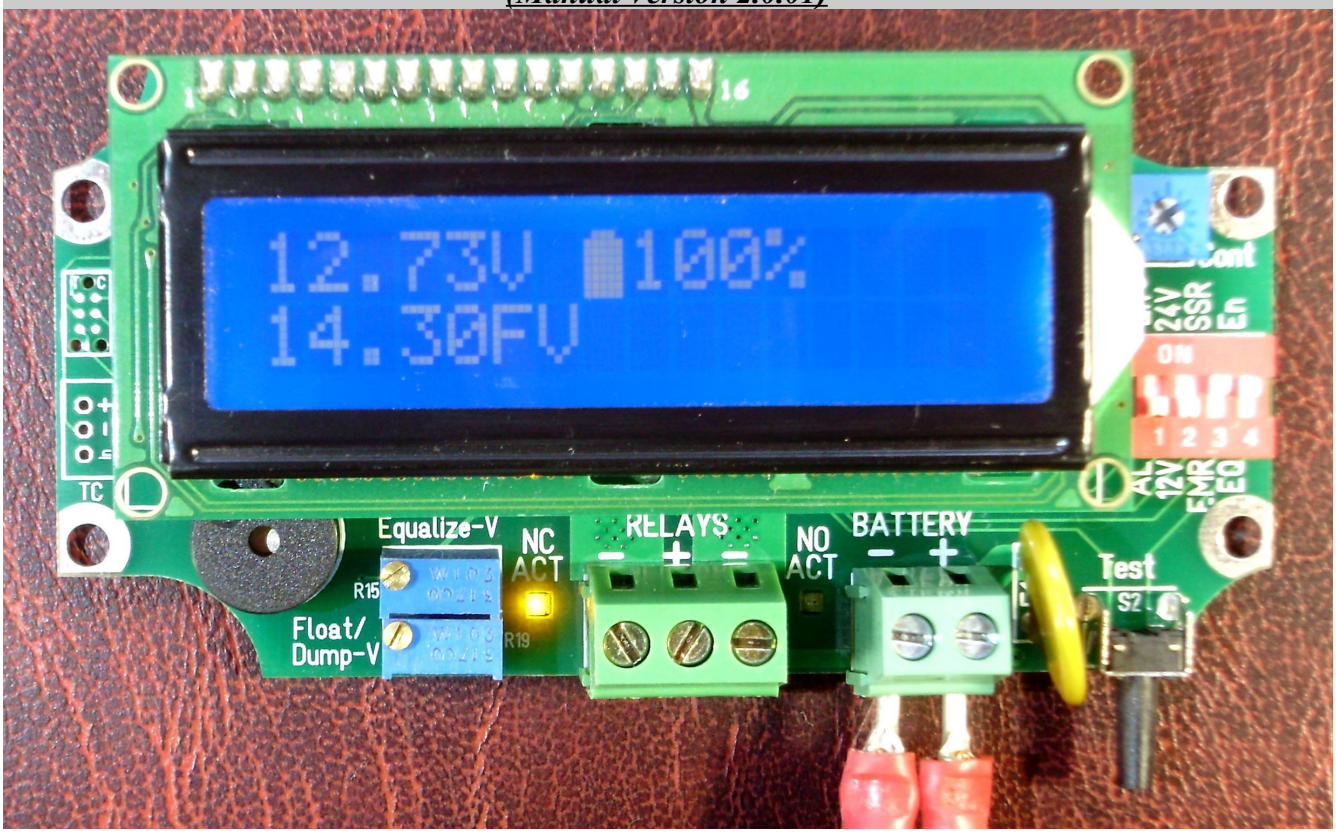
2 UNIVERSAL RELAY DIVERSION CHARGE CONTROLLER "Basic Model"
MODEL 2URDC-1224-B*asic* 12V/24V *(Board Version 2.0.X)*
For both EMR's *(ElectroMechanical Relays)*
and SSR's *(Solid State Relays)*
2-STAGE charging using SSR'S
For Wind, Solar and Hydro
(Manual Version 2.0.01)



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.

This device is designed for resistive loads (power resistors, DC water heater elements, etc) ONLY! It is NOT designed to use electronic devices as loads (inverters, etc) because of the fast switching.

WARNING!

If using NC connector to switch PV/Solar panels, you need to connect the "PV Positive" directly to battery Positive and "SWITCH the PV Negative". Switching the "PV Positive" can/will produce high energy pulses at PV Open Circuit Voltages that can/will destroy the controller and Solid State Relay/s! This will VOID your warranty as this controller and most DC SSR's control circuits are rated at 32VDC MAX!

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 10ms on – 10ms off or faster SSR's Only!)*
- ✔ Manual Equalization Mode *(using 10ms on – 10ms off or faster SSR's Only!)*
- ✔ Normally Open Output *(EMR's and SSR's)*
- ✔ Normally Closed Output *(For Special Applications with SSR's Only!)*
- ✔ 12V Adjustable Dump/Diversion/On-Off Set-point *(13 to 15 Volts in 0.05V increments)*
- ✔ 12V Adjustable Equalization Voltage Set-point *(14 to 15.75 Volts using SSR's Only)!*
- ✔ 24V Adjustable Dump/Diversion/On-Off Set-point *(26 to 30 Volts in 0.05V increments)*
- ✔ 24V Adjustable Equalization Voltage Set-point *(28 to 31.5 Volts using SSR's Only!)*
- ✔ Extremely Low Power Consumption *(≤ 25ma)*
- ✔ Battery Gauge-divided in 10% increments (based on Trojan Batteries FLA SOC chart)
- ✔ Accurate Battery Volt Meter and Tracking *(±0.2%)*
- ✔ Switching Speeds Up To 50 On-Off Cycles Per Second When Using SSR's *(≤50Hz)*
- ✔ 8-Bit Microcontroller running at 32Mhz
- ✔ Latest SMT *(Surface Mount Technology)* for Compact Size and Improved Performance
- ✔ Self Resetting Fuse
- ✔ Relay Powered/Active LED Indicators
- ✔ Test/Equalization Button
- ✔ Alarms to help diagnose system problems
- ✔ 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.

