhancements. In order to inform you of these events please fill out the following Warranty Registration information.

Name _____

Permanant Address _____

City _____ State _____ Zip _____

Model _____ Serial Number _____ Purchased From _____

Date of Purchase _____ Comments _____