Coleman Air

C440-HVA
440 Amp Diversion Controller

With Dual Volt/Amp Meter

Pre-wired with DC Breakers

Version 5.00

With Extended Diversion Mode

All connections to the batteries, solar panels and turbines are made to the six terminals on the bottom of the unit. If you will be using a wind turbine, you will need to connect your diversion load to the two terminals on the left-hand side of the unit. This unit may be used for wind (or hydro) only, solar only or both. **Multiple solar panels and or wind turbines may be hooked up as long as you do not exceed the total capacity of the unit.** More information on these subjects is provided later in this manual.

Note: All electronic components and terminals are isolated from the back-plate and steel enclosure preventing ground loops as well as providing a degree of lighting protection.

Introduction

This diversion controller is the result of our many attempts to use the controllers currently on the market (offered by some of the largest names in the business), to work in conjunction with our wind turbines. None of these diversion controllers did what we needed a diversion controller to do. So we designed our own -- and added all of the features that are truly needed in a diversion controller.

Some of the key features of this controller are:

- **Microprocessor controlled** -- This is very important for both stability and functionality.
- **User changeable settings** -- Several controllers on the market set the dump level, and that's that!
- **High amp rating** - 440 amps surge, **125 amps continuous.**
- **Multiple voltage settings** – Easy to set jumper allows use on 12, 24 or 48 volt systems.
- **High Contrast LED battery voltage meter**.
- **High Contrast LED turbine amperage meter**.
- **Two pre-wired 150 Amp DC Breakers with disconnects and reset.**
- **On/Off switch for Meter**.
- **Battery status LED** - Several controllers do not tell you what's going on - This one does!
- **Push to test**. - Ever wonder if your controller & load are working OK?
- **Reverse polarity protected** – This unit will not be damaged if you inadvertently reverse the battery sense lines.
- **Over Voltage protection.** The circuit board is protected against over voltage and over current.
- **Steel enclosure** - with multiple conduit openings.
- **Large terminals** - that can actually terminate large wire.
- **EDM – Extended Diversion Mode,** allows you to run a diversion load for an extended period of time.
- **Pre-wired for both solar and wind. Super easy terminations and hookup.** Saves hours of time and trouble not having to interconnect all of these components.
- **Both Solar and Wind. –** Perfect for use with both wind and solar systems, including both at the same time. Can of course be used with either solar or wind as well.

Some specifics

The microprocessor is the heart of the controller. It is given the battery voltage and the user changeable trip points. This information is analyzed and acted upon by the microprocessor. The battery level is checked and based on that information the Green LED flashes or is illuminated as follows:[1]

1 - (One) Flash indicates the battery is less than 12 volts
2 - (Two) Flashes indicates the battery is 12 to 12.5V
3 - (Three) Flashes indicates the battery is 12.6 to 13v
4 - (Four) Flashes indicate the battery is 13.1 to 13.5V
5 - (Five) Flashes indicates the battery is above 13.5V but less than 13.9V

Steady green means the battery is full.

(Settings are adjustable)

The red LED is illuminated when the battery is being dumped at 14.5v or the charge source diverted. The dump remains active for a minimum of 5 seconds, at which time it is checked by the microprocessor. If battery voltage drops below the "Dump Cancel " level, the dump is disabled, otherwise the dump is continued and rechecked every 5 seconds.

When you click the "TEST" push-button - the 5 second cycle is started (one time, unless the batteries are within the "Dump start" and "Dump Cancel" zone.)

Settings are user changeable! By simply turning a simple potentiometer with a small screwdriver, you can quickly adjust the trip point.

High amp rating -- 440 Amps surge, 10,000 Watts -- This is a big controller.

About wire size – Insure you have selected an adequate size wire for the amperage you will be controlling. Undersized wire can result in high heat build up in the wire and connections possibly leading to a fire.

Use a fuse or DC disconnect! Hooking up an alternate energy source or diversion load without a fuse or disconnect can result in serious injury or death!

