Remote Area Protective System
Master Alarm & Protective Controller "Basic Model"
MODEL 1HLVA-Basic 12V (Board Version 1.0.X)
For both EMR's (ElectroMechanical Relays)
and SSR's (Solid State Relays)
(Manual Version 1.0.0 Preliminary Release)

PLEASE READ ALL INSTRUCTIONS CAREFULLY FIRST!!

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

Introduction

These controllers were brought about by there being a lack of low cost expandable relay controllers on the market. 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 1HLVL-12-Basic_1.x.x_Manual.pdf** from WindAndSunPower.com

I also want to thank Matt of ElectricFix.com.au in Tasmania for his suggestions which made this controller possible. Jeff

DESCRIPTION

The **RAPS Master Alarm & Protective Controller** is a low cost, Microprocessor controlled controller designed for the **DIY** (**D**o **I**t **Y**ourselfer).

Function: *When battery voltage rises above the High or drops below the Low trip/set points, it will activate or deactivate external relays (dependent on **J**umper 1 setting) to connect or disconnect sources, loads and/or alarms.*

Jumper On (Output Normally Open)	**Jumper Off** (Output Normally Closed)
Low Voltage Connect / Alarm activation	Low Voltage Disconnect
High Voltage Connect / Alarm activation	High Voltage Disconnect

Potential Uses: Connect/Disconnect loads to protect circuits from Over/Under Voltage situations. Activate alarms and disconnect voltage sensitive circuits. etc.

Basic Operating Principle: Basic operation principle is quite simple. The Microcontroller constantly monitors the battery voltage. When battery voltage meets the above criteria, the Microcontroller activates or deactivates the LED's and external relays.

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. It will also control DC-DC Solid State Relays (SSR). 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
- Extremely Low Power Consumption (≤ 12ma)
- Accurate Battery Voltage Tracking (±0.2% Internally)
- User Settable High and Low Set-points in 0.1V increments
- The Ability to switch 1.25A @ 12V Directly for Very Small Systems
- 8-Bit Microcontroller running at 4Mhz
- Latest SMT (Surface Mount Technology) for Compact Size and Improved Performance
- Self Calibrating
- Self Resetting Fuse
- LED Status Indicator
- LED Relay Power/Activated Indicator
- LED Trip/Set point Indicator
- Test Button
- Reverse Polarity Protection
- Over Voltage Protection
- Over Current Protection
- Transient/Lightning/Surge Protection

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***.
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

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. 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.

