UNIVERSAL RELAY DIVERSION CHARGE CONTROLLER "Basic Model"
MODEL 1URDC-Basic 12V (Board Version 1.0.X)
For both EMR's (ElectroMechanical Relays)
and SSR's (Solid State Relays)
2-STAGE charging using SSR'S
For Wind, Solar and Hydro
(Manual Version 1.1.0)

READ ALL INSTRUCTIONS CAREFULLY FIRST!!

CONTROLLERS OF THIS TYPE ARE MORE COMPLEX SETTING UP THAN YOUR ALL IN ONES!! YOU MUST CALCULATE THE MAXIMUM POWER YOUR SYSTEM CAN POTENTIALLY GENERATE AND THEN CALCULATE THE SIZE OF THE LOADS AND WIRES ACCORDINGLY FOR MAXIMUM SAFETY!!! IF YOU HAVE ANY DOUBTS ABOUT YOUR ABILITIES TO PUT TOGETHER A SYSTEM OF THIS TYPE THEN DON'T DO IT!! FIND AND/OR HIRE SOMEONE QUALIFIED WHO CAN!!

ATTENTION: USE PRECAUTIONS FOR HANDLING ESD ELECTRO-STATIC SENSITIVE DEVICES.

Introduction

These diversion controllers were brought about by there being no low cost expandable diversion controllers on the market that would minimize maintenance while maximize battery charge and life. The 1URDC-Basic was created by request for a simpler, more inexpensive version of the 1URDC.

Months of testing and research both on these and other commercially available dump controllers, had proven that the On-Off algorithm using **EMR**'s (**E**lectro**M**echanical **R**elays) in diversion/dump mode is seriously lacking. EMR's are slow (most can not be switched faster than 2 sec on, 2 sec off to prevent self destruction and contact bounce), this delay knocks the surface charge too low when switching a load on and off so that the battery cannot absorb enough energy to fully charge. This works fine however when disconnecting the charging source from the battery and letting the battery voltage drop naturally. The majority of wind and hydro generators cannot simply be disconnected from battery and allowed to free spin as this could cause them to over rev at high speeds and self destruct. Most SSR's (Solid State Relays) on the other hand can be switched at 20ms on and 20ms off **or faster** so as not to let the battery voltage drop too low. Thus allowing the batteries to absorb more energy, resulting in the batteries charging at a much faster rate and to a higher **SOC** (**S**tate **O**f **C**harge) which leads to a greatly extending battery life (**batteries are the greatest consumable cost in renewable energy systems**).

In the process of developing an effective charge algorithm for use with SSR's in which I call **ULFAPWM** (**U**ltra **L**ow **F**requency **A**daptive **P**ulse **W**idth **M**odulation). I started seeing how many features and how much protection I could add and still keep them inexpensive. Also I have tried to make these as user friendly, adaptable and expandable as possible. These controllers are what **I WANTED** in a controller of this type and not the simple, barely adequate ones that were being offered on the market in this and higher price ranges.

I will try to keep this manual as simple and straight forward as possible as to not over complicate things. To keep cost down and prevent unnecessary waste this manual is available in PDF format only (just printout what you need). The latest version of this manual is **Free** for **DOWNLOAD HERE 1URDC-12-Basic 1.1.x Manual.pdf** from WindAndSunPower.com

I also want to thank John in Canada for his help in testing, observations and suggestions which made this version possible.

Jeff

DESCRIPTION

The Universal Relay Diversion Controller/Regulator is a low cost, Microprocessor controlled Diversion/Dump type controller designed for the **DIY** (**D**o **I**t **Y**ourselfer). It is designed to switch up to 8 conventional automotive style electromechanical relays (EMR) directly with up to 1.25A total coil current draw with up to 320A power handling capability.

Also unlike other controllers of this type of design, it will also control DC-DC Solid State Relays (SSR) in Legacy/Conventional (Dump) diversion mode or use a much more efficient **2-Stage** charge algorithm including a manual **Equalization mode**. It is theoretically able to directly switch up to 50 SSR's at 25ma each (untested). If using just 40 amp SSR's that adds up to a potential 2000A (4000A using 80 amp SSR's) power handling capability.

To keep cost down, this controller was designed for the DIY (Do It Yourselfer) and is the **BOARD ONLY** and does **not** include an enclosure. It can be mounted directly on a wall in an area protected from the environment or in an **Optional** or **user supplied** enclosure.

FEATURES

- The ability to Directly Switch up to 8 Electromechanical or 50+ DC-DC Solid State Relays
- Legacy Dump/Diversion/On-Off (Electromechanical or Solid State Relays)
- 2-Stage – Dump/Diversion (using 20ms on – 20ms off or faster SSR's Only)
- Manual Equalization Mode (using 20ms on – 20ms off or faster SSR's Only)
- Preset Equalization Voltage Set-point (15.15 to 15.45 Volts using SSR's Only)
- Extremely Low Power Consumption (≤ 20ma)
- Accurate Battery Voltage Tracking (±0.2% Internally)
- Switching Speeds Up To 25 On-Off Cycles Per Second When Using SSR's (≤25Hz)
- User Settable Dump/Diversion/On-Off Set-point (13.2 to 15.4 Volts in 0.05V increments)
- The Ability to Divert/Dump 1.25A Directly for Very Small Systems
- 8-Bit Microcontroller running at 32Mhz
- Latest SMT (Surface Mount Technology) for Compact Size and Improved Performance
- Self Calibrating
- Self Resetting Fuse
- Bi-colored LED Status Indicator
- Relay Power/Active LED Indicator
- Test/Equalization Button
- Reverse Polarity Protection
- Over Voltage Protection
- Over Current Protection
- Transient/Lightning/Surge Protection

BASIC OPERATING PRINCIPLE

Basic operation principle is quite simple. The Microcontroller constantly monitors the battery voltage. When battery voltage meets the specific criteria, the Microcontroller activates or deactivates the LED’s and external relays.

MOUNTING

To keep cost down, this controller was designed for the **DIY** (**D**o **I**t **Y**ourselfer) and is the board only and does not include an enclosure. It can be mounted directly on a wall in an area protected from the environment or in an **optional** or **user** supplied enclosure.
This Board has been designed to fit in the following inexpensive **BUD Industries** NEMA Enclosures with molded external mounting brackets:
PN-1320-C-MB Poly Carbonate/Light Gray Body with ***Clear Cover***.
Also:
PN-1320-DG-MB ABS/Dark Gray Body and Cover.
PN-1320-MB Polycarbonate/Light Gray Body and Cover.

