Coleman Air
Diversion Controller
Model C40

Version 2.0

With Extended Diversion Mode

Designed for 12 volt battery based systems.

The Coleman Air model C40 charge controller is a compact, simple to use controller specifically designed for use with moderate wind and small solar systems. The unit is supplied with one 40 Amp relay. Additional relays can be purchased to increase the total amperage to as high as 160 amps.

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** – 40 amps with the one included relay. Additional relays can be added.
- **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?
- **Steel enclosure** - Steel face, with standard singlewide outlet box with conduit openings.
- **Easy terminations** – Simple to install.
- **Reverse polarity protection**. – The electronics are protected against accidental reverse polarity.
- **Versions 2.0 and greater** now have an extended diversion mode **(EDM.)**
- **Ability to divert the source** from the batteries to the load, or dump both the batteries along with the source.

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 - (One) Flash indicates the battery is low -- less than 12 volts.
2 - (Two) Flashes indicates the battery is 12 to 12.3V
3 - (Three) Flashes indicates the battery is 12.4 to 12.7v (A fully charged lead acid battery at rest)
4 - (Four) Flashes indicate the battery is 12.8 to 13.0V
5 - (Five) Flashes indicates the battery is above 13.1V but less than 13.5V

Steady green means the battery is full

Settings are adjustable. Changing the trip point will alter the flashing levels of the green Led.

The red LED is illuminated when the battery is being dumped at 14.4 volts 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 -- 40 Amps as configured!

There is nothing stopping you from adding more relays to increase the total load capability.

The following precautions must be taken into account if you wish to add more relays. The internal regulator can handle 4 relays (40 amp automotive type).

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 "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 its 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.

Specifications:

Maximum continuous input voltage on the Battery sense leads (+/- terminal blocks) is 35vdc

Maximum intermittent input voltage on the Battery sense leads (+/- terminal blocks) is 42vdc

Maximum recommended input voltage on the Relay contacts is 45 volts.

12-volt systems: 40 Amps, not to exceed 900 watts for the normally open contacts; 30 Amps/720 watts for the normally closed contacts.

This controller has been designed for 12 volt battery banks only.

Diversion Load Types:

A diversion load needs to be larger (by at least 20%), than the sum total of all your solar/wind/hydro charge sources combined. When the diversion load is too small, battery voltage may continue to rise, even when the dump 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 from your batteries. A common dummy load is a standard 120vac, 2000 watt heating element readily available from your local hardware store. Please note, a 2000 watt element will not dissipate 2000 watts at lower voltages, therefore you may need to install multiple elements in parallel to achieve the desired load specifications.

Please use the following chart as a quick guide in using 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 – 1.0 amps
120Vac -- 2000 Watts, at 16.7 amps

Another acceptable diversion load are power resistors. These can be obtained on our website at: http://www.ColemanAir.us

Use the following chart values of power resistors to obtain a 500-watt diversion load.

60Vdc dump (48Vdc system) -- (1) 500 watt, 8 ohm resistor (450 watts)
30Vdc dump (24Vdc system) -- (1) 500 watt, 2 ohm resistor (450 watts)
15Vdc dump (12Vdc system) -- (1) 500 watt, .5 (1/2) ohm resistor (450 watts)

The 500 wattage rated resistors in the chart above are an example only, it is perfectly acceptable to use higher wattage power resistors if they can be obtained economically.

Place multiple resistors in parallel for a higher wattage load. When you place 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.

Step 1:

Remove the two screws that are holding the faceplate of the controller onto the switch box and carefully remove the controller from the box. Set the controller electronics aside. Mount the box as desired, indoors and out of high moisture areas. Punch out one of the openings in the switch box (bottom side normally.)

Take a look at the bottom of the relay and you will notice some numbering. This is the numbering referenced in the hookup drawings that follow:

Mount the relay next to the controller.

Step 2:

Hookup the relay coil(s), terminals 85 and 86 on the relay, to the relay wires from the controller – These are the white and orange wires. Please see the image for the Standard diversion control wiring diagram (or any of the other hookup drawings.) -- Be sure to wire through the opening you punched out in the controller's box.