Use extreme caution when installing or servicing this controller. High amperages can KILL you. – Always disconnect the energy source before servicing this unit.

This unit is designed for mounting in a dry indoor environment. **The enclosure will not protect the contents from moisture**. Please do not mount outdoors where rain, snow or high moisture content is a possibility.

[1] This information is for a 12 volt system. It will be double for a 24 volt system, etc.

About load diversion

The basic operating philosophy of a diversion controller is quite simple. Monitor the battery voltage, and if it should rise to a predetermined level, connect a diversion load or "Dummy Load", of sufficient size, to the battery or energy source to prevent the battery voltage from increasing any further. This is a very simple, yet very effective way of preventing battery overcharging. All alternate energy systems should have some form of battery overcharge protection.

Several schools of thought on the subject.

1. The source of power (wind turbine, solar panels etc.) -- should remain connected to the batteries while the dump load controller is actively dumping the excess voltage.
2. The source should be diverted to the load directly and disconnected from the batteries.

   We happen to believe that is far better to leave the wind turbine connected to the batteries at all times. Why? When you remove the battery level voltage from a wind turbine and send it's power directly to a load, then it sees for all practical purposes a short circuit (depending on the resistance of the load and lead wires.) This may cause the turbine blades to slow dramatically and in some cases bring it to a halt. This braking action can cause heat build up in the stator if it is repeated every few seconds or so (if the battery is just a little over the top). **When you allow the turbine to see the batteries, along with the load, the turbine remains more within its design realm** -- always a good thing.

Please note: this controller does not include a blocking diode or an A/C to D/C rectifier, as these are specific to your application. If you are using the controller with a DC turbine or solar panels, you may need to purchase a blocking diode. A/C turbines require rectification from A/C to D/C.

FAQ: Do I need a diversion load for a wind turbine?

Yes. Diversion controllers work by diverting excess energy from the wind turbine to a diversion or "dummy load". This diversion allows the turbine to remain under a load at all times. A solar panel may be safely disconnected from the batteries, but an active wind turbine should never be disconnected from its load (battery/diversion load). When a wind turbine is not loaded, it can easily speed out of control in high wind events, which can lead to catastrophic failure of the turbine as well as the possibility of damage and injury to other property and people. **It is very important that your turbine has a very reliable load at all times.**

Please see our FAQs located on our website, www.ColemanAir.us for more information on this subject and many others.

Diversion Load Types

A diversion load needs to be larger (by at least 10-20%), than the sum total of all your solar/wind/hydro charge sources combined that will be routed through the diversion load. When the diversion load is too small, battery voltage may continue to rise even when the diversion is active. It is also important to use a load that is not likely to fail. Light bulbs and similar such loads are not good diversion (dummy) loads, since they will fail and you may be left with no method to dump the excess energy going into your batteries.

It is commonly thought that a standard 120vac, 2000 watt heating element (readily available from your local hardware store), would make a good load; however, in reality, they are not well suited, as it takes several of these elements to actually be effective in lower voltage systems. A 2000 watt, 120VAC element will not dissipate 2000 watts at lower voltages. You will need to install multiple elements in parallel to achieve the desired load specifications.

Please use the following chart as a quick guide in using a 2000-watt, 120 VAC heating elements.

60Vdc dump (48Vdc system) -- 500 Watts -- 8.3 amps
30Vdc dump (24Vdc system) -- 125 Watts -- 4.2 amps
15Vdc dump (12Vdc system) -- 35 Watts – 2.1 amps
120Vac -- 2000 Watts, at 16.7 amps

Basically, a standard 2000-watt, 120 VAC element, in a 12-volt system will only dissipate 35 watts.

Water heating elements designed specifically for 12, 24 and 48-volt systems are by far a better choice.

A very acceptable diversion load is a power resistor. These can be obtained via your Coleman Air dealer. Various wattages are available as either completed load centers or individual power resistors.