The board does not generate much heat but it does generate some and the more relays, the more heat. Because heat sinking is incorporated into the board design and to prevent shorting, the board should be mounted at least ¼ inch off the surface using some sort of standoffs if not mounted in one of the above enclosures.

With EMR's the controller and the relays can usually be mounted in the same enclosure if there is adequate room because under normal operating conditions the EMR's **usually** generate little heat. However if you are using SSR's they can generate a lot of heat and the SSR heat-sink assembly should be mounted in a well ventilated area on a metal surface in free air preferably or in a well ventilated metal inclosure. The same goes for power resistors.

WIRING

If you look at the wiring diagrams you can see the wiring is pretty straight forward. You should use pairs of 22 to 16 gauge AWG wire between the controller and batteries, also from the controller to the relays. Keeping distances between components close as possible for maximum efficiency and accuracy. But **NOT** in the same enclosure with the Batteries as arcing from the relays can ignite the Hydrogen gasses produced by the batteries and explode! Also the corrosive gasses can damage the electronics. The loads, fuses and wires from the relays to the loads and power sources to the batteries will need to be calculated for your systems maximum potential output.

Min. Copper Gauge	Max. Amperage	Min. Copper Gauge	Max. Amperage
18AWG	7.5A	**8AWG**	45A
16AWG	10A	**6AWG**	60A
14AWG	15A	**4AWG**	80A
12AWG	20A	**2AWG**	100A
10AWG	30A	**1AWG**	125A

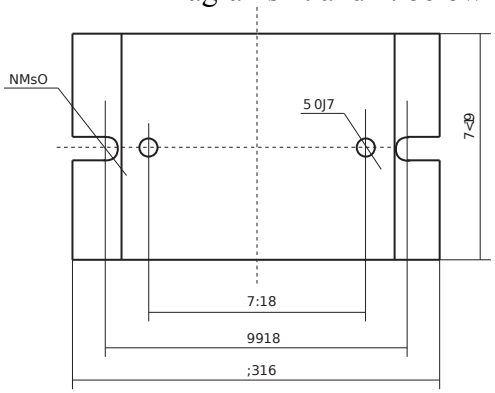
Function Selection Switch

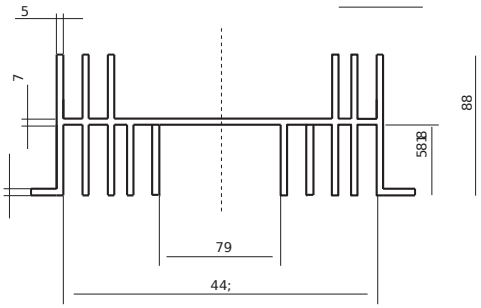
1. **SS/EM = Relay type switch –** Top position = **SS** 2-Stage Mode **(Use With SSR's Only!!)**, Bottom position = **EM** Legacy On/Off Mode (EMR's or SSR's)
2. **EQ = Equalization Mode (Use With SSR's Only!!)** - Top position button is **Enabled,** Bottom position button is **Disabled**

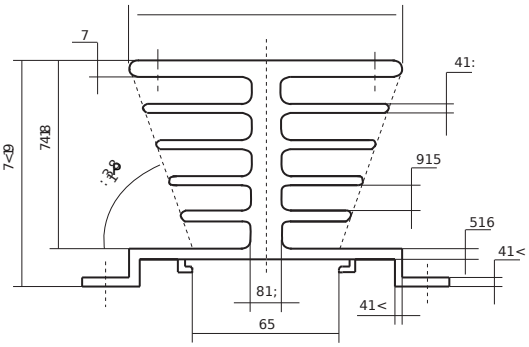
RELAYS

This was designed to use up to 8 Automotive style EMR's (the ones you can find in auto parts stores for about 3 to 5 dollars each) or up to 50 DC-DC SSR's. Multiple relays need to be wired in parallel. This can be used with other types of NON-LATCHING EMR's with nominal **coil ratings of 12VDC 1.25A max and the contacts MUST be rated above your battery bank voltage**. You will need to test them out to see if they will perform suitably. Dependent upon load, batteries and generator output, this controller can regulate the battery voltage to within ±0.2% +0.03V or less on the average with SSR's. Whereas using EMR's with On/Off type Diversion controllers, battery voltage can fluctuate a volt or more. This was designed for use with **DC-DC** SSR's Only! SSR's need adequate heat-sinking as they can get **HOT**!

Diagrams 1. and 2. below are some examples of SSR Heat Sinks.







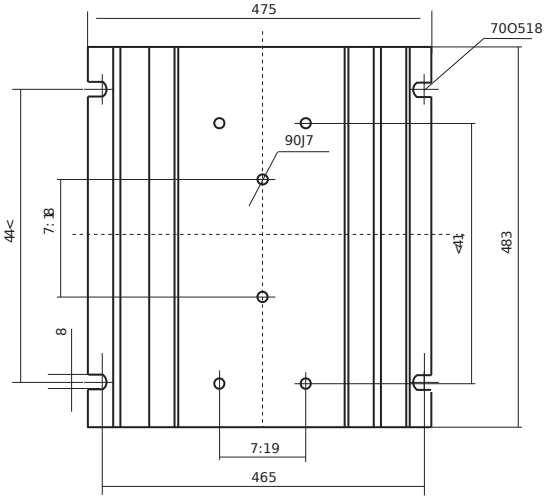


Diagram 1.
15A SSR Heatsink Example
Approximately 2"L x 2.5"W x 2"H

Diagram 2.
40A-80A SSR Heatsink Example
Approximately 6"L x 5.5"W x 2"H

Note: SSR's used for 2-Stage and Equalization modes MUST be able to switch 20ms On & 20ms Off or FASTER!!

Also some SSR Manufactures suggest using their SSR's at less than 70% of it's rated power (40A=28A Max).

Here are some inexpensive 40A DC-DC SSR's tested:

SMUNGLE SG D2240D **BAD** – NO GOOD JUNK SSR (eBay)
FOTEK SSR – 40 DD **WORKS OK** – But doesn't seem to fully turn on (eBay)
Mager MGR-1 DD220D40 **GOOD** – Tested to 35A@12V, marked 24-220VDC (eBay)

LOADS

This controller was designed for use with **Resistive** loads such as P**ower Resistors** and **DC Water Heating Elements** and such. This was **NOT** designed to use Grid Tie Inverters and other electronic devices as loads, the switching speeds could damage or destroy your electronics! What you would be looking for is a **Load Controller** that turns something on when the batteries reached a set voltage and then turn it off when the voltage drops to a set voltage.

You can buy resistive loads such as power resistors and DC water heating elements on many RE websites with the volts, amps and watts listed for them. Or to save money you can do the calculations yourself and purchase at a lower cost from electronic suppliers and/or surplus sellers. Also if your real handy you can build your own from junkyard parts.

