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Voyager™ VS50 battery charge controller available in 12V, 24V & 48V versions for the Ampair 300 and a solar array

Congratulations, you have bought a high quality Ampair product that will reliably charge your batteries for many years.

However reliable operation does not just depend on quality but also on correct installation and adherence to these guidelines. Please read this manual carefully before installing and keep in mind our safety instructions and wiring notices. Your safety is our main concern.

Use

The regulator is manufactured to be used with the Ampair 300 wind generator and one solar array. It is available in 12V, 24V or 48V versions that must be selected at the time of order:

VS 50 – 12	for nominal 12V systems
VS 50 – 24	for nominal 24V systems
VS 50 – 48	for nominal 48V systems

The input from either source (channel) should not exceed 25A under normal working conditions, giving a total combined input of 50A. It can be used with or without one solar array. It CANNOT be used to regulate two Ampair 300 wind generators or two solar arrays without modification.

It is suitable for flooded lead acid or sealed lead acid (gel or AGM) batteries. The electronics of the charge regulator are fully potted to protect from humidity and vibration.

Safety

Ensure that work on the electrical system, such as installation, maintenance and repair is carried out by competent persons only and that they have studied the instructions given in this manual before starting work.

Batteries store a large amount of energy. Avoid short circuiting the batteries at all costs. Fuse protection is included.

Charging lead-acid batteries produces inflammable hydrogen gas. Unsealed lead acid batteries have vent holes releasing hydrogen, which forms a combustible mixture with the ambient air. A small spark e.g. from an electrical switch can detonate the explosive gas mixture. Therefore always provide sufficient ventilation to avoid an explosion.

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Avoid touching and short circuiting wires or terminals. Beware that voltages on specific terminals or wires can be significantly higher than the nominal battery voltage. Only use insulated tools, stand on dry ground and keep your hands dry.

Please also follow the instructions in the Ampair 300 manual, and the safety recommendations of the battery and solar panel manufacturers.

The internal dump loads will become hot and so the unit must be mounted in a ventilated area and the cooling grills must not be blocked, or covered with flammable material.

Exclusion of liability

Ampair shall not be liable for damages caused by use other than as intended and described in this manual, or if the recommendations of the battery or solar panel manufacturers are neglected. Ampair shall also not be liable if there has been service or repair carried out by any unauthorized person, unusual use, wrong installation or inappropriate system design. Modifying the charge regulator voids warranty.

Technical Data

	<i>12V</i>	<i>24V</i>	<i>48V</i>
Nominal voltage	12V	24V	48V
Max. charging voltage adjustable range (20°C)	13.8 to 15.9V	27.6 to 31.8V	57.2 to 63.6V
Max. current per channel	25A	25A	25A
Total dump load resistance (approx.)	0.5 Ω	2.0 Ω	8.0 Ω
Number of charging outputs	1	1	1
Number of Inputs	2	2	2
Connectors	M4	M4	M4
LED indicating that battery voltage is low	yes	yes	yes

Functions

The regulator has been especially produced to be used with an Ampair 300 wind generator and optimizes battery charging. When the batteries have reached their maximum charge voltage the regulator circuitry automatically diverts the wind turbines surplus power to the dump load resistors. Thus, even with batteries fully charged, the generator continues operation and provides useable power as soon as an electrical load is applied.

When used in conjunction with a solar array the solar channel will simply switch the array on and off thus obviating the need for a dump load.

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A parking switch is incorporated and can be used to stop/ park the generator by turning it to the “STOP” position. But, just as a parking brake on a car should not be relied on to stop it completely, so should the parking switch be not relied on in strong winds and storms. Use it to slow the generator down, then turn out of the wind and tie a blade to the mast with a rope. To run the generator, untie the generator and turn the parking switch to “RUN”.

The charge light indicator informs the user about the status of the regulator as per the following table:

Indicator Name	Description	Charge Indicator
Charging	Battery voltage is above 11V	STEADY Green
Charging	Battery voltage is below 11V	FLASHING Green to Orange
Not Charging	Battery voltage is below 11V	FLASHING Red
Charge Divert Solar	Current not flowing (no dump load)	STEADY Orange
Charge Divert Wind	Current flowing to dump load	STEADY Red
Not Charging	No current or voltage	NONE No light

Locating the Regulator

The Voyager regulator is designed for undercover use and should be mounted in a place protected from the weather.

When the batteries are fully charged all the power will be dissipated through the dump load resistors so, it is important to mount the regulator vertically, to invoke the chimney cooling effect and ensure that there is adequate ventilation. On a yacht a good place for the regulator is ordinarily in the engine compartment.

Relocating the dump loads

It is permissible to relocate the internal air-cooled dump load resistors to an external location, for example to provide space heating. If this is done they must be reconnected in the circuit the same way as they were supplied, and they must be located in a well-ventilated location with sufficient protection that they cannot cause a fire or injury. It is also possible to disconnect the internal air-cooled resistors and replace them with a water heating resistor, in which case care should be taken to select an equivalent electrical rating.

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Connecting the Regulator

Before connecting the regulator, prevent your Ampair 300 wind generator from starting unintentionally by tying one of the rotor blades to the mast (if accessible). Make sure the batteries are disconnected.

Make sure that the parking switch on the regulator board is turned to the "STOP" position as this will ensure a controlled start when you are ready to operate your generator.