Product Code: L675W12V


45A/12V 675 Watt Diversion Dummy Load Resistor Heater -- For 12 volt systems

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Product Code: 2R100W


2 Ohm, 100 Watt power resistor for 12v systems.

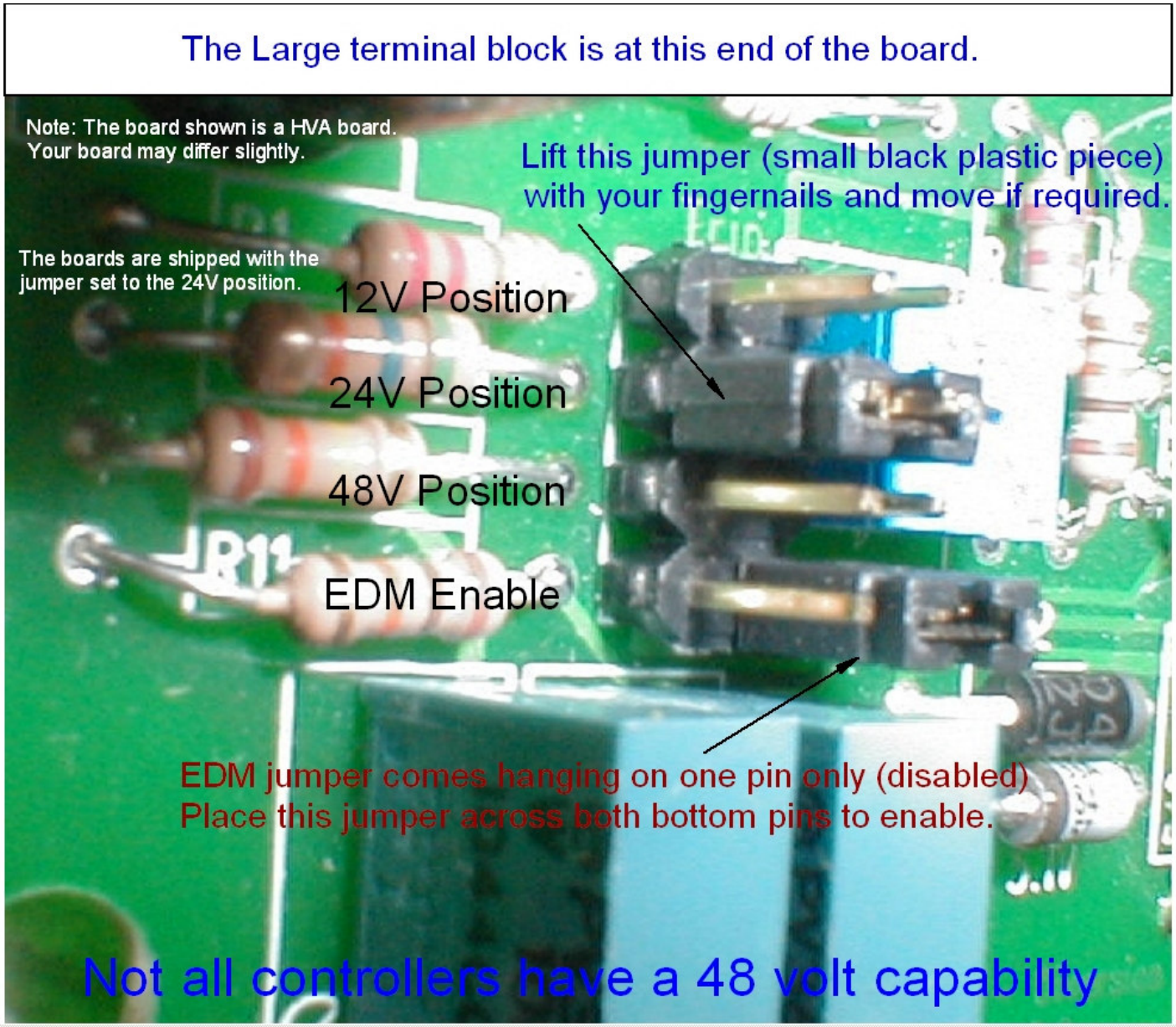
Place multiple resistors or load centers in parallel for a higher wattage load. When you place the same value resistors in parallel, you double the wattage rating, and ½ the resistance. This is a safe method of doubling the wattage/amperage handling capability of your diversion load.