Your Loads preferably need to be **MORE** (1.3 to 1 or 130% or higher recommended) than the Maximum power that your system could potentially generate For Proper Operation. To calculate your systems maximum watts simply multiply the maximum amperage your system can generate by your batteries maximum charge voltage V x I =W. If you are going to switch the source generator, you should use the maximum voltage and amperage that it can generate to calculate the size of your loads.

1. The Hard Way to Calculate Loads:

The power dissipated by a linear resistor may be calculated from its resistance, and voltage or current. The formula is a combination of Ohm's law and Joule's laws:

Where **P** is the power in watts, **R** the resistance in ohms, **V** the voltage across the resistor, and **I** the current through it. This formula is applicable to devices whose resistance varies with current.

$$P = V \cdot I = \frac{V^2}{R} = I^2 \cdot R$$

2. The Easy Way to Calculate Loads:

Here's an assortment of online Voltage-Current-Resistance-Power calculators

WindAndSunPower.com Ohm's Law Power Calculator
OHMITE http://www.ohmite.com
OPAMPLABS http://www.opamplabs.com/eirp.htm
the12volt.com http://www.the12volt.com/ohm/page2.asp

Here's some links on homemade/DIY Resistors/Loads **(I Accept No Responsibility For Any Information in any of these Documents, Use AT YOUR OWN RISK!)**
www.thebackshed.com/Windmill/articles/200wDumpLoad
www.thebackshed.com/Windmill/articles/BuildingEncapsulatedResistors

Resistive loads can get extremely **HOT,** hot enough to start a fire or cause severe burns so be sure to follow proper safety precautions, such as:

1. **Do Not** mount Power resistors directly to flammable materials.
2. **Do Not** put flammable materials on or in close proximity to Power resistors.
3. **Do** mount Power resistors to a metal surface/plate, preferable with stand offs between wall and resistor mounting plate for cooling.
4. **Do** mount Power resistors in a location where children, pets or yourself will not come into physical contact with them as they can get hot enough to cause severe burns. If necessary purchase or build a protective cage around them.
5. Lastly **Do Use Common Sense!**

Charge Algorithm Selection

Legacy Electromechanical Relay *On/Off Mode*:

1. Wiring diagram 1: Dumping the battery. Good if your on a tight budget. Not good for batteries because of the slow switching speeds used to keep the EMR's from self-destructing and to prevent contact bounce. The deeper discharge during this delay prevents the batteries reaching a high SOC resulting high sulfation rates. ("14.7/13.7 volts (2.45/2.28 vpc) for on/off charging with a minimum array amp-hour to load amp-hour ratio of about 1.3." Sandia National Laboratories)
2. Wiring diagram 3: Dumping the charging source. This works good with sources such as solar panels. This is **NOT** recommended for wind or hydro, because by fully loading the generator down, you could cause it to over heat and possibly result in damage to it.
3. Wiring diagram 4: Disconnecting charging source from batteries. This works good with sources such as solar panels. This is **NOT** good for wind or hydro, because if you unload the generator it could over rev and self destruct.

2-Stage-*Bulk and Float Stages with SSR's:*

Wiring diagram 2: Dumping the battery. Good for Float Service systems (I recommend setting up to 0.2 to 0.3 volts above manufactures recommended Float voltage) and systems that are subject to daily cycling with average to heavy loads (For FLA batteries, I recommend setting up to 0.2 to 0.3 volts above manufactures recommended Daily Charge voltage. For SLA/Gel and other sealed batteries, do not exceed manufactures Daily Charge voltage).

TEST BUTTON

Pressing the test button simulates a high battery voltage condition, activating the status LED and dump relay/s. If equalization is in progress it cancels it out.

1. Pressing down the test button for approximately 5 seconds until it flashes Green/Red activates the relay/s 4 times.
2. Continuing to hold it down for approximately 5 more seconds until it starts flashing Red and then releasing it before it stops, starts the equalization cycle.

EQUALIZATION
(Solid State Relays in 2-Stage Mode Only)

A lot of small systems may not generate enough power to fully equalize the batteries. To equalize your FLA batteries (Follow Manufactures Recommendations! Check/Fill Battery water level Before and After!):

1. Disconnect/Turn Off (dependent upon device) any and all devices that cannot handle equalization voltages (usually 15.5 volts and higher).
2. Make sure the EQ switch is set to **EN (**enabled).
3. Push and hold the button for approx 10 seconds until the Status LED starts flashing Red and release it. The Status LED will flash Red 5 times and then start flashing alternating Red and Green

Equalization mode will continue until 1 of 3 conditions are met:

1. The total time accumulated that the batteries are at between the set equalization voltage of 15.15-15.45 volts of the set equalization voltage equals approximately 2 hours.
2. It times out after approximately 48 hours if the batteries do not accumulate 2 hours at equalization voltages.
3. The test button is pushed canceling equalization.

WARNING! If using this controller with Sealed, Gel Cell or other like batteries, Disable and DO NOT use the equalization option! Not following these precautions can cause the battery voltage to rise high enough to damage and/or destroy your batteries!

DUMP/DIVERT VOLTAGE SET-POINT ADJUSTMENTS

The controller is preset at 14.3 volts. This is **usually** a safe point for most batteries, it is low gassing and will charge most batteries to approximately 90 to 95 percent of their rated capacity. However this setting will **not** charge most FLA (Flooded Lead Acid) deep cycle batteries fully and the batteries maximum capacity will, little by little, drop lower with each subsequent charge (due to sulfation). Check the battery manufactures recommended charge voltage which you can usually find on their website. Most FLA deep cycle batteries have a high daily charge voltage (currently TROJAN recommends 14.8 V daily charge and 15.5 V equalization charge). Both of which causes higher water loss (adding distilled water more frequently), and **VERY HIGH GASSING** which unless you have a proper ventilation system in place and follow proper safety practices can be **DANGEROUS!** If you can't meet these requirements leave the setting at 14.3V or lower (Set to 14.1V when using SSR's in 2-Stage).

(Note: When using the legacy EM mode to dump Lead Acid batteries scientific studies have shown that a high SOC is not reached and sulfation builds up quickly at dump settings below 14.7-14.8V.)