Tech note: 12 volts is always available at the +12v coil terminal block. The Relay Sink terminal block is what is switched on and off, basically there is no ground for the 12v coil until the dump is activated.

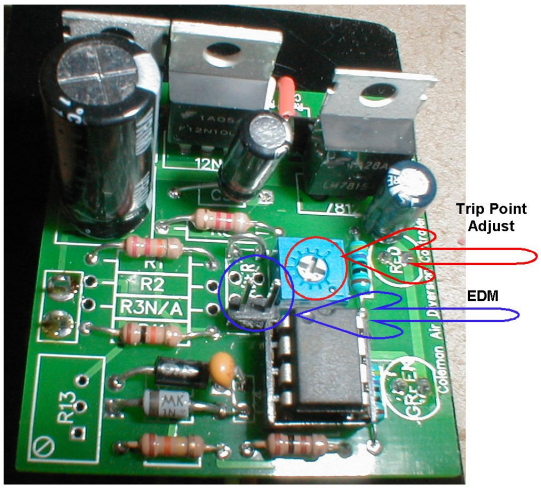
Step 3:

Hookup the red and black wires from the controller directly to your battery bank. The red wire goes to the positive post of your battery. The black wire goes to the negative post of your battery. You will of course need to add some additional wire to reach your batteries, simply tie your wires to the red and black wires of the controller using wire nuts or a similarly suitable termination method.

Mount the electronics back onto the box.

Step 4:

Hookup the contacts from the relay(s) as required for your system. Please refer to the wiring diagrams that follow for more information on hooking up the relay contacts. The controller will now be fully functional. It has been factory calibrated; however, you may change these settings if desired.



EDM: The two-pin jumper allows for enabling EDM. As shipped, this 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 small black jumper across both of the pins extending from the PCB.

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 below), 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 (motors larger than 10 amps per relay), 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.

Calibrating the Diversion Controller.

The factory using the following settings has already calibrated this controller.

The Green LED will be illuminated as follows

1 - (One) Flash indicates the battery is low -- less than 12 volts.
2 - (Two) Flashes indicates the battery is 12 to 12.3V
3 - (Three) Flashes indicates the battery is 12.4 to 12.7v (A fully charged lead acid battery at rest)
4 - (Four) Flashes indicate the battery is 12.8 to 13.0V
5 - (Five) Flashes indicates the battery is above 13.0V but less than 13.5V

Steady green means the battery is 13.5 volts or higher.

The red LED is illuminated when the battery has reached a voltage level of 14.4v or higher