Note: you cannot simply use a lower value resistance without also increasing the wattage rating of your resistor. For instance, attempting to use a single 500 watt power resistor of 2 ohms on a 48 volt battery system (60v dump), will result in the dissipation of 1800 watts, however the resistor is only rated at 500 watts, and will be destroyed.

A diversion load is not required for solar only systems.
Please visit our online store for a selection of diversion loads, diodes and rectifiers.

Selecting your battery system voltage

The Coleman Air C440-HVA can handle 12, 24 or 48 volt system. To set the controller for use with a 12 volt system, place the jumper in the 1st position closest to the large terminal block; use the 2nd position for 24 volt systems; and the 3rd position for 48 volt systems.



Note: Position 4 is the EDM jumper on versions 3.2 (EDM) and later. If you elect to use EDM, install this jumper in addition to the voltage selection jumper. You will always select a particular voltage, regardless if you elect to use EDM or not. EDM is discussed in detail later in this manual.


←This jumper position would select a 24 volt system.

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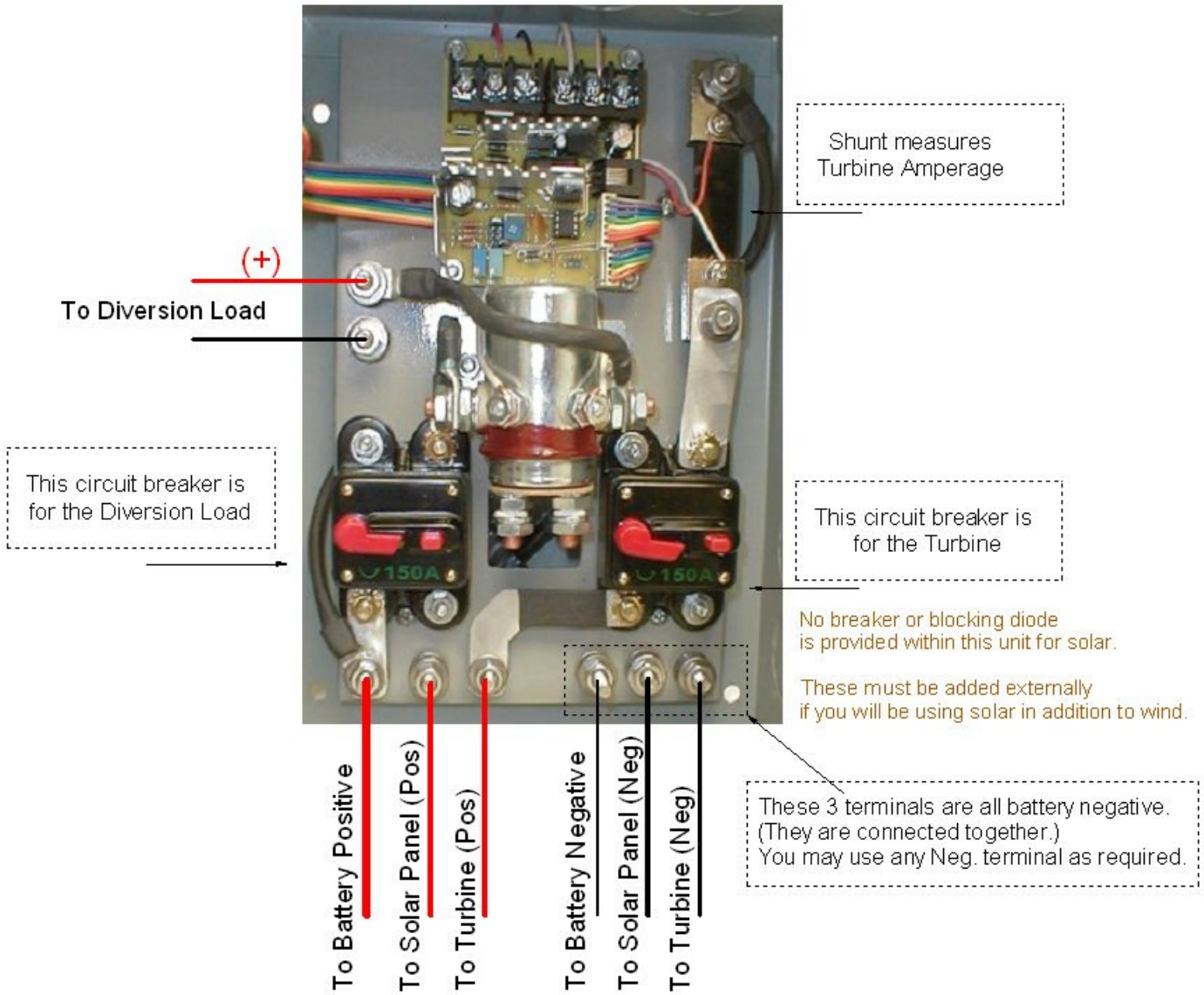