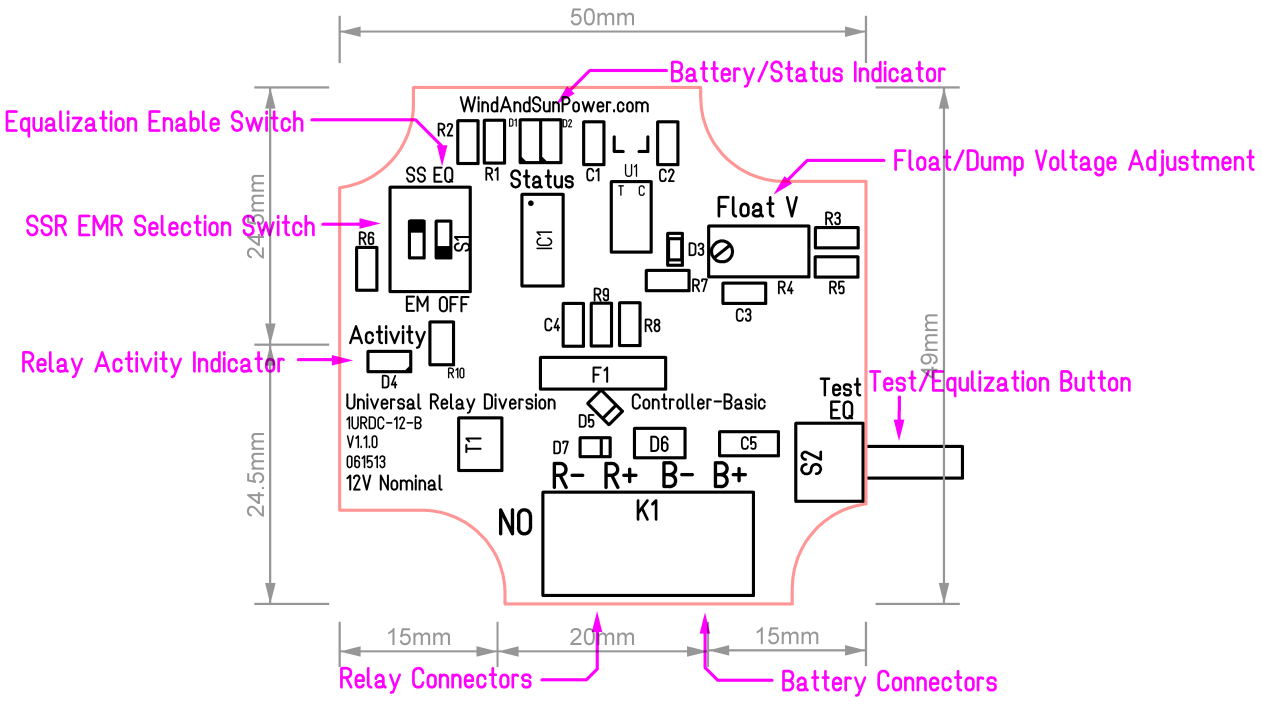
The 14.3V was settled on because most smaller systems are not generating all the time and it was the voltage that gave the highest charge capacity with low gassing. There are so many variations in systems and batteries it's imposable to have a "**perfect universal**" default Dump/Absorption setting. It is up to you, to decide on the best Dump/Absorption voltage for your system. This is why all good controllers have adjustable set points.

This could take some time. The potentiometers are fairly sensitive, you barely need to turn one to change a setting 0.05V. You will be adjusting the potentiometer marked **DUMP** on the PCB.

1. Hook an accurate volt meter directly to your batteries.
2. Let the batteries fully charge to the current set-point and stabilize.
3. If lowering the set-point slowly turn counterclockwise until the battery voltage reaches the desired setting, let it stabilize and repeat up or down if necessary until your satisfied with the setting. If raising the set-point slowly turn clockwise until the yellow dump led goes out. Wait for the voltage to rise to the new set-point and stabilize, Check your volt meter to see if it dumps at the desired voltage. Repeat adjusting the pot up or down if necessary until your satisfied with the setting.
4. Disconnect volt meter if you wish.

Note: If your using SSR's with the 2 stage setting and your constantly generating power with your batteries staying fully charged most of the time. You might want to set the dump voltage down closer to the manufactures recommended float voltage and equalize the batteries more often.

Diagram 3.