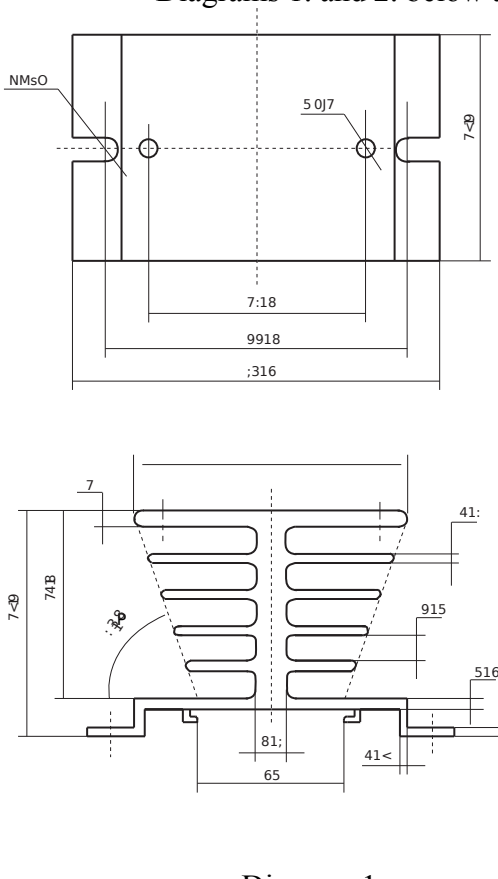


Diagram 1.
15A SSR Heatsink Example
Approximately 2”L x 2.5”W x 2”H

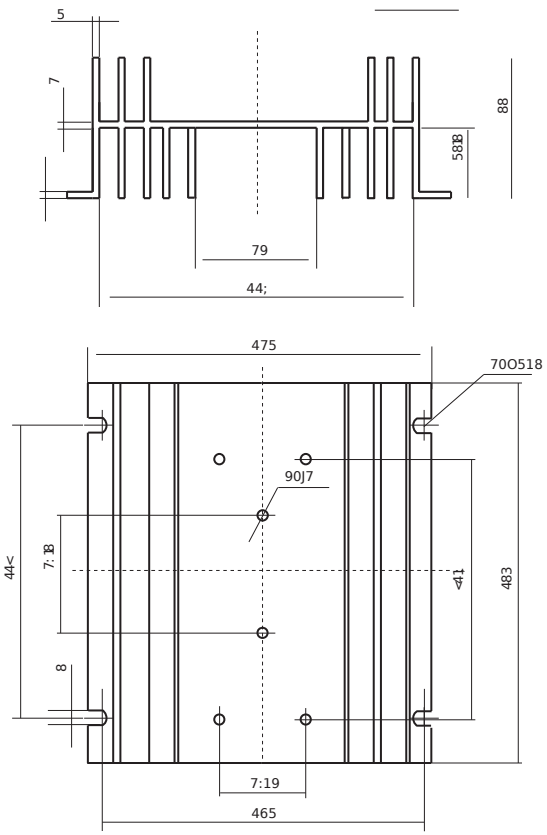
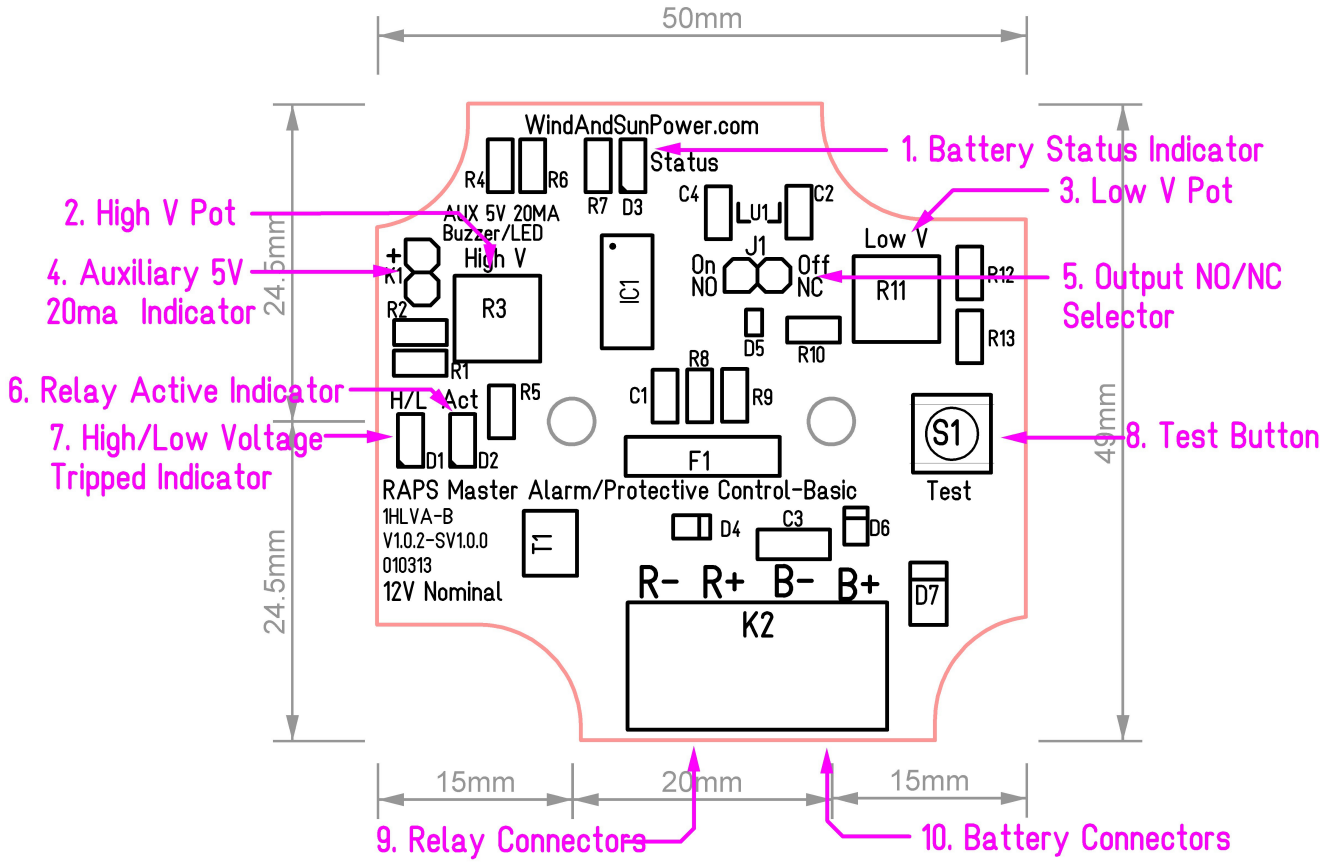