Press the RED button on the Circuit breaker to disconnect either the Diversion Load or Turbine.
Swing the red latch upwards to reset the breaker (or reconnect)

All connections to the batteries, solar panels and turbines are made to the six terminals on the bottom of the unit. If you will be using a wind turbine, you will need to connect your diversion load to the two terminals on the left-hand side of the unit. This unit may be used for wind (or hydro) only, solar only or both. Multiple solar panels and or wind turbines may be hooked up as long as you do not exceed the total capacity of the unit.

The solenoid in this unit is rated at 440 amps, up to 10,000 watts. We have installed two 150-amp breakers as a standard configuration. This allows for 9000 watts of wind power in a 48-volt system, 4500 watts in a 24-volt system and 2250 watts in a 12-volt system. **Solar systems should be designed for no more than 125 amps continuous current.**

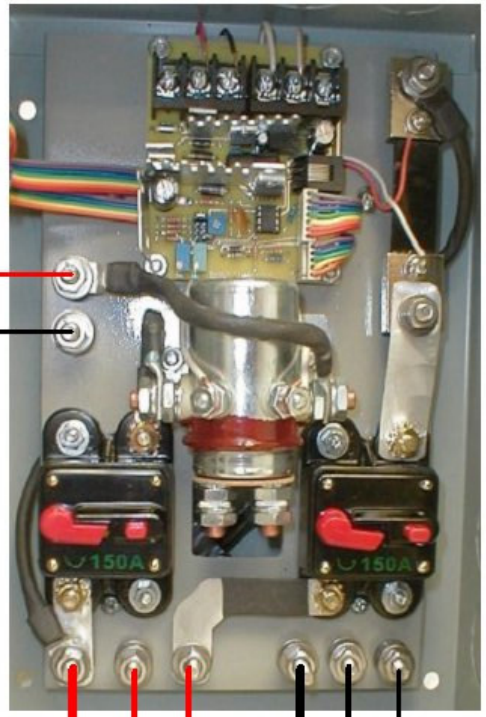
For wind only hookups, use these same terminal designations shown above. For solar only, please see the hookup drawing labeled, “Solar Only Wiring Diagram”

To help prevent over-voltage, always hookup the controller to the batteries before hooking up your turbine or solar leads.

12, 24 or 48 Volt Dual Control Diversion Control for Wind Disconnect Control for Solar Wiring Diagram

When the batteries reach the trip point, the relay is activated which opens the normally closed circuit from the solar panels to the batteries.

At this same time, the diversion load is activated, allowing the turbine to remain running without overcharging the batteries.



Wind or Hydro Energy Source

(+)

Diversion Load:
Required for Wind Turbines.
Polarity is not important for most resistive loads

Solar Array - Open collector voltage should not exceed double your battery system nominal voltage.

Caution:
Disconnect solar Input, before disconnecting the controller from the batteries.

Disconnect the controller from the batteries before servicing.