Introduction

These diversion controllers were brought about by there being no low cost expandable diversion controllers on the market that would minimize maintenance while maximizing battery charge and life. The **2URDC-1224-B***asic* was created by request for a basic version with an LCD readout.

Months of testing and research both on these and other commercially available dump controllers, had proven that the On-Off algorithm using **EMR**'s ***(ElectroMechanical Relays)*** 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 10ms on and 10ms 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** ***(State Of Charge)*** 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 **ULFA-PWM** ***(Ultra Low Frequency Adaptive - Pulse Width Modulation)***. 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 2URDC-1224-B_Manual_V2.0.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 Controllers/Regulators are low cost, Microprocessor controlled Diversion/Dump type controllers designed for the **DIY** ***(Do It Yourselfer)***. It is designed to switch up to 8 conventional automotive style electromechanical relays *(EMR)* directly with up to 1.25A @ 40C 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.

MOUNTING

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.
This Board has been designed to fit in the following inexpensive **BUD Industries** NEMA Enclosures with molded external mounting brackets:
PN-1321-C-MB Poly Carbonate/Light Gray Body with ***Clear Cover***.
Will fit the following also:
PN-1321-DG-MB ABS/Dark Gray Body and Cover.
PN-1321-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

Note: Relays need to be connected *BEFORE* power is applied to the controller!

RELAYS

12V mode requires EMR's with 12V nominal coils, 24V mode requires EMR's with 24V nominal coils!!

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 or 24VDC** *(depending on use with 12V or 24V mode)* **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.

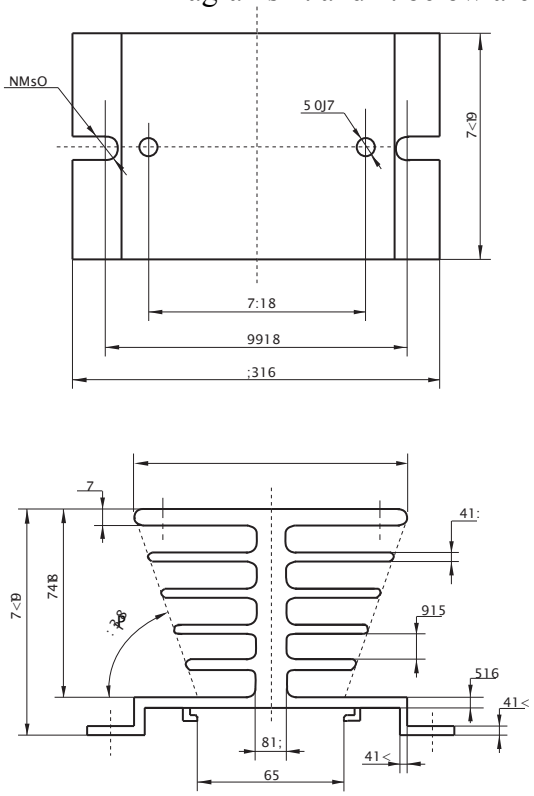


Diagram 1.
15A SSR Heatsink Example
Approximately 2”L x 2.5”W x 2”H

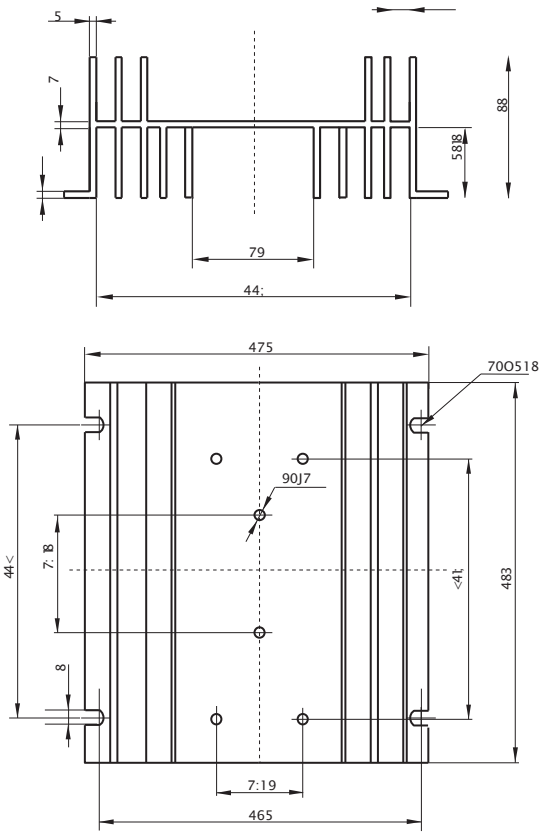


Diagram 2.
40A-80A SSR Heatsink Example
Approximately 6”L x 5.5”W x 2”H

Notes:

SSR's used for 2-Stage and Equalization modes *MUST* be rated to switch at 10ms On & 10ms Off or FASTER!!

12V mode *REQUIRES* EMR's with 12V nominal coils, 24V mode *REQUIRES* EMR's with 24V nominal coils!!

Relays need to be connected *BEFORE* power is applied to the controller!

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 Chinese DC-DC SSR's tested:

Mager MGR-1 DD220D80 GOOD – Tested W/ 75A@15V Load, <=50HZ (eBay, AliExpress)
Mager MGR-1 DD220D60 GOOD – Tested W/ 55A@15V Load <=50HZ (eBay, AliExpress)
Mager MGR-1 DD220D40 GOOD – Tested W/ 39A@15V Load, <=50HZ (eBay) (I've tested/used/using several of these for several years now and they're all still working)
Mager MGR-1 DD220D25 GOOD – Tested W/ 20A@15V Load, <=50HZ (eBay, AliExpress)
Mager MGR-1 DD220D10 GOOD – Tested W/ 8A@15V Load, <=50HZ (eBay, AliExpress)
SMUNGLE SG D2240D Failed – Tested W/ 35.75A@14.3V Load, <50HZ (eBay) Latched closed
FOTEK SSR – 40 DD Failed – Tested W/ 35.75A@14.3V Load, <50HZ (eBay) Latched Open until it cooled off (Over Temperature Protection?)
FOTEK HPR-40 DD Failed – Tested W/ 35.75A@14.3V Load, <50HZ (eBay) Short to ground
FOTEK SSR-80 DD Failed – Tested W/ 71.5A@14.3V Load, <50HZ (Aliexpress) Latched closed
Needless to say, I don't recommend, nor am I probably going to test any more FOTEK's from eBay or Aliexpress as these are all probably Chinese counterfeits and not the real ones made in Taiwan.