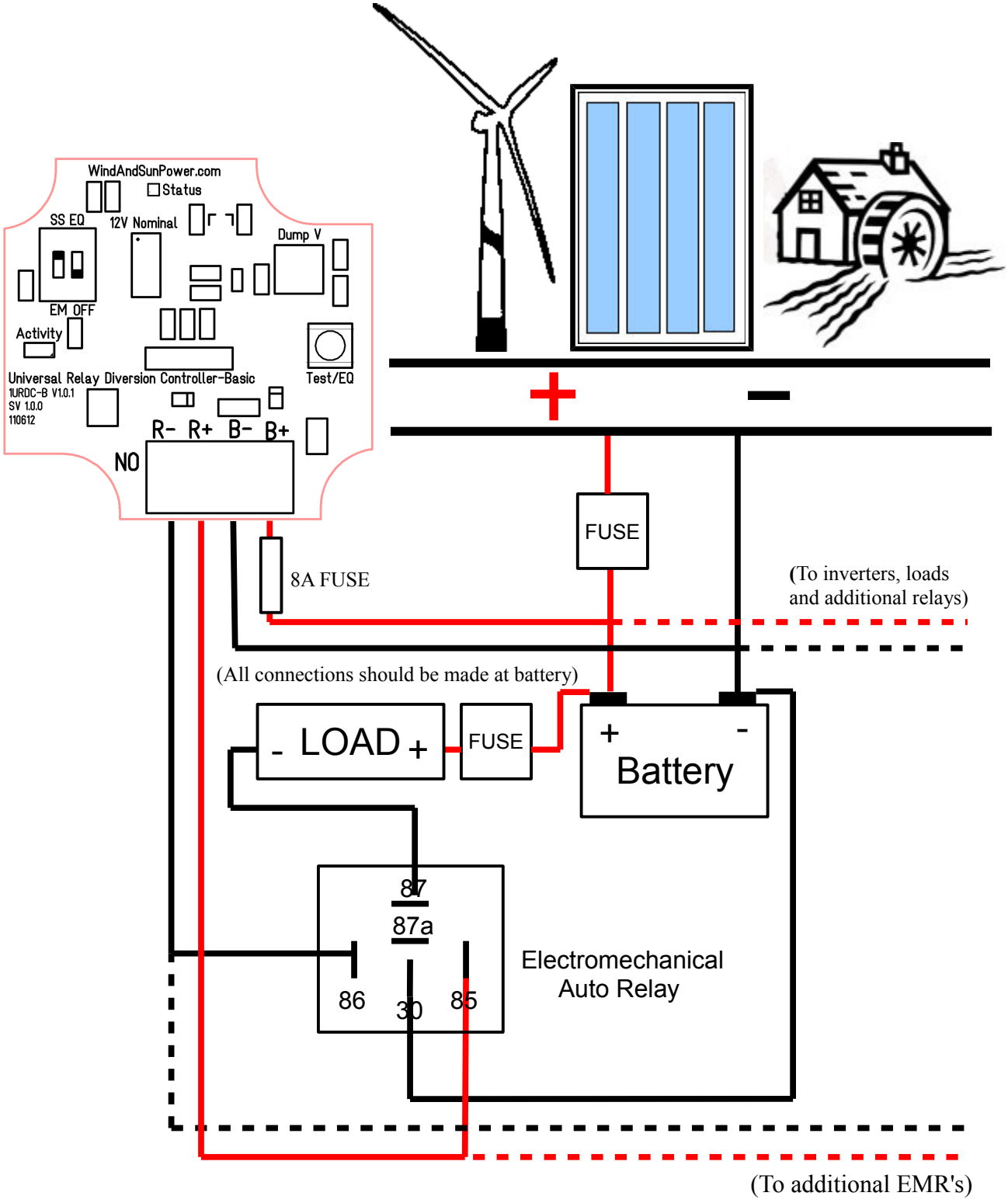


1. **Battery Status Indicator** – Fancy power indicator. (See LED Flash Legend.)
2. **Float/Dump Voltage Adjustment** – Used to set the High Voltage Set/Trip Point in 0.05V increments.
3. **Selection Switches**
   - ***1*-SSR EMR Selection Switch** – Selects SSR *(Solid State Relay)* or EMR *(ElectroMechanical Relay)* operating mode.
   - **2-Equalization Enable/Disable Switch** – Enables/Disables Equalization in SSR mode.
4. **Relay Active Indicator** – LED indicates if the relays are powered up or not.
5. **Test Button** – Pressing the test button simulates a high battery voltage condition, activating the status LED and dump relay/s. If equalization is in progress it cancels it out.
   - Pressing down the test button for approximately 5 seconds until it flashes Green/Red activates the relay/s 4 times.
   - Continuing to hold it down for approximately 5 more seconds until it starts flashing Red and then releasing it before it stops, starts the equalization cycle.
6. **Relay Connectors** – Positive and Negative 12V battery output connectors to external electromechanical (EMR) or solid state relays (SSR). (There is a 2 second delay between all switching operations)
7. **Battery Connectors** – Positive and Negative 12V battery power/sense connectors.

Wiring Diagram 1. ELECTROMECHANICAL RELAY (EMR) DIVERSION/DUMP MODE

SOLAR YES
WIND YES
HYDRO YES

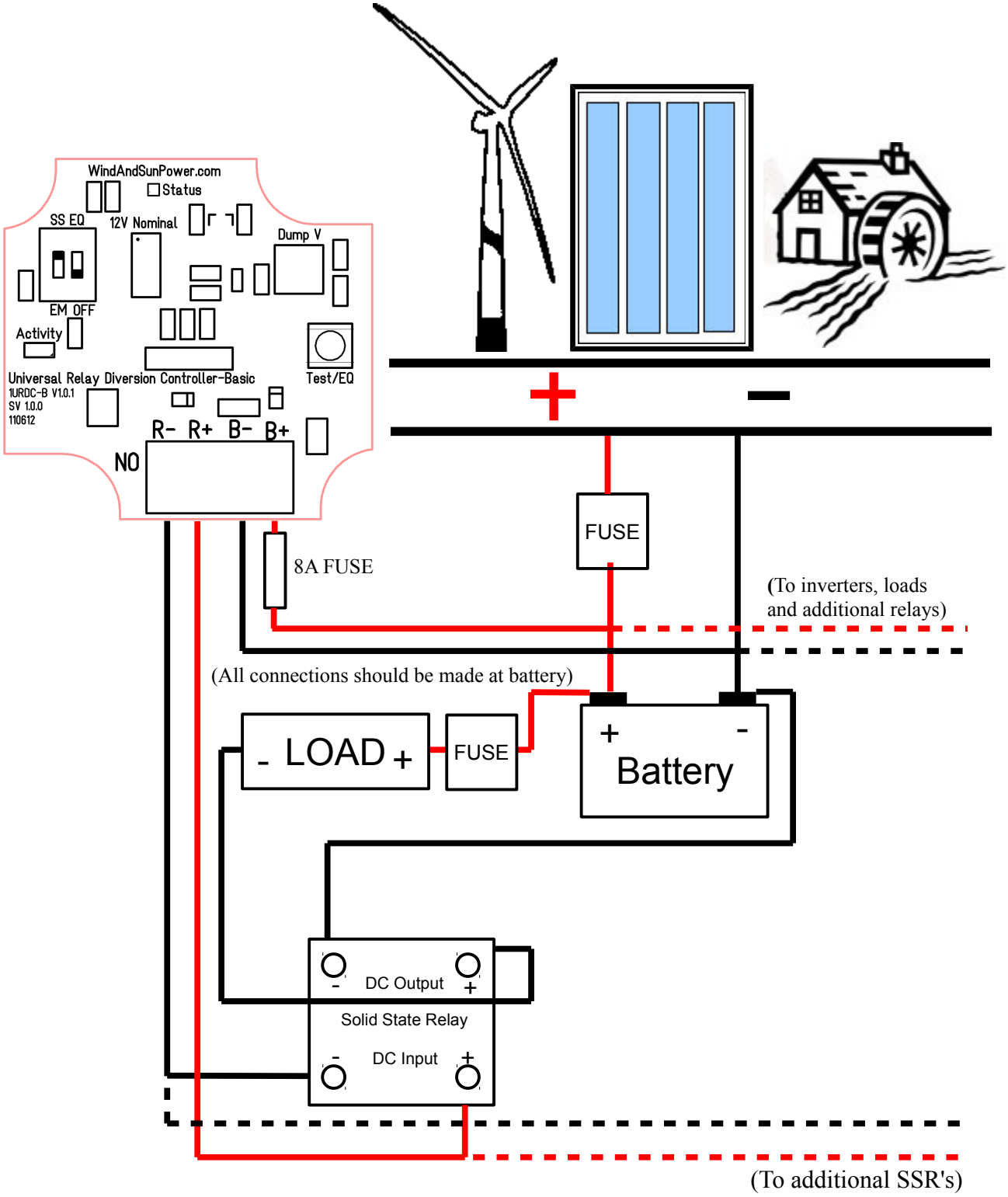
(You can have all 3 sources connected to/charging)
(the batteries at the same time in this configuration)