Fuse

Blocking Diode

(+)

Battery Bank

(-)

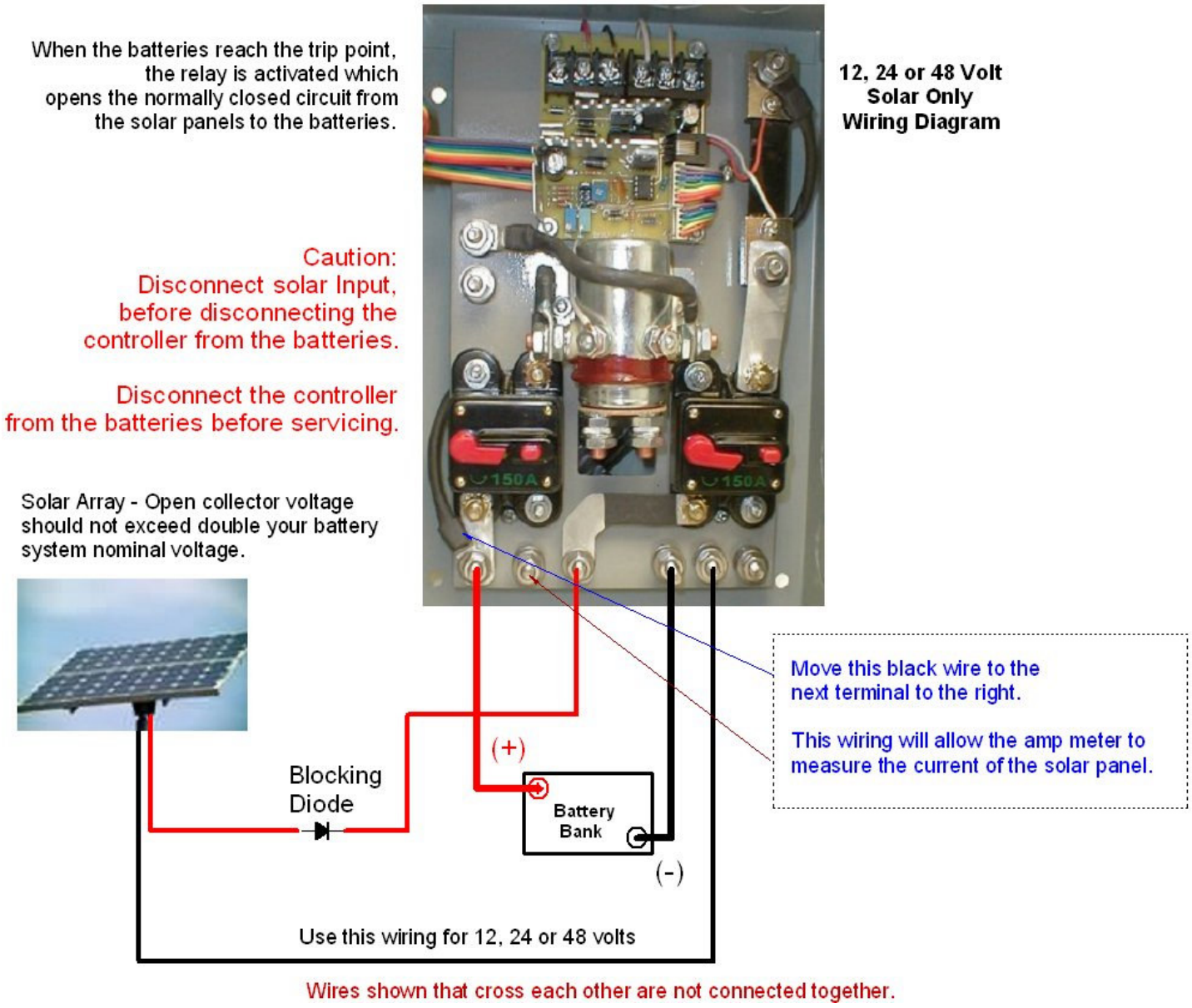
Fuse Rating:
No more than 400 Amps

Use this wiring for 12, 24 or 48 volts

Output of turbine shown to be DC (after the rectifier) for clarity of diversion control.