LOADS

This controller was designed for use with **Resistive** loads such as **Power 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** *(Approximately 1.3 to 1 or 130% 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 online Voltage-Current-Resistance-Power calculator

WindAndSunPower.com Ohm's Law Power Calculator

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

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

Wiring diagram 1: *Dump the battery.*

For Float Service systems

I recommend setting to manufactures recommended Float voltage usually 13.2 to 13.5 volts.

For systems that are subject to daily cycling with average to heavy loads

For FLA batteries, I recommend setting up to manufactures recommended Daily Charge voltage, usually 14.1 to 14.4 volts.

*For SLA/Gel and other sealed batteries, **DO NOT** exceed manufactures Daily Charge voltage usually 13.5 to 13.9 volts*

Legacy Electromechanical Relay *On/Off Mode*:

1. **Wiring diagram 2:** Dump 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 from reaching a high SOC resulting in 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.*

Legend

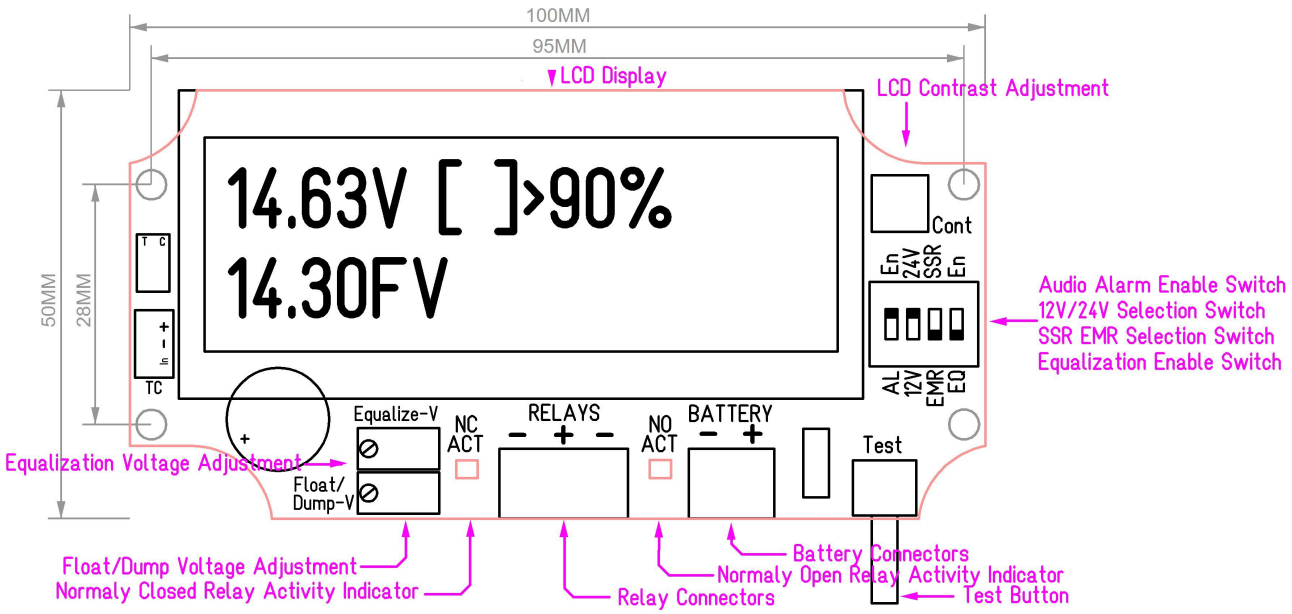


Diagram 3.

1. **LCD Display** – LCD readout for battery voltage, status, functions, etc.
2. **LCD Contrast Adjustment** – Used to adjust the LCD displays contrast for best viewing. If needed, slowly turn clockwise or counterclockwise for best readability.
3. **Switches**
   (a) **AL-Audio Alarms** –
   - On = All Audio Alarms Enabled.
   - Off = LV (Low Voltage) and HV (High Voltage) Audio Alarms Disabled. OV (Over Voltage 32V and higher) always enabled.

   (b) **12V/24V Selection Switch** – Selects 12V or 24V nominal operating mode.
   - On = 24V.
   - Off = 12V.

   (c) **SSR EMR Selection Switch** – Selects SSR *(Solid State Relay)* or EMR *(ElectroMechanical Relay)* operating mode.
   - On = SSR.
   - Off = EMR.

   (d) **Equalization Enable/Disable Switch** – Enables/Disables Equalization in SSR mode.
   - On = Enabled.
   - Off = Disabled.
4. **Float V Adjustment** – Used to set the SSR/EMR Float/Dump Voltage Set/Trip Point in 0.05V increments. In Float mode it will be displayed as xx.xxFV (xx.xxDV in EMR mode) in the lower left side of the LCD display. Turn clockwise to raise or counterclockwise to lower the Float/Dump Voltage Set/Trip Point until you have your desired setting.
5. **Equal V Adjustment** – Used to set the SSR Equalization Voltage Set/Trip Point in 0.05V increments. In Equalization mode it will be displayed as xx.xxEV in the lower left side of the LCD display. To set, you need to be in SSR mode and EQ switch needs to be set to the EN or ON position. Hold down the Test/EQ button until you see the word “Equalization” to the right of the battery voltage on the top line and release the Test/EQ button. Turn clockwise to raise or

counterclockwise to lower the Equalization Voltage Set/Trip Point until you have your desired setting.