Diagram 2.
40A-80A SSR Heatsink Example
Approximately 6”L x 5.5”W x 2”H

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)
Mager MGR-1 DD220D40 **GOOD** – Tested to 35A@12V, marked 24-220VDC (eBay)

Diagram 3.



1. **<u>Battery Status Indicator</u>** – Fancy power indicator. (See LED Flash Legend.)
2. **<u>High V Pot</u>** – Used to set the High Voltage Set/Trip Point in 0.1V increments. Default setting is centered at 14.5V (See diagram 4.)
3. **<u>Low V Pot</u>** – Used to set the Low Voltage Set/Trip Point in 0.1V increments. Default setting is centered at 11.5V (See diagram 5.)
4. **<u>Auxiliary 5V 20ma Indicator</u>** – Supplies 5V and up to 20ma to external 5V buzzers and/or LED indicators when battery voltage is above or below the set High or Low Set/Trip-Points.
5. **<u>Output NO/NC Selector</u>** – If jumper is **On** then the relays are ***powered on*** when battery voltage is above or below the set High or Low Set/Trip-Points. If jumper is **Off** then the relays are ***powered off*** when battery voltage is above or below the set High or Low Set/Trip-Points.
6. **<u>Relay Active Indicator</u>** – LED indicates if the relays are powered up or not.
7. **<u>High/Low Voltage Tripped Indicator</u>** – LED indicates if battery voltage is above or below the set High or Low Set/Trip-Points.
8. ***<u>Test Button</u>*** – Pressing the test button simulates a high/low battery voltage condition, activating the status LED and dump relay/s. It will activate the relay/s, 5V Aux out and flash all 3 status LEDS on and off 4 times.
9. **<u>Relay Connectors</u>** – 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)
10. **<u>Battery Connectors</u>** – Positive and Negative 12V battery power/sense connectors.