Add a blocking diode or 3 phase rectifier if applicable for your turbine.

Wires shown that cross each other are not connected together.



Use this wiring diagram for solar only installations.

You will need to disconnect and move the black wire that has been terminated to the far left terminal, and terminate it to the very next terminal on the right.

This wiring will route the solar energy through the breaker on the right, through the shunt (so the amp meter can measure the current flow of the solar energy), then through the normally closed contacts of the solenoid, and then finally to the positive of the battery bank. You do not need a separate breaker for the solar panel since you will be using the breaker already installed in the controller.

No diversion load is required for a solar only installation. When the batteries reach the trip point, the solar energy will be disconnected from the batteries until the batteries drop by about five percent. At that time the circuit will be closed again, allowing the batteries to be charged. This cycle will continue, allowing the batteries to remain very close to the upper trip point.

To help prevent over-voltage, a**lways hookup the controller to the batteries before hooking up your turbine or solar leads.**

Extended Diversion Mode -- EDM

The basic operating philosophy of a diversion controller is quite simple. Monitor the battery voltage, and if it should rise to a predetermined level, connect a diversion load, of sufficient size, to the battery or energy source to prevent the battery voltage from increasing any further. The amount of time the diversion load is connected is generally only 10 to 30 seconds. In this amount of time, the battery voltage will have dropped enough to be back in the normal region. The controller will continue to engage and disengage the relays as often as necessary to prevent battery overcharge. This is the normal mode of operation. The microprocessor uses several advanced algorithms to prevent rapid relay cycle, yet it is common for the relays to be engaged and disengaged a few times a minute. This constant attention keeps the batteries very close to (or just below) the trip point you have set.

There are however, situations where you would really like the controller to engage the relays for a longer period of time once the batteries get to a "Full" state. This is what we call Extended Diversion Mode. When you enable this mode (see jumper settings), and the batteries reach the trip point you have set (the same trip point as the normal mode), the controller will engage the relays for approximately five minutes or until our batteries are depleted by 15%, which ever comes first.

The EDM mode is very useful for running such items as water pumps or small grid tie inverters that you do not want turning on and off every few seconds. When you enable the EDM mode, the wiring remains the same; the difference is that the load you connect will be engaged for a longer period of time.

It is very important that the load you choose is 100% dependable if this controller is being used to prevent battery overcharge. If the load is not present, then your batteries will overcharge. Grid-tie inverters are not a load if the grid fails (power outage due to thunderstorm etc.). Such a loss of load can also cause damage to your wind turbine if it depends on this load.

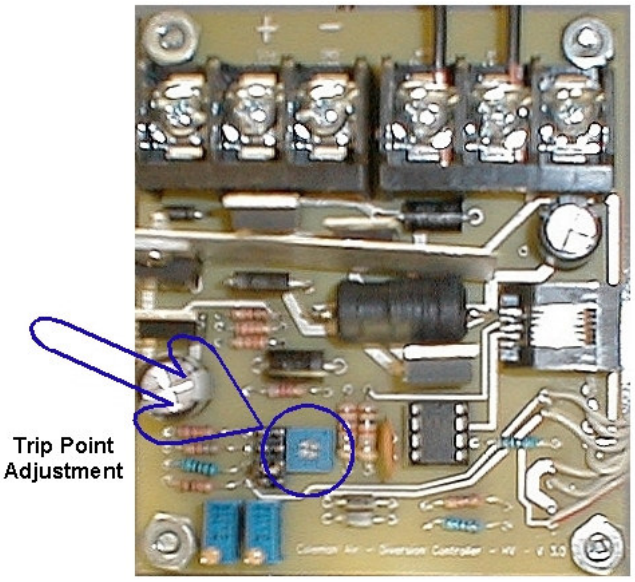
If you will be using the EDM mode with a load that may not be present at all times, then it is important that you have another controller in parallel that is also monitoring the system with a slightly higher trip point. This second, failsafe controller will then divert the excess energy to a diversion load that is 100% dependable should the 1st controller's load not be present or capable of disbursing all of the excess energy.