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

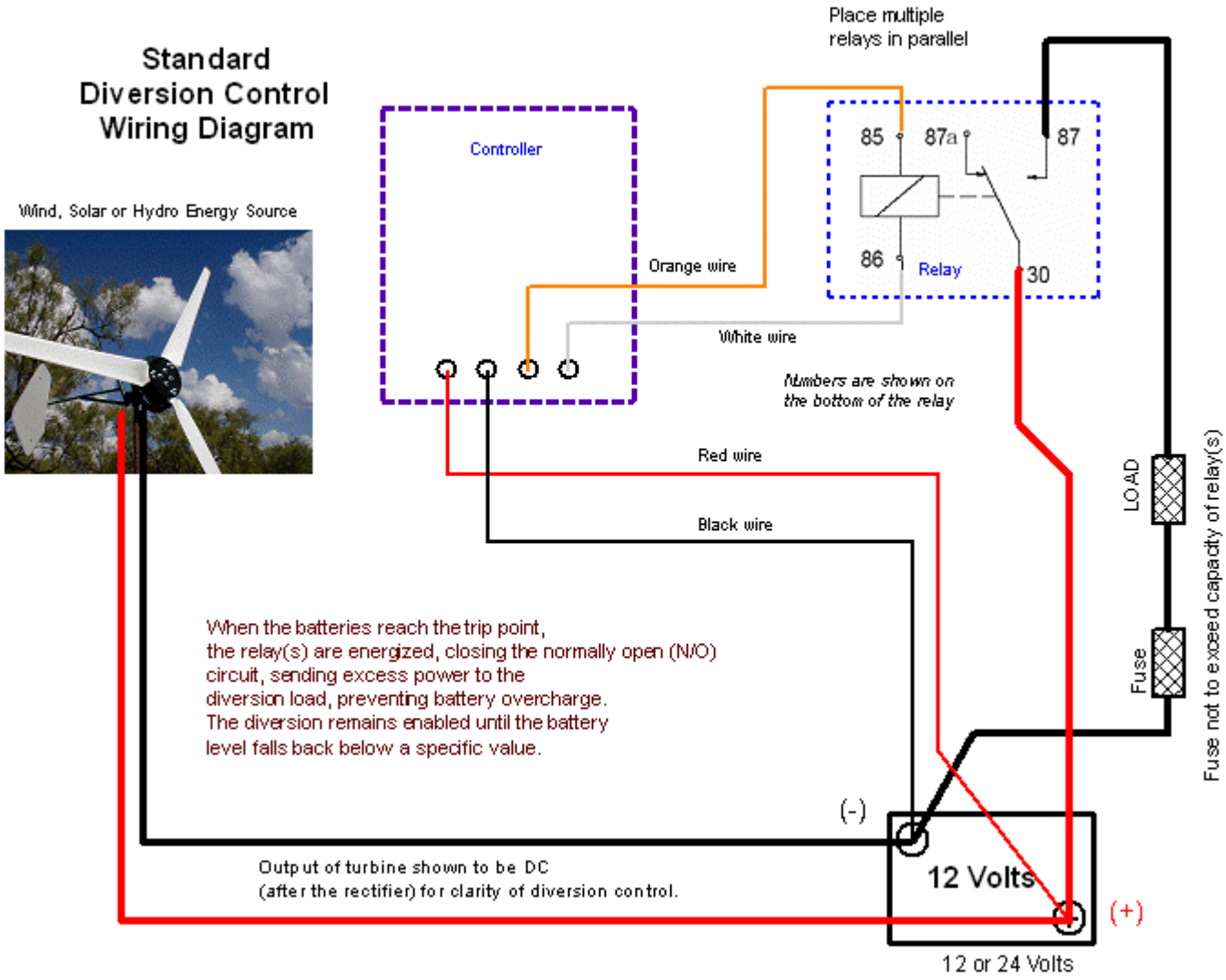
If you own a variable voltage power supply, then the following procedure is recommended.

1) Turn the dump level potentiometer fully counter clockwise with a small screwdriver. (Small blue box with little white cross in the middle of the controller.)
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.