6. **Battery Connectors** – Positive and Negative 12V/24V battery power/sense connectors.
7. **NO Relay Active Indicator** – LED indicates if the *Normally Open* relays are powered.
8. **NC Relay Active Indicator** – LED indicates if the *Normally Closed* relays are powered. *Disabled* in EMR mode.
9. **Relay Connectors** – Positive and Negative battery output connectors to external electromechanical (EMR) or solid state relays (SSR).
    - **Center Positive –** Polarization usually only pertains to SSR's. With EMR's +/- polarization usually doesn't matter.
    - **NO – Normally Open/Off Negative –** This is the negative terminal used for EMR's and SSR's in most applications. It turns On (*Activates*) the relay/s when the battery voltage reaches the Set/Trip Points.
    - **NC – Normally Closed/On Negative -** This is the negative terminal used for SSR's. It turns Off (*Deactivates*) the relay/s when the battery voltage reaches the Set/Trip Points. It is *Disabled* in EMR mode. This is a requested feature for use in "*specialty applications*".
10. **Test/EQ Button** – Pressing the Test/EQ button simulates a high battery voltage condition. Holding the Test/EQ button will cause it to scroll through menu items every 1.5 seconds next to the battery voltage readout. Release the Test/EQ button when the menu item you desire appears to select it.
    - **RESET –** Reboots the system displaying version and other information.
    - **TEST – A**lternately activates/deactivates the relay/s and flash Activity LEDS 4 times.
    - **CANCEL EQ –** Cancels Equalization.
    - **EQUALIZE –** Starts Equalization if using SSR's and Equalization mode is enabled.

FLOAT/DUMP VOLTAGE

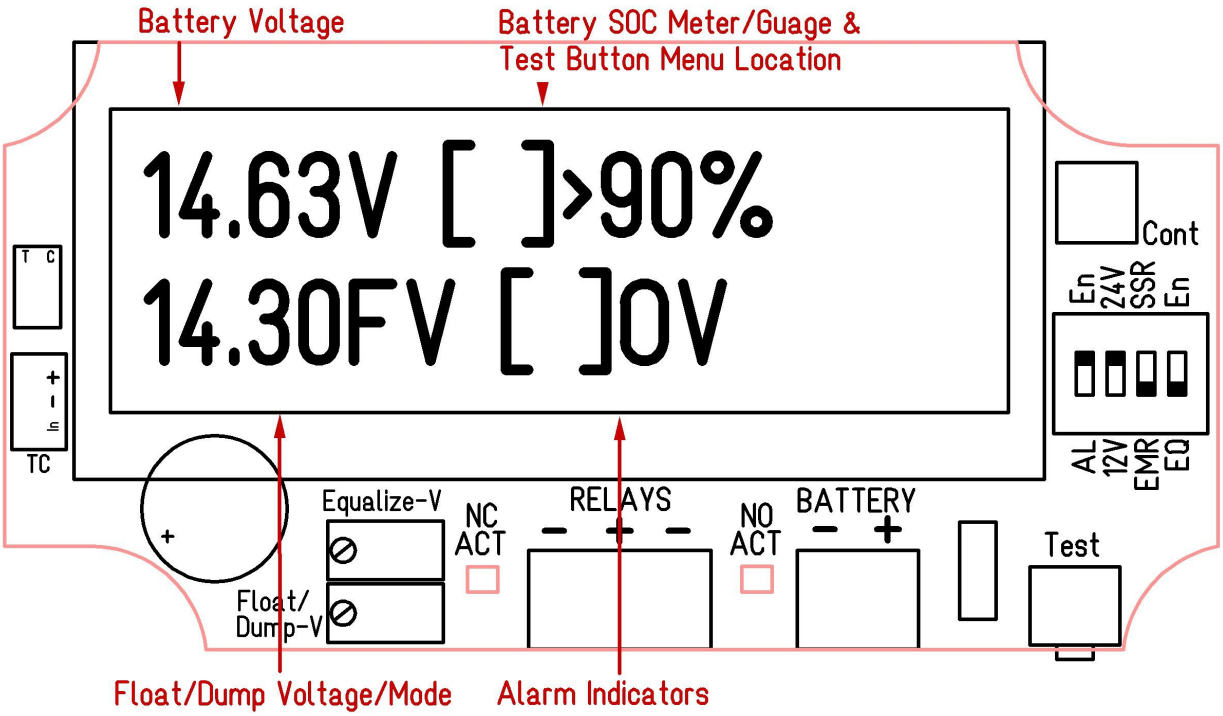


Diagram 4.

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 14.4V 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 less.

(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 Float/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.

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.

Battery State Of Charge Gauge

Based On Trojan Batteries FLA SOC chart. Gauge is divided into 10% increments using the "<" Less Than and ">" Greater Than symbols. For accurate voltage SOC readings, batteries must remain idle (no charging/discharging) at least 6 hours but preferably up to 24 hours.

State of Charge as Related to Specific Gravity and Open Circuit Voltage

Percentage of Charge	Specific Gravity Corrected To	Open-Circuit Voltage					
		Cell	6v	12v	24v	36v	48v
100	1.277	2.122	6.37	12.73	25.46	38.20	50.93
90	1.258	2.103	6.31	12.62	25.24	37.85	50.47
80	1.238	2.083	6.25	12.50	25.00	37.49	49.99
70	1.217	2.062	6.19	12.37	24.74	37.12	49.49
60	1.195	2.04	6.12	12.27	24.48	36.72	48.96
50	1.172	2.017	6.02	12.10	24.20	36.31	48.41
40	1.148	1.993	5.98	11.89	23.92	35.87	47.83
30	1.124	1.969	5.91	11.81	23.63	35.44	47.26
20	1.098	1.943	5.83	11.66	23.32	34.97	46.63
10	1.073	1.918	5.75	11.51	23.02	34.52	46.03