Wiring Diagram 2. SOLID STATE RELAY (SSR) DIVERSION/DUMP MODE

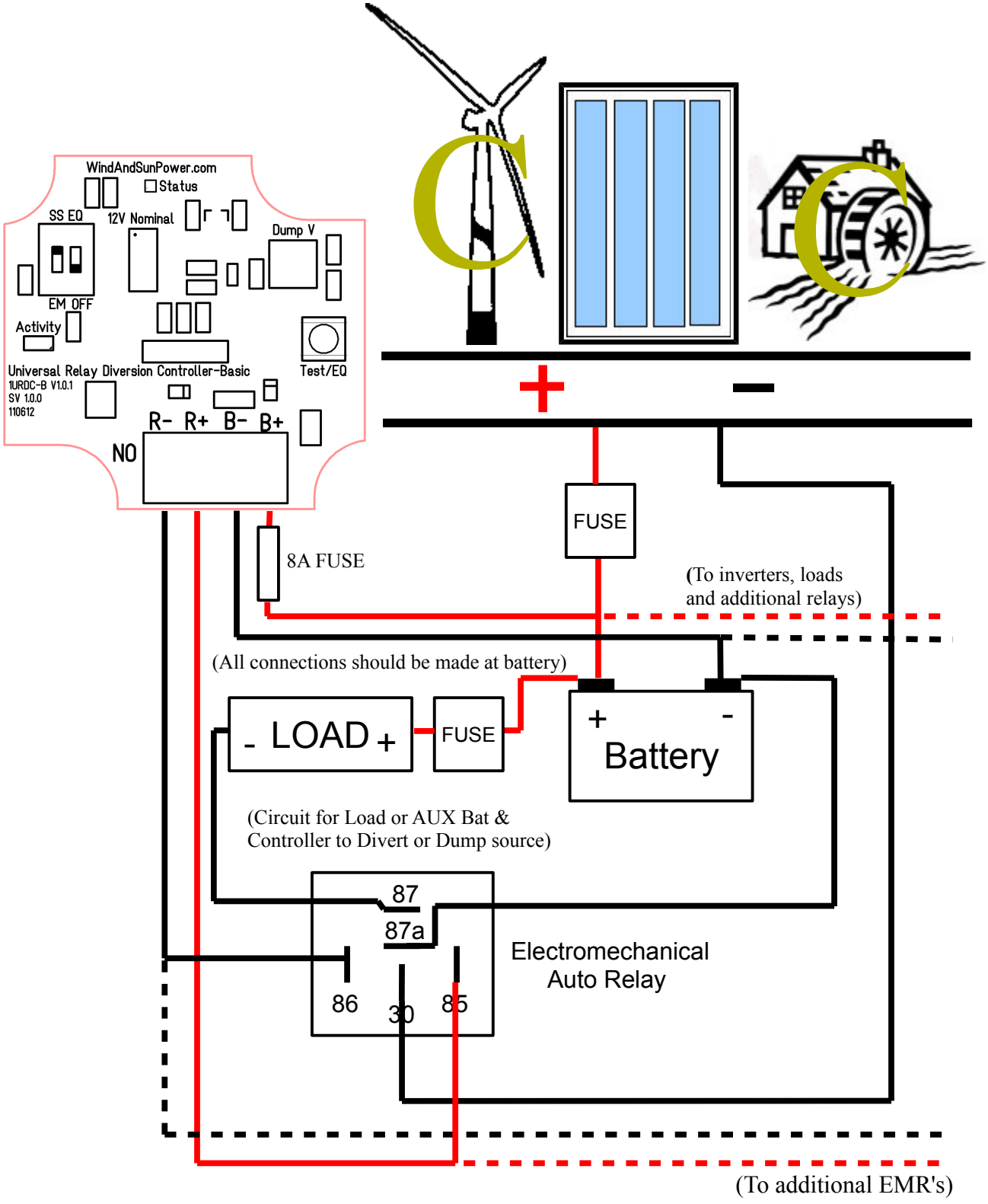
SOLAR YES
WIND YES
HYDRO YES

(You can have all 3 sources connected to/charging)
(the batteries at the same time in this configuration)



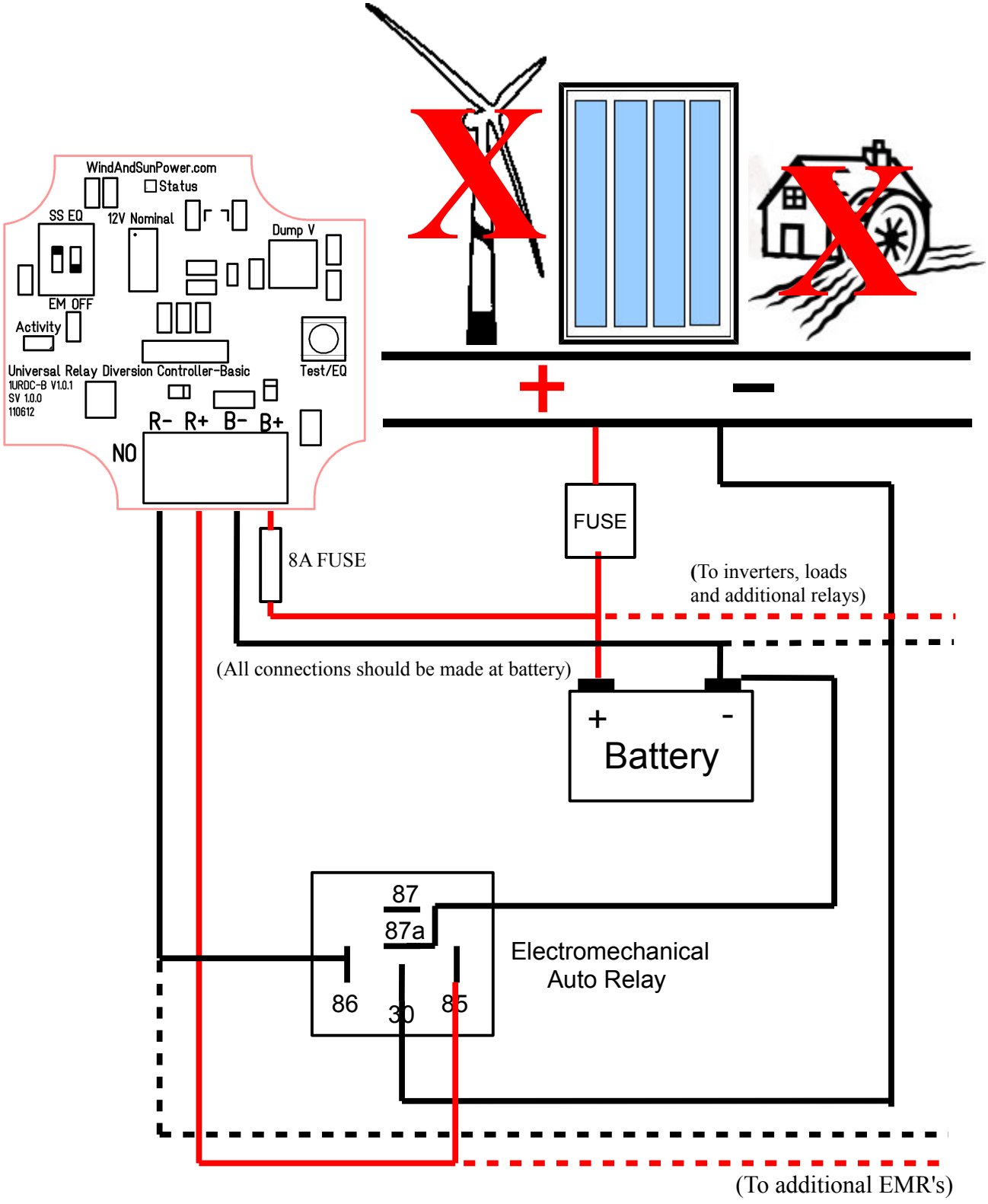
Wiring Diagram 3. ELECTROMECHANICAL RELAY (EMR) ON-OFF DIVERSION/DUMP SOURCE MODE