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

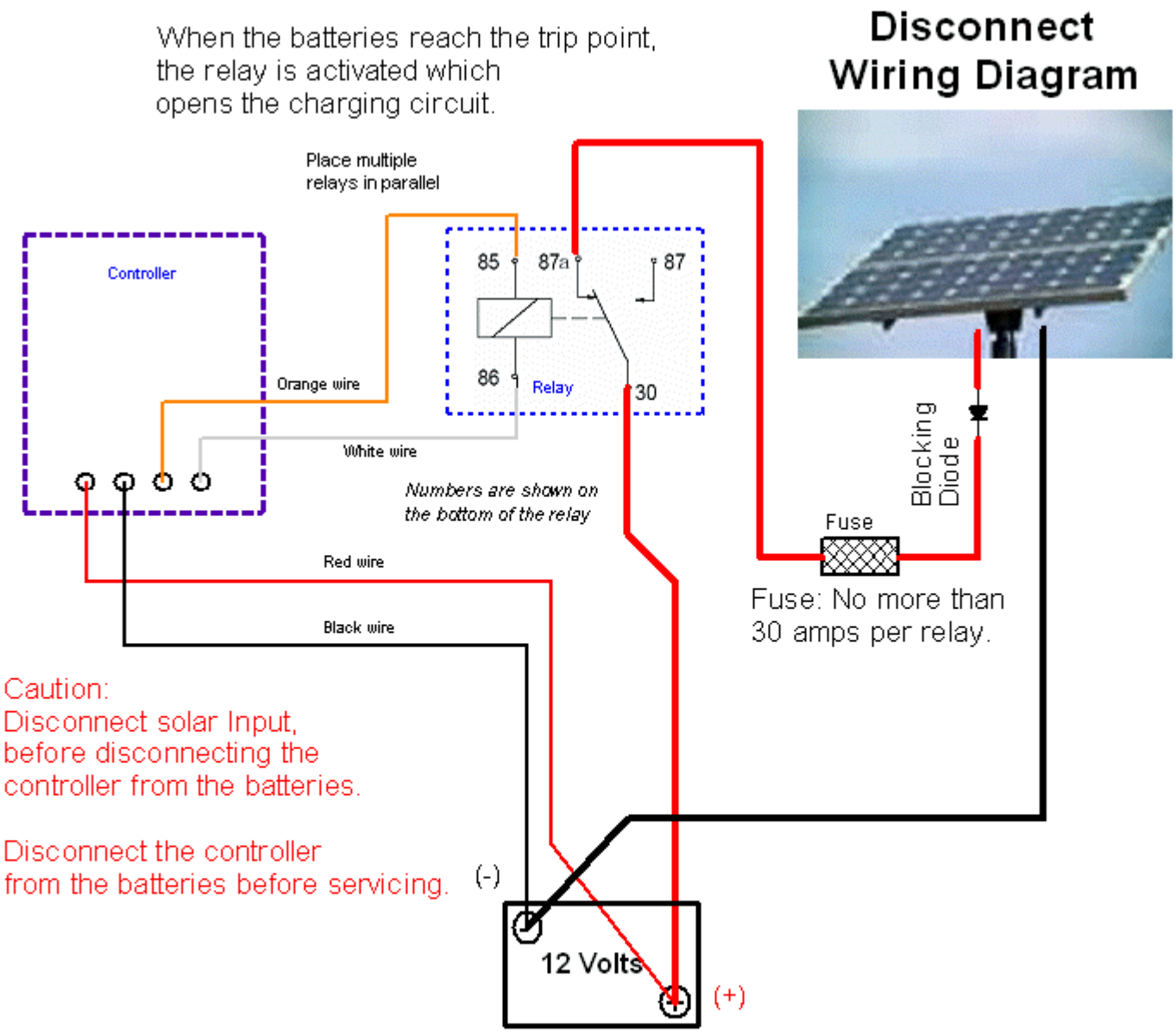
If you do not own a variable voltage power supply, or would rather set the controller while it is installed, then another option, should you have an inverter that is able to set the float or bulk charge voltage of the battery bank to a particular level, use the inverter as your variable voltage supply.

If you do not have an inverter that is capable of this, then you will need to cause your batteries to be brought to the 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.



This is the most used hookup method, particularly for wind and hydro units. This wiring method is also suitable for solar.

Note: Your turbine hooks up to your battery directly – not to the controller. (You may need a rectifier or blocking diode, depending on the type of turbine you have). Please see the notes at end of the manual.