As in the case with the normal mode, the load you connect cannot exceed the capacity of the relays. Do not attempt to hookup highly inductive loads, as the relays will be damaged due to high currents during the motor start.

Important. Pressing the test button with the EDM jumper set, may at times engage the relays for a full 5 minutes. This is especially true if you have pressed the test button for a very short time or have pressed it repeatedly.

As shipped, the EDM (Extended Diversion Mode) jumper will be hanging on one terminal only. We have shipped it in this manner so the jumper is available to you but not actually being used. To enable EDM, place the jumper across both of the bottom pins as shown in the voltage selection image above

Calibrating the Diversion Controller



The controller has already been calibrated by the factory using the following settings, and does not require calibration, unless the trip point used is not satisfactory for your installation.

The Green LED will be illuminated as follows:

One flash indicates the battery is less than 12 volts (12 volt system - double for 24 etc)
Two flashes indicates the battery is 12 to 12.5V
Three flashes indicates the battery is 12.6 to 13v
Four flashes indicate the battery is 13.1 to 13.5V
Five flashes indicates the battery is above 13.5V but less than 13.9V
Steady green means the battery is 13.9 volts or higher.

The Red LED is illuminated when the battery has reached a voltage level of 14.5v or higher

Note: Disable the EDM Jumper, while calibrating.

If you would like to change the dump level trip point, please use the following procedure.

If you own a variable voltage power supply**,** then the following procedure is recommended.

1) Turn the dump level potentiometer fully counter clockwise.
2) Set the voltage of the power supply to the desired dump level trip point (for instance 14.2 volts)
3) Slowly turn the dump level potentiometer clockwise until the green LED is illuminated steady.
4) Pause for at least 5 seconds, then slowly continue to turn the dump level potentiometer clockwise until the red LED is illuminated.
5) Lower the voltage of the power supply by at least one volt.
6) Slowly turn the voltage of the power supply up until the red LED is illuminated, checking to see if you achieved your desired setting. Please note; the input level is only checked once every 5 seconds while the green LED is flashing, and only once every second while the green LED is steady, so you must make very slow adjustments during this procedure. If you feel you have passed your set point, then restart the procedure. Turning off the power supply to force all voltages to be dissipated, can be very helpful.

Please note: Changing your dump level set point will also change the voltage levels for which the green LED flashes.

If you do not own a variable voltage power supply, or would rather set the controller while it is installed, then if you have an inverter that is able to set the float or bulk charge voltage of the battery bank to a particular level, use the inverter as your variable voltage supply.

If you do not have an inverter that is capable of this, then you will need to cause your batteries to be brought to desired dump level trip point via your wind/solar/hydro energy source. Then once they have achieved this set point, turn the dump level set point potentiometer fully counter clockwise. Wait 15 seconds, or until the green LED is flashing no more than 3 times. Then slowly turn the same potentiometer clockwise until the green LED is illuminated steady. Wait 5 seconds, then, slowly turn the same potentiometer until the RED is illuminated.

Note: **The circuit boards shown in the pictures above are from earlier version of this controller**. The newer versions of the circuit board contain a fuse to help prevent both over current within the circuit board itself and over-voltage at the battery sense leads. We factory install a 4 amp, standard rate fuse (not a slow blow). If you need to replace the fuse, please use a fuse between 2 and 5 amps. Do not exceed 5 amps. This fuse also works in conjunction with over-voltage protection circuitry in versions 5.0 and greater. If the voltage at the controller's input (+/- terminals), reaches or exceeds 115 volts, the fuse will be blown instantly by the internally circuitry to prevent component failure within the circuit board. If you find that you are blowing fuses, then please check that your system is not exceeding 115 volts and that you have not inadvertently grounded any portion of the circuit board, battery sense leads, or relay wires. To help prevent over-voltage, always hookup the controller to the batteries before hooking up your turbine or solar leads.