Diagram 4.
Approx High Voltage trip/set points

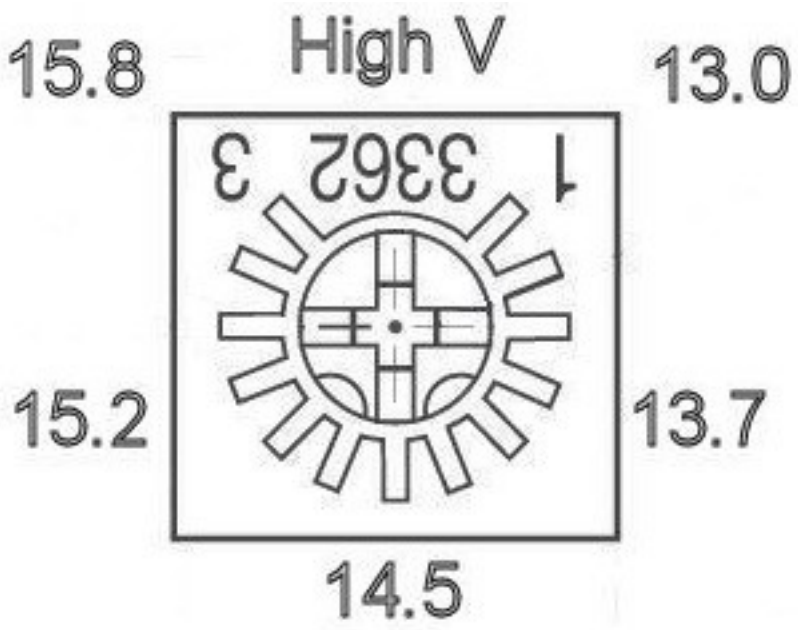
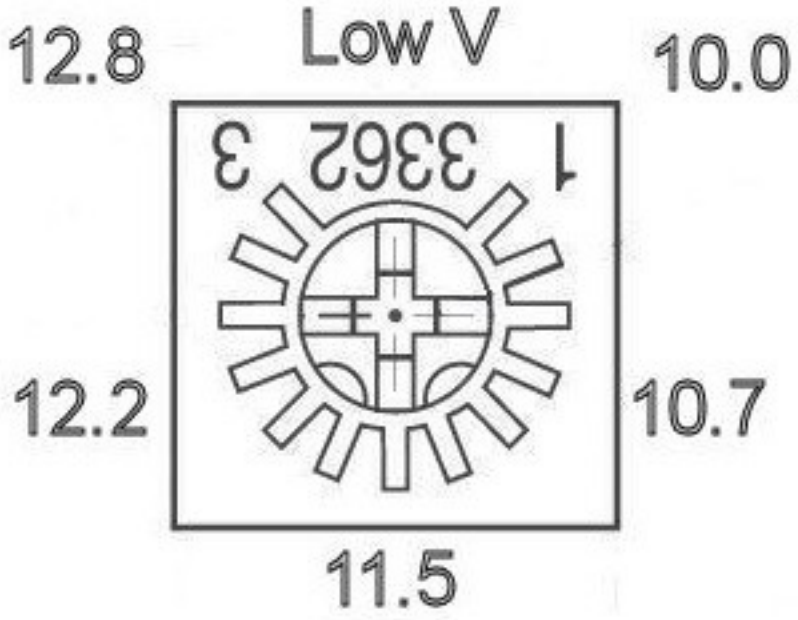