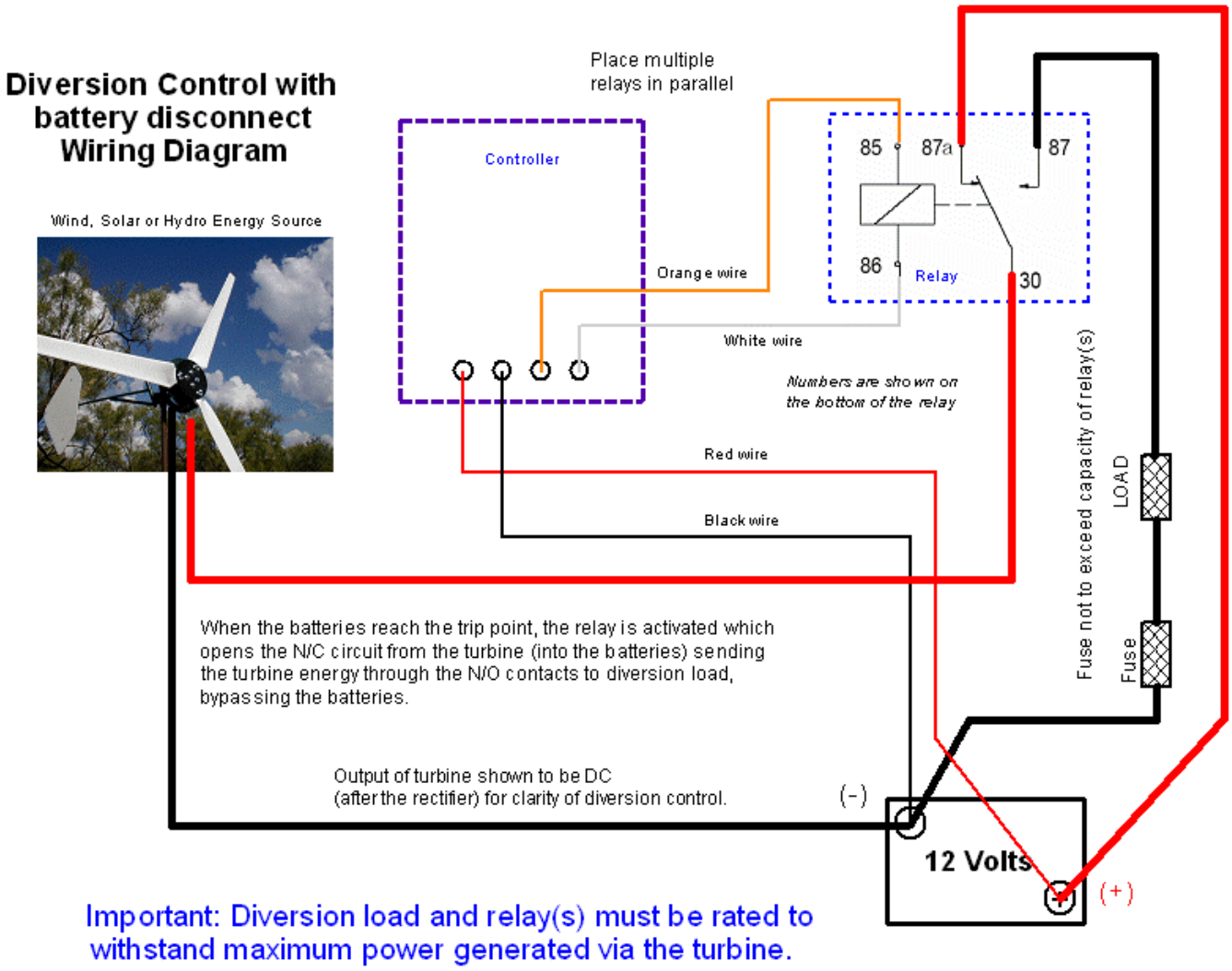


Note: Wind and hydro turbines should not be hooked up via this wiring method as they normally need to remain under a load while operating.