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

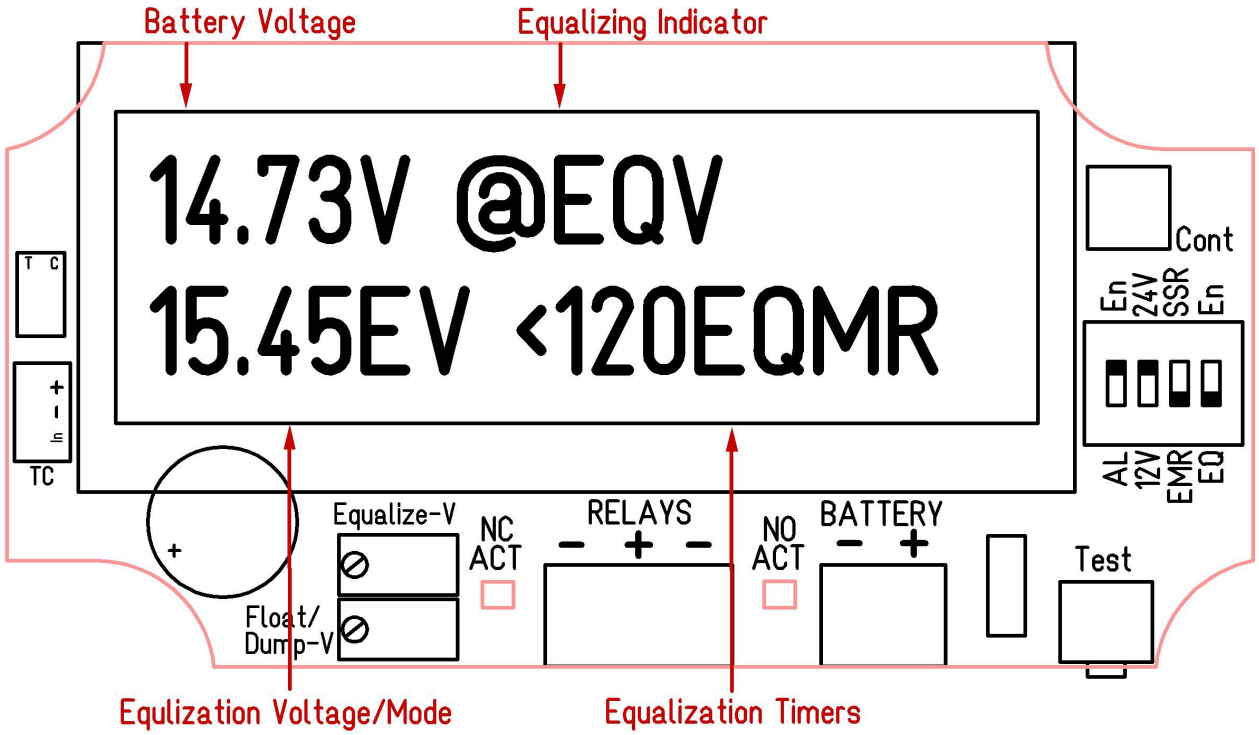


Diagram 5.

<u>WARNING!</u> 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!

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. Hold down the Test/EQ button until you see the word "Equalization" to the right of the battery voltage on the top line and release the Test/EQ button.
   Once it enters Equalization mode, the bottom line will display, the Equalization voltage Set/Trip Point xx.xxEV. Next to it will be displayed, 120EQMR *(120 Equalizing Minutes Remaining)* countdown timer, alternating every 2 seconds with 48HTCR *(48 Hours To Cancer Remaining)* countdown timer.

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

1. The total time accumulated that the batteries are at equalization voltages equals 2 hours. *(Once the batteries reach the set equalization voltage, as long as the battery voltage remains between it and -0.40V in 12V mode (-0.80V in 24V mode), the 120 min clock will countdown. If the battery voltage drops -0.40V in 12V mode (-0.80V in 24V mode) below the Equalization Voltage Set/Trip Point, Battery voltage will have to reach the Equalization Voltage Set/Trip Point once again to start the 120 min Equalization clock.)* If batteries are at equalization voltages, @EQV *(At EQualization Voltages)* will be displayed at the upper right corner of the LCD display and the 120 minute timer will be counting down.
2. It times out after approximately 48 hours if the batteries do not accumulate 2 hours at equalization voltages.
3. The test button is used to cancel equalization mode.