Diagram 5.
Approx Low Voltage trip/set points



LED FLASH LEGEND

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

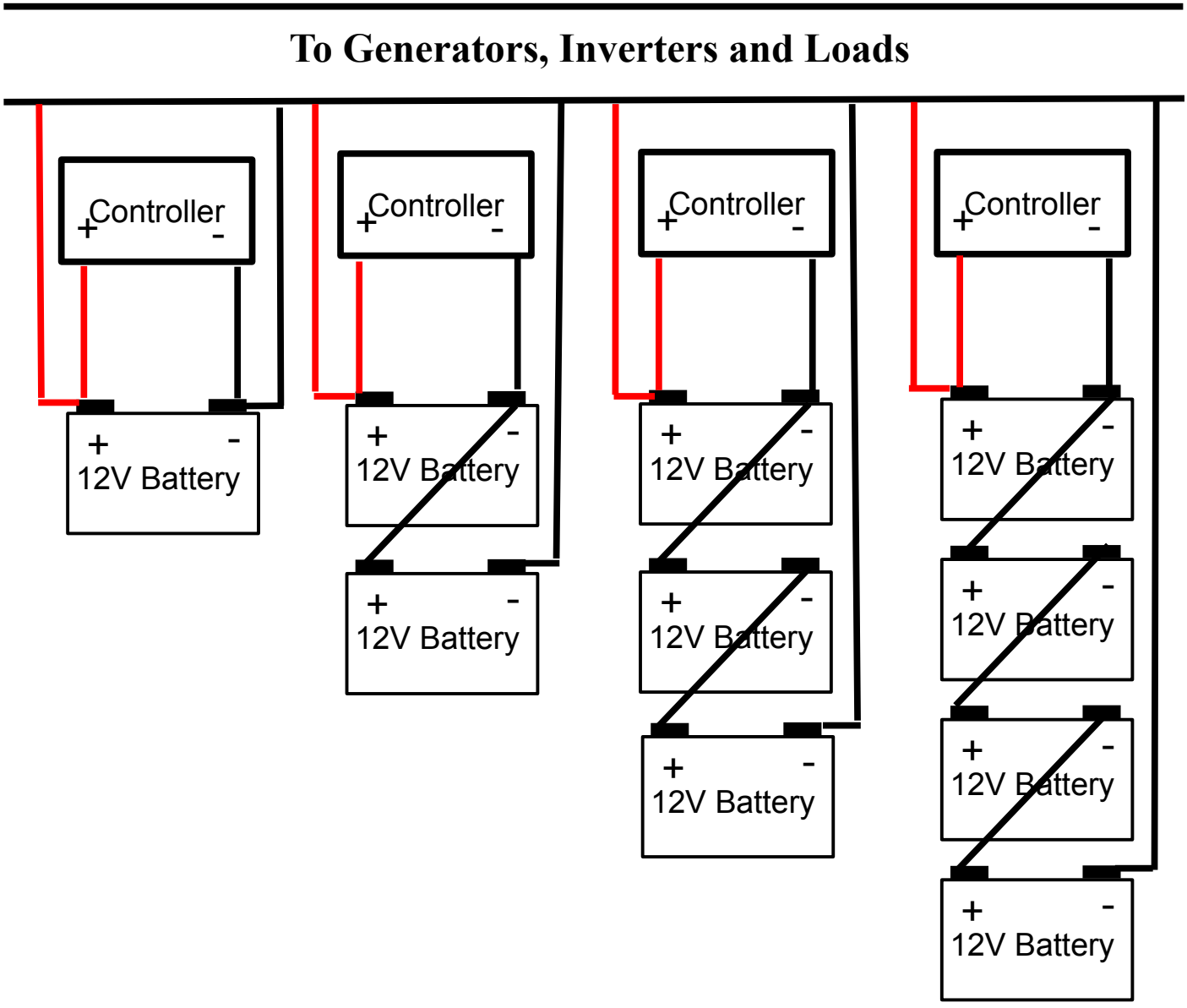
	**GREEN** LED **1** flash every 10 sec	10.50 volts or lower
	**GREEN** LED **1** flash every 5 sec	10.51-11.00 volts
	**GREEN** LED **2** flashes every 5 sec	11.01-11.50 volts
	**GREEN** LED **3** flashes every 5 sec	11.51-12.00 volts
	**GREEN** LED **4** flashes every 5 sec	12.01-12.50 volts
	**GREEN** LED **5** flashes every 5 sec	12.51-13.00 volts
	**GREEN** LED **2** flashes every sec	13.01-13.50 volts
	**GREEN** LED **4** flashes per sec	13.51-14.0 volts
	**GREEN** LED **10** flashes per sec	14.01-14.50 volts
	**GREEN** LED Steady/Constantly on	14.51 volts or higher
	**RED** H/L LED Lit, battery voltage above the High or below the Low trip/set points	
	**YELLOW** Act LED Lit, Relay Activated	

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 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. (Tolerances are also multiplied)

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**



SPECIFICATIONS

Nominal Operation Voltage	12VDC	**Min. Operating Volts** **Max. Operating Volts**	7 VDC 30 VDC
Power Use	≤ 12ma Max.	**Aux. Output**	5V @ 20ma Max.
Power Sunk Max.	-1.25A Max. @ 60C Ambient Temperature	**Accuracy**	±0.2% or ±0.04V or less Typical @ 23C
Automotive style ElectroMechanical Relays	up to 8 30 to 40 Amp with 12VDC 160ma coil	**Solid State Relays**	DC-DC 1 to 50?
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