SOLAR YES
WIND CAUTION (You can use this circuit but understand that by fully loading the generator)
HYDRO CAUTION (down, you could cause it to over heat and possibly result in damage to it)



Wiring Diagram 4. ELECTROMECHANICAL RELAY (EMR)
DISCONNECT or ON-OFF MODE

SOLAR YES
WIND NO! (You can NOT use this circuit for wind or hydro, because if-)
HYDRO NO! (you unload the generator it could over rev and self destruct)

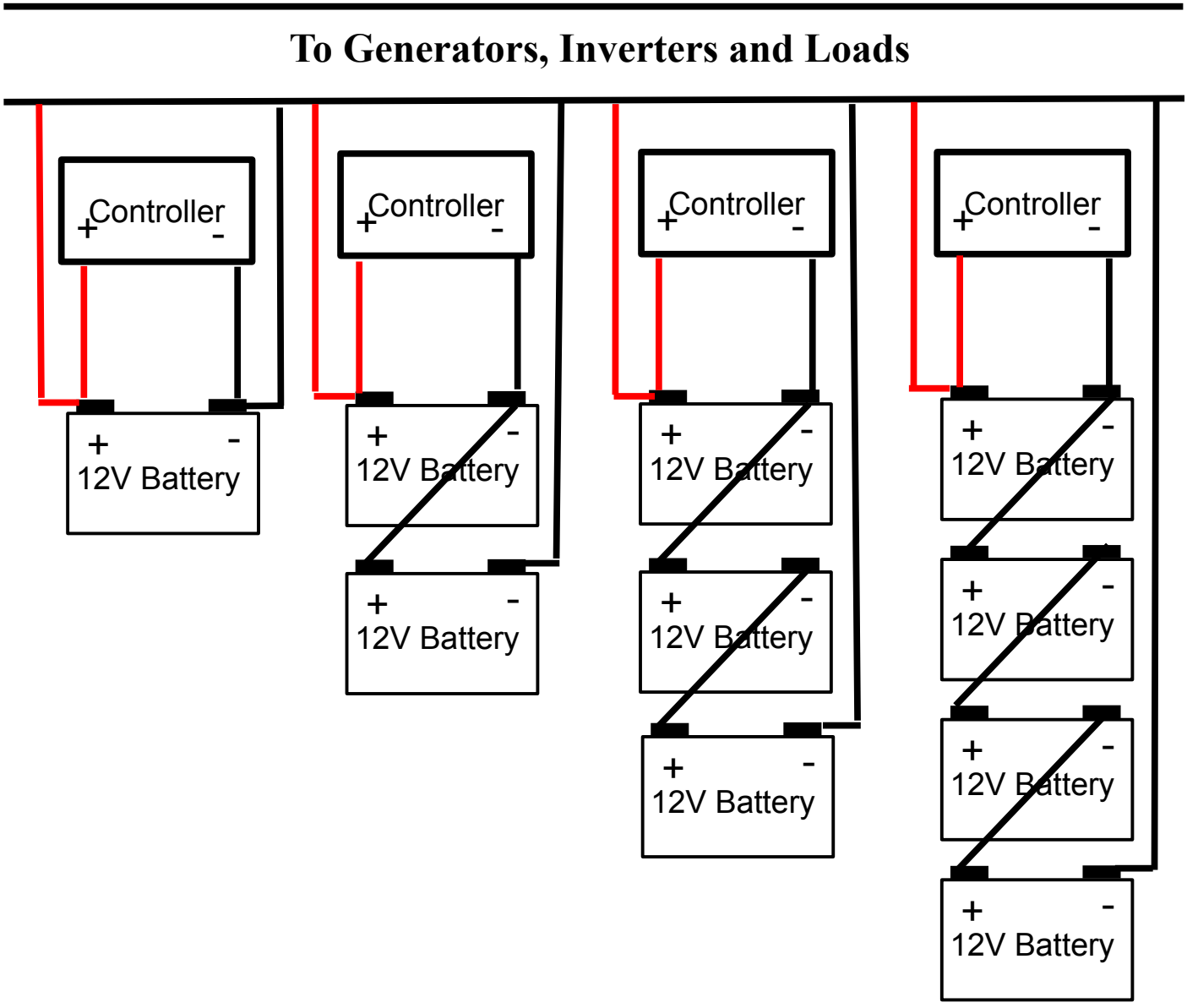


Wiring Diagram 5. Battery Wiring Diagrams for 12, 24, 36 and 48 Volt Systems

You simply hook the controller's "**Battery**" leads to a **12V cell** in your 24, 36, 48, 60, etc. volt battery bank and you connect your properly configured loads, inverters and generators across the full voltage of your battery bank. **The relay's Coil/Input needs to be 12V nominal, the Contacts/Output Needs to exceed the battery banks maximum voltage.** If your batteries are in good shape, all set points, temperature compensation, and LED indicator voltages are proportionally compensated. You just take the nominal system voltage and divide by 12, you the take the resulting answer and use it to multiply the set points and LED voltages.

Examples 24v / 12v = 2 then 2 x 14.3v = 28.6v
48v / 12v = 4 then 4 x 14.3v = 57.2v

(Tested)	(Tested)	(UnTested)	(UnTested)
12 Volt System	**24 Volt System**	**36 Volt System**	**48 Volt System**
	Set Point & LED Voltages		
X1	**X 2**	**X 3**	**X 4**



LED FLASH LEGEND

Approximate State of charge at 80ºF (26.6ºC) and at rest for 6 hours or more.