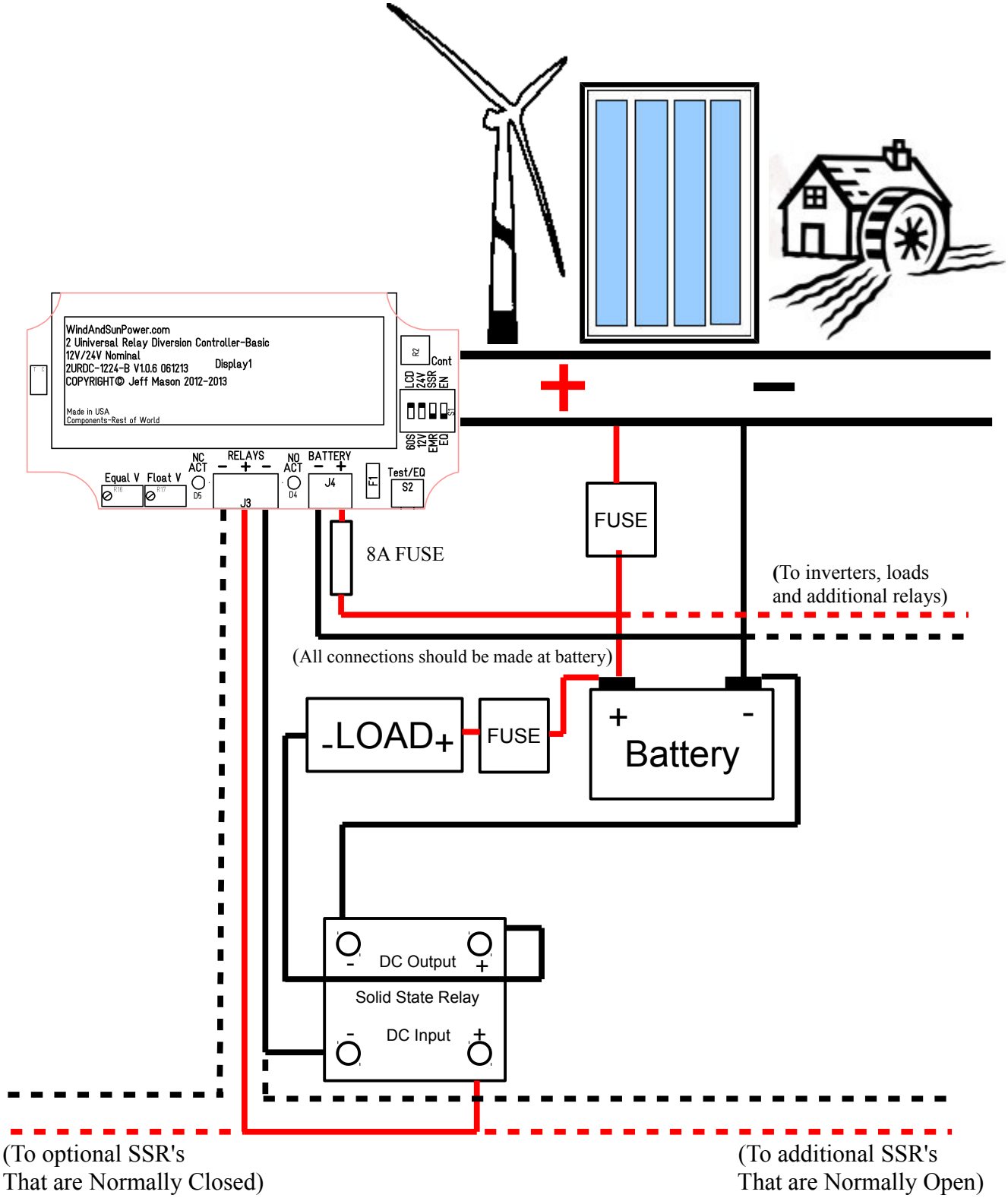
Troubleshooting/Alarms

Alarm Type	Possible Causes	Possible Solutions
LV Alarm Dead Battery Battery voltage ≤10.5V in 12V Mode ≤21.0V in 24V Mode	1. Normal over discharge of battery 2. Bad Battery 3. Loose/Bad connection 4. Latched/Bad relay 5. Battery to small for load size (Intermittent while dumping)	1. Charge Battery 2. Test and replace battery if needed 3. Check/tighten all connections 4. Test and replace relay if needed 5. Reduce load size or increase battery size
HV Alarm Battery voltage >0.5V in 12V Mode >1.0V in 24V Mode Float/Dump setting	1. Bad Battery 2. Loose/Bad connection 3. Latched/Bad relay 4. Loads to small for power being generated (Intermittent or continuous while dumping)	1. Test and replace battery if needed 2. Check/tighten all connections 3. Test and replace relay if needed 4. Add larger/more loads
OV Alarm Controller voltage ≥32.0V Maximum operating voltage exceeded (possible damaging high voltages to controller and/or most SSR's)	1. Bad Battery 2. Loose/Bad connection 3. Latched/Bad relay 4. Loads to small for power being generated (Intermittent or continuous while dumping)	1. Test and replace battery if needed 2. Check/tighten all connections 3. Test and replace relay if needed 4. Add larger/more loads
Yellow Activity LED is *On Constant* And Relay is *OFF*	1. Loose/Bad connection 2. Latched/Bad relay 3. Circuit MOSFET/s blown	1. Check/tighten all connections 2. Test and replace relay if needed 3. Contact WindAndSunPower.com for Repair/Replacement
Yellow Activity LED is *OFF* And Relay is *On Constant*	1. Shorted connection 2. Latched/Bad relay	1. Check/tighten all connections 2. Test and replace relay if needed

Wiring Diagram 1. SOLID STATE RELAY (SSR) DIVERSION/DUMP MODE

SOLAR YES
WIND YES
HYDRO YES

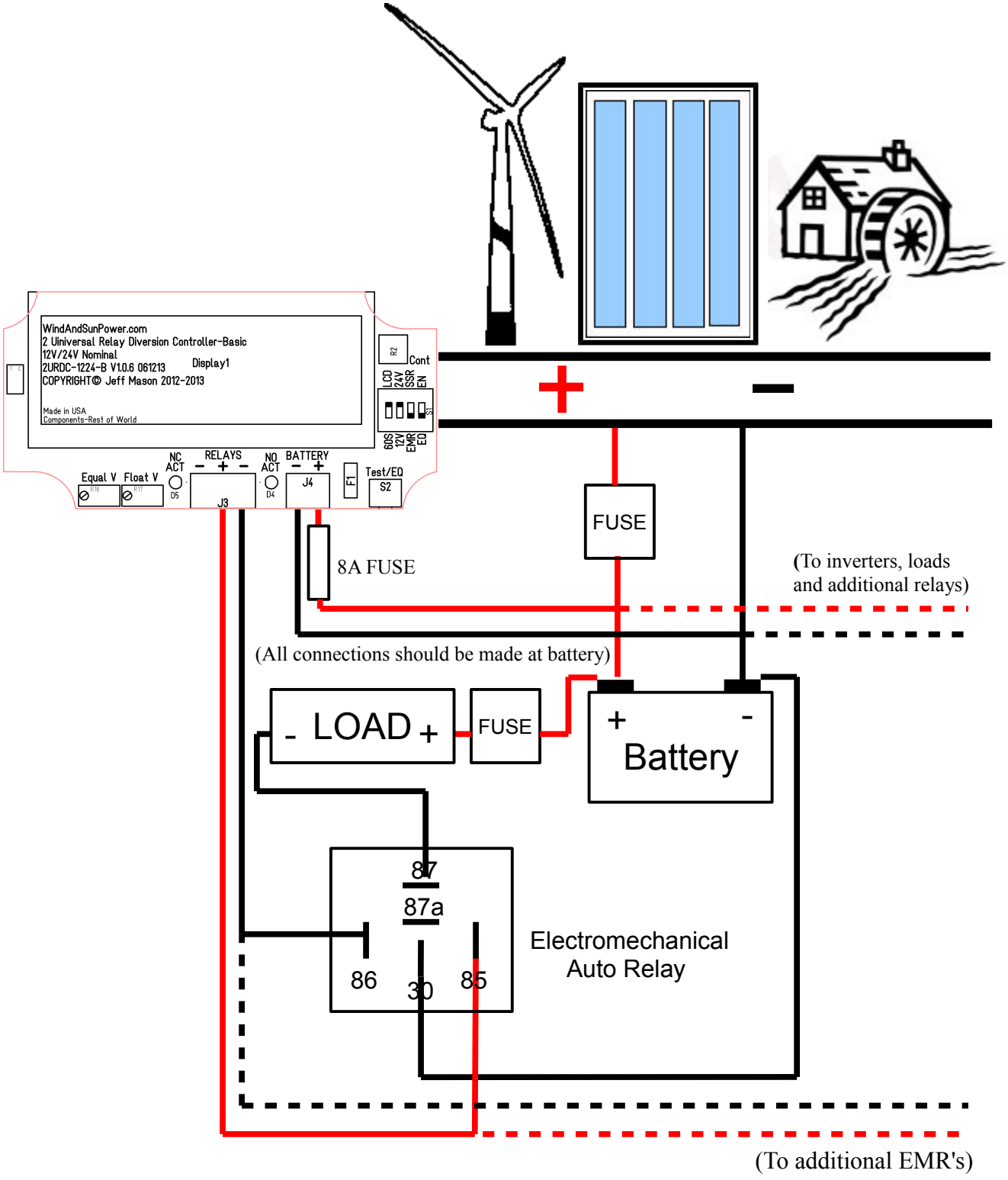
(You can have all 3 sources connected to/charging)
(the batteries at the same time in this configuration)