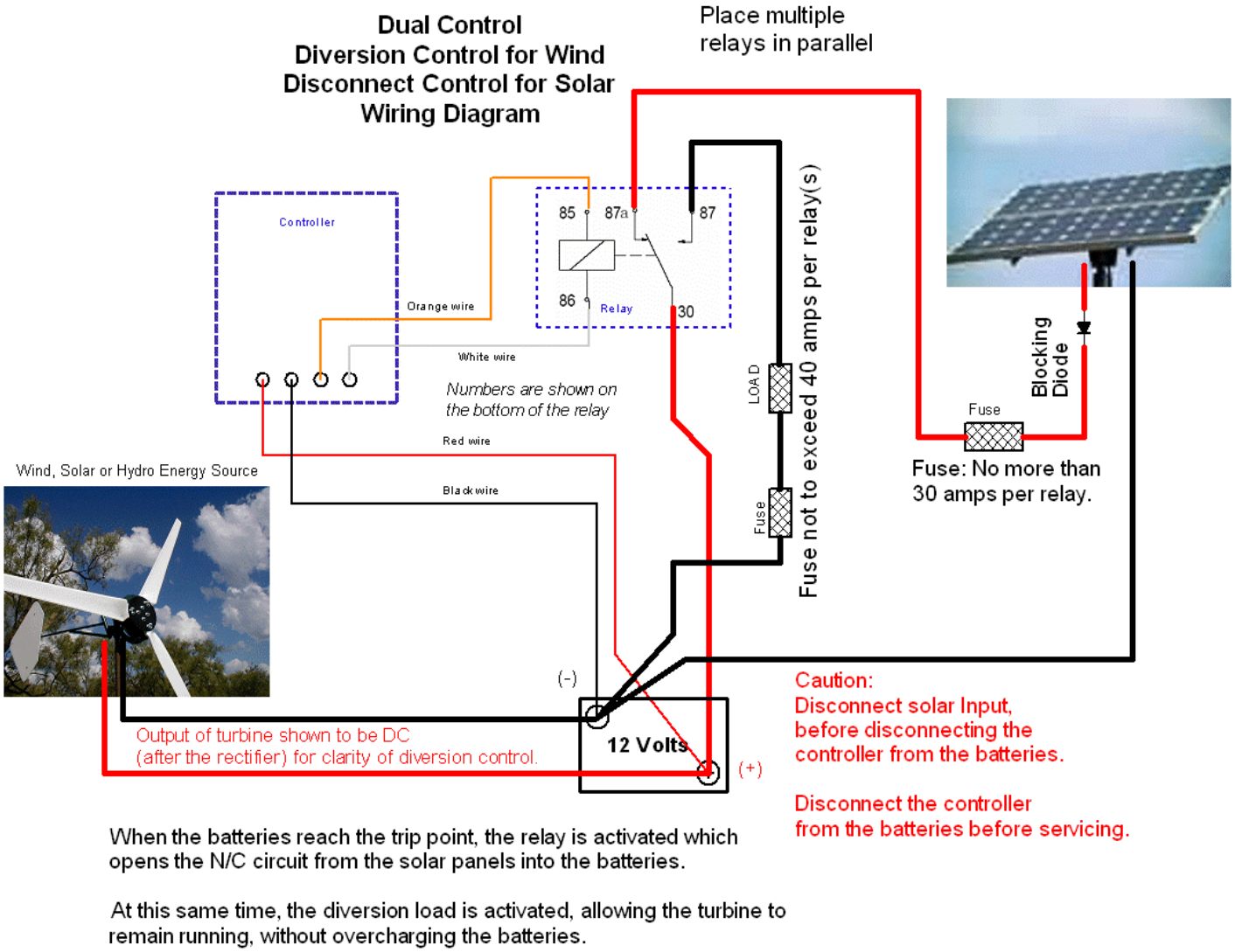
For Wind/Hydro, please wire the controller as a diversion controller.
See the graphic for Standard Diversion Control Wiring.

This wiring is for solar systems.

In this mode, the charge source is disconnected from the batteries and no diversion load is used. **This wiring method is not suitable for wind/hydro units since they need to remain under a load during normal operation to prevent over-speed.**



This wiring method is similar to the standard diversion control wiring, except that when the trip point is reached, power from the charge source (wind/solar etc) is no longer allowed to reach the batteries, but instead is sent directly to the diversion load. Use this method if you want your turbine to see a larger load when the batteries are full, possibly causing a slow down in your turbine RPM. Please see the notes about diversion philosophy in the earlier portions of this manual.



Perfect if you have both Solar and Wind (or Solar and Hydro), and want to control both of them with a single controller.

Note: Your turbine hooks up to your battery directly – not to the controller. (You may need a rectifier or blocking diode). Please see the note at end of the manual.

Parts list for Coleman Air - Diversion Controller v 2.0

(1) PCB Circuit Board assembled, tested and calibrated, mounted onto a solid steel faceplate.
(1) Single gang switchbox (standard outlet box.)
(1) 12V – 40A Relay.
(2) Red spade connectors.
(3) Yellow spade connectors.

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.

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