(No Charging or Discharging) (LED SOC Generalized for FLA Deep-Cycle Batteries)

If more precise Voltage monitoring is necessary connect an accurate voltmeter directly to the batteries.

ORANGE = (Red/Green Status LED lit simultaneously)

	RED LED **1** flash every 10 sec	11.35 volts or lower	0% state of charge
	GREEN LED **1** flash every 5 sec	11.36-11.65 volts	1 to 20% state of charge
	GREEN LED **2** flashes every 5 sec	11.66-11.95 volts	21 to 40% state of charge
	GREEN LED **3** flashes every 5 sec	11.96-12.25 volts	41 to 60% state of charge
	GREEN LED **4** flashes every 5 sec	12.26-12.5 volts	61 to 80% state of charge
	GREEN LED **5** flashes every 5 sec	12.51-12.7 volts	81 to 99% state of charge
	GREEN LED **2** flashes every sec	12.71-13 volts	100% state of charge
	GREEN LED **4** flashes per sec	13.01-13.5 volts	
	GREEN LED **10** flashes per sec	13.51-14.0 volts	
	GREEN LED Steady/Constantly on	14.01 volts or higher	
	RED and **GREEN** LED Alternating – Equalization Mode. Ends if it Accumulates 2 hours time with battery at 14.15 to 14.45 Volts, the 48 hr timer runs out or the test button is pushed canceling Equalization Mode.		
	ORANGE and **YELLOW** LED's Flash Simultaneously (Status LED looks like it's Flickering in SS mode) Relay Active – EMR and SSR modes		

TROUBLESHOOTING

Symptom	Probable Causes	Possible Solutions
Status LED Flashes Random Combinations	Bad or corroded wiring connection.	Check, clean and/or tighten all connections.
Both Status LED is ORANGE and YELLOW "Relay Active" is Constantly ON	1. Relay malfunction. Bad or corroded wiring connection. 2.Dump load too small.	1. Check for bad relay. Check, clean and/or tighten all connections. 2. Increase load size.
Status LED is ORANGE and YELLOW "Relay Active" LED is OFF	1. (V1.0.1 & up) Too high relay load or short in power section, relays and/or wires. 2. MOSFET is damaged or destroyed	1. Reduce number of relays, check for bad/shorted relays, check wires from controller to relays for shorts. 2. Contact WindAndSunPower.com for repair or replacement.
Board appears dead, then Both Status LED is ORANGE and YELLOW "Relay Active" is ON, then board goes dead again.	1. (V1.0.0) Too high relay load or short in power section, relays and/or wires.	1. Reduce number of relays, check for bad/shorted relays, check wires from controller to relays for shorts.
Status LED is GREEN and YELLOW "Relay Active" LED is Constantly ON	1. MOSFET is damaged or destroyed	1. Contact WindAndSunPower.com for repair or replacement.

SPECIFICATIONS

Min. Operating Volts	7 VDC	**Max. Operating Volts**	30 VDC
Nominal Operation Voltage	12VDC	**Standby Power Use**	≤ 2ma Min. ≤ 12ma Max.
Power Used Max.	≤ 25ma	**Power Sunk Max.**	-1.25A Max. @ 40C Ambient Temperature
Dump Voltage Adjustment Range	13.2 to 15.4 Volts in 0.05V increments @ 23C	**Equalization Voltage Preset Range**	15.15 to 15.45 Volts ±0.6% @ 23C
Battery Voltage Regulation (High/Low Volts Using EMR's)	± 6% ± 0.93V (**This specification can fluctuate due to system variables and design**)	**Battery Voltage Regulation (High/Low Volts Using SSR's)**	±0.2% ±0.04V or less Typical @ 23C (**This specification can fluctuate due to system variables and design**)
Status LED Accuracy	±0.2% or ±0.04V or less Typical @ 23C	**Internal Battery Voltage Tracking**	±0.2% or less Typical @ 23C
Automotive style ElectroMechanical Relays	1 up to 8 30 to 40 Amp with 12VDC 160ma coil	**Solid State Relays 2-Stage & Equal**	DC-DC 1 to 50? ≤20ms On or less ≤20ms Off or less
EMR Operating Frequency	Dump Volt Setting Min. 4 Sec. On Min. 0.5 Sec. Off	**SSR Operating Freq. 2-Stage**	Min. 0.02 Sec. On Min. 0.02 Sec. Off ≤25Hz(On+Off 25 x Sec.)
Operating Temp. Storage Temp.	-20°C to 50°C -50°C to 150°C	**Dimensions**	50 mm x 49 mm (1.97 in. x 1.93 in.)

Specifications subject to change without notice.

Made in USA-Components Made in Rest of World

WARRANTY:

WindAndSunPower.com. Model 1URDC-B is warranted to be free of defects in material and workmanship for three years from the date of purchase. Failure to provide correct installation, operation or care for this product, in accordance with the instruction manual, will void the warranty. Product liability shall be limited to repair or replacement at the discretion of the manufacturer. The manufacturer is not responsible for the labor or other charges necessitated by the removal, transportation, or re-installation of any defective product. Warranty does not cover damage due to, mishandling, abusive conditions, lightning or exposure to weather. No specific claim of merchantability shall be assumed or implied beyond what is printed in this manual. No liability shall exist from circumstances arising from the inability to use this product, or it's inappropriateness for any specific purpose. In all cases it shall be the responsibility of the customer to insure a safe installation in compliance with local, state and national electrical codes.

RETURN PROCEDURE:

To return a model 1URDC for warranty service please contact WindAndSunPower.com for return authorization and shipping instructions. Provide the following information shipped with the controller. Name/Company name, return address, daytime phone number, detailed description of failure, copy of sales receipt. Include $4.00 for return shipping

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Tip's n Tricks

1. You can use 1 relay to activate multiple relays.
2. You can start with EMR's and upgrade to SSR's later.

Amendments

1. Due to a few user accidents showing the potential for a 30V+ and high current supply being connected. I now recommend putting an 8 amp “Catastrophe” fuse between the battery positive connector and the battery.

11/15/12

Version 1.0.2 to 1.1.0

1. Changed the single turn Float V pot to a 25 turn pot for less sensitive setting.
2. Changed Test Button to long 90 degree button to extend through side of enclosure.
3. Minor increase in regulation at settings from 13.1 thru 13.95 volts.
4. Minor increase in accuracy reading battery voltage.
5. Fixed, red LED not flashing during test.
6. Reduced standby current consumption by approximately 5ma.