Wiring Diagram 2. ELECTROMECHANICAL RELAY (EMR) DIVERSION/DUMP MODE

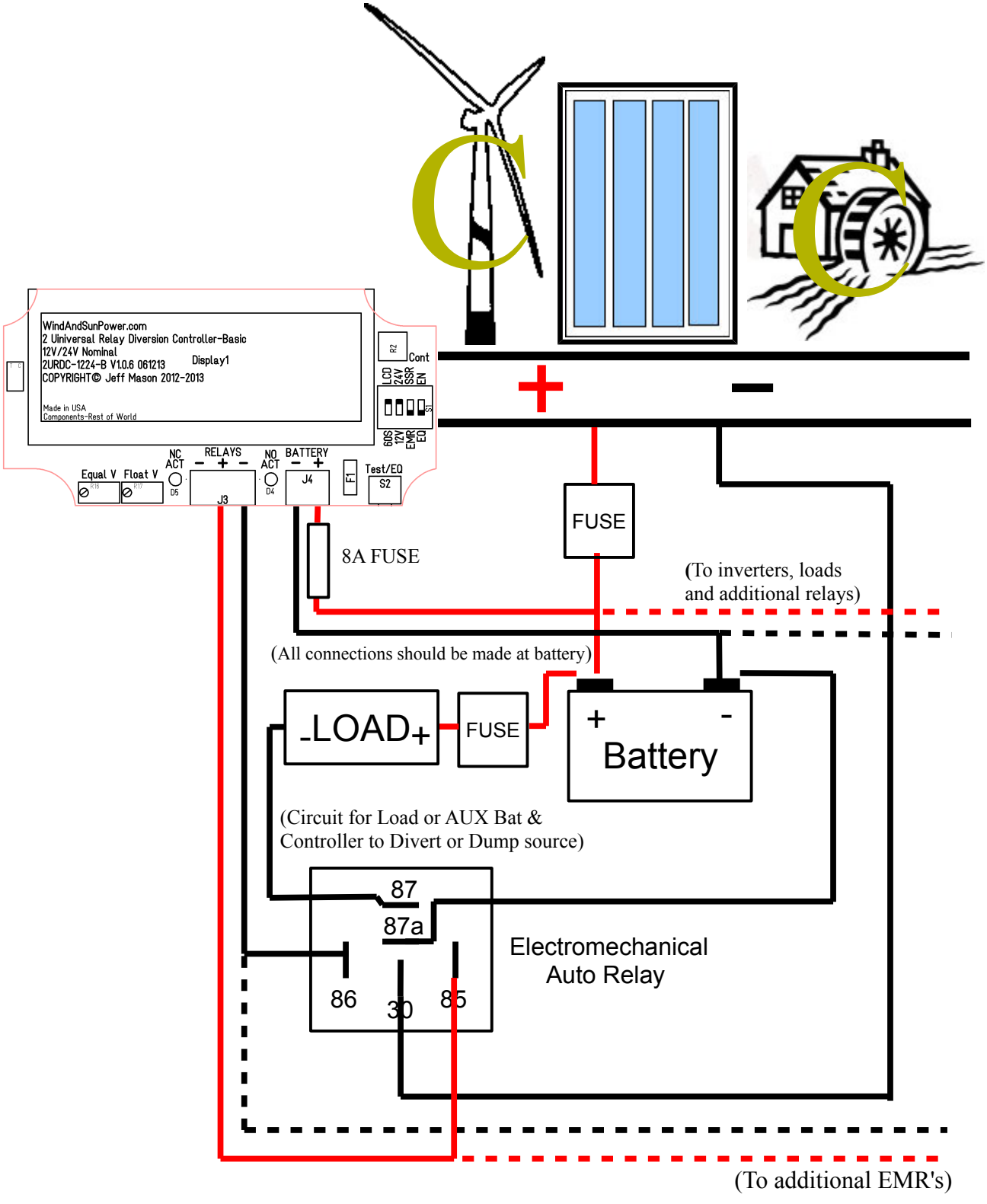
SOLAR YES
WIND YES
HYDRO YES

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



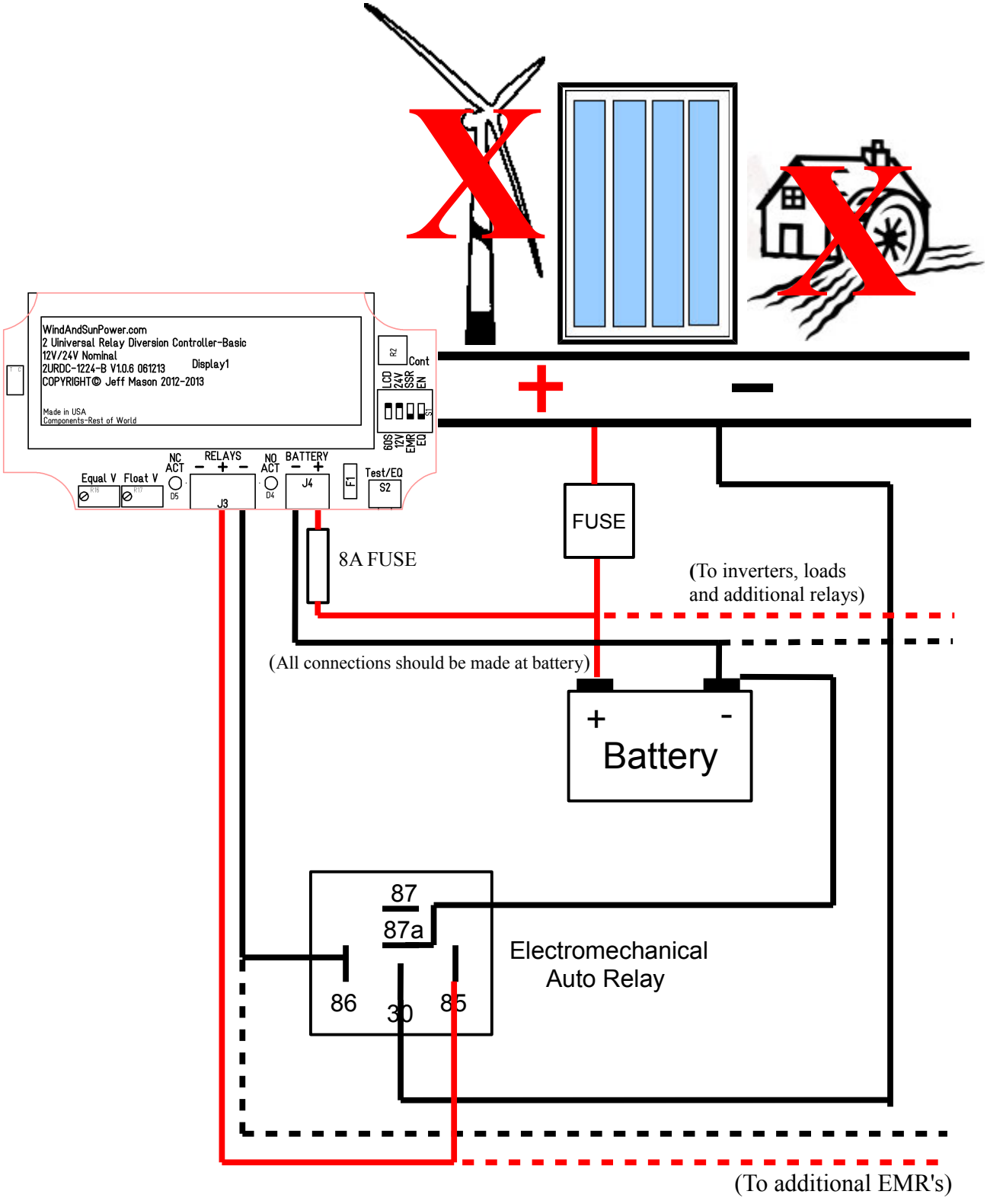
Wiring Diagram 3. ELECTROMECHANICAL RELAY (EMR) ON-OFF DIVERSION/DUMP SOURCE MODE

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)



SPECIFICATIONS

Min. Operating Volts	7 VDC	**Max. Operating Volts**	32VDC
Nominal Operation Voltage	12VDC or 24VDC	**Volts Max.**	35VDC
Max. Power Used by Controller	≤ 26ma LCD On ≤ 20ma LCD Off	**Power Sunk @ Ambient Temp.**	-1.25A Max. @ 40C -1.00A Max. @ 60C
12V Dump Voltage Adjustment Range	13.0 to 15.0 Volts in 0.05V increments	**12V Equalization Voltage Adj. Range**	14.00 to 15.75 Volts in 0.05V increments
24V Dump Voltage Adjustment Range	26.0 to 30.0 Volts in 0.05V increments	**24V Equalization Voltage Adj. Range**	28.00 to 31.5 Volts in 0.05V increments
Relay Connectors Output Voltage	= Battery Voltage	**Battery SOC Meter/Gauge**	10% Increments
Battery Voltage Regulation (High/Low Volts Using EMR's)	± 6% ± 0.93V (**This specification can fluctuate widely due to system variables and design**)	**Battery Voltage Regulation (High/Low Volts Using SSR's)**	<±0.2% or <±0.07V or less Typical @ 23C (**This specification can fluctuate due to system variables and design**)
LCD Accuracy Battery Voltage	<±0.2% or <±0.07V or less Typical @ 23C	**Internal Battery Voltage Tracking**	<±0.2% or <±0.07V or less Typical @ 23C
Automotive style ElectroMechanical Relays	1 up to 8 30 to 40 Amp with 12/24VDC 160ma coil	**Solid State Relays 2-Stage & Equal**	DC-DC 1 to 50? ≤10ms On or less ≤10ms Off or less
EMR Operating Frequency	Dump Volt Setting Min. 5 Sec. On Min. 0.1 Sec. Off	**SSR Operating Freq. 2-Stage**	Min. 0.01 Sec. On Min. 0.01 Sec. Off ≤50Hz(On+Off 50 x Sec.)
Operating Temp. Storage Temp.	-20°C to 60°C -50°C to 150°C	**Dimensions**	100 mm x 50 mm (3.93 in. x 1.96 in.)

Specifications subject to change without notice.

Made in USA-Components Made in Rest of World

WARRANTY:

WindAndSunPower.com. Model 2URDC-1224-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

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 35V+ 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

2. V1.0 to V2.0

- Added SOC meter/battery gauge.
- Added diagnostics alarms.
- Various minor hardware and software tweaks.

10/14/14