Also cover your solar panels with a blanket or cardboard, this will help prevent short circuiting.

Open the fuses.

All that is now required is to connect the battery voltage sense leads, the wind turbine generator, the solar panels (optional) and batteries.

Note 1: *There are different cabling routes for your Voyager regulator depending on your mounting situation that can be catered for by utilizing the various knockouts surrounding the terminals. Cable glands are supplied and can be fitted where your cabling goes through.*

IMPORTANT: To prevent your system from damage the regulator must be connected in the following order:

1. Connecting the sense leads

IMPORTANT: Failure to connect the sense leads could result in the batteries becoming overcharged and exploding. You **MUST** connect sense leads.

Any voltage drop along the charging wires to the positive battery terminal will waste power, but it will not affect the charging voltage of the battery if the voltage sense wires are connected. That is the primary reason for using separate sense wires on the controller to allow systems to have shunts, long wire runs, dual battery isolators, and other devices in the charging wires that cause voltage drops. Because the sense wires go directly to the battery the controller will push the battery to the peak levels even with some loss in the charging wires as long as the voltage in the charge wires is above the battery voltage.

Connect sense leads between the Voyager sense lead terminal block and the battery terminals. Use 1.5mm² or 2.5mm² black wire from the negative sense lead terminal to the negative battery terminal and 1.5mm² or 2.5mm² red wire to connect the positive Voyager sense lead terminal block to the positive battery terminal.

Note 2: *In order to avoid accidentally short-circuiting, first connect the cables to the charge regulator and then to the battery.*

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Note 3: *The positive sense wire has a 2A fuse wired in between the battery and the charge controller to protect from power surges and short-circuits.*

IMPORTANT: The inputs for the Ampair 300 generator and solar array must NOT be interchanged.

2. Connecting the wind generator

The output from your Ampair 300 generator is alternating current (AC) of a varying three phase voltage and therefore has a triple core cable, which runs to a female connector. The generator is supplied with a male connector to which a triple 2.5mm² core cable can be connected and run to the regulator. For minimum cable sizes see the tables at the back of these instructions.

The regulator has three terminals for the “turbine” connection, one for each of the three cores of the connecting cable. The cores can be connected to the turbine terminal in any order but, it is conventional to connect like colours to like (2.5mm² cable end ferrules can be used to avoid fatigue).

3. Connecting the solar panels

You may connect enough solar panels such that no more than 25A is generated. For a 12V system a maximum of 300W_p, for a 24V system a maximum of 600W_p and for a 48V system a maximum of 1200W_p of solar panels can be installed.

The cable size tables at the back of these instructions give the cable lengths to achieve no greater than a 10% voltage drop but, increasing cable gauge will always result in better performance.

4. Connecting the batteries

IMPORTANT: Connecting the batteries in reverse polarity will blow the rectifier and void the warranty

You can connect just one battery bank to the regulator. Remove the cover and wire the negative battery terminal to the black wire in the terminal-block on the right hand side and the positive battery terminal to the red wire in the terminal-block next to the yellow and green earth terminal. Wire the earth terminal, yellow and green wire, to your earth system.

IMPORTANT: Use a cable of at least 10mm² cross sectional area between the batteries and the regulator.

Note 4: *In order to avoid accidentally short-circuiting, first connect the cables to the charge regulator and then to the battery.*

Setting the regulator for different battery types

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The Voyager regulator will charge most types of battery. To fine tune to the particular battery type that you are using the peak charge voltage can be adjusted between:

13.8V to 15.9V	for the 12V regulator
27.6V to 31.8V	for the 24V regulator
55.2V to 63.6V	for the 48V regulator

There is a small screw next to the charge regulator light, turn it anticlockwise to decrease the maximum charging voltage and clockwise to increase it. The small indent marks the factory setting of 2.375V per battery cell producing a peak charge of 14.25V. Refer to the battery manual for maximum charge voltages, or see the table below:

Table of Typical Battery Charging Voltages:

Battery Type	12V System Nominal Max. Charging Voltage	24V System Nominal Max. Charging Voltage	48V System Nominal Max. Charging Voltage
Sealed:			
AGM	14.4 to 14.5V	28.8 to 29.0V	57.6 to 58.0V
Gel	14.1 to 14.4V	28.1 to 28.8V	56.2 to 57.6V
Flooded Lead-Acid	14.2 to 15.0V	28.4 to 30.0V	56.8 to 60.0V

To set the peak charge voltage, ensure that the batteries are fully charged and that the divert light does not come on for more than 10 seconds (If it is quicker than that then your voltmeter readings will be inaccurate). To make sure that this is the case, on the solar channel, cover some of the modules with a blanket or cardboard. If it comes on more often, on the wind channel, turn the parking switch to the stop position.

Turn the screw most of the way towards positive (clockwise)

Connect a digital multi-meter measuring D.C voltage across the battery terminals and watch for the highest voltage that you want the batteries to charge to. If you do not have a digital multi-meter then the moving coil voltmeter will provide a suitable guideline. When the wind or solar is charging, slowly turn the screw towards negative (anticlockwise) until the divert light comes on (steady red or orange).

Allow the controller to cycle a few times while watching the voltmeter, and fine tuning the adjustment for the exact upper switch voltage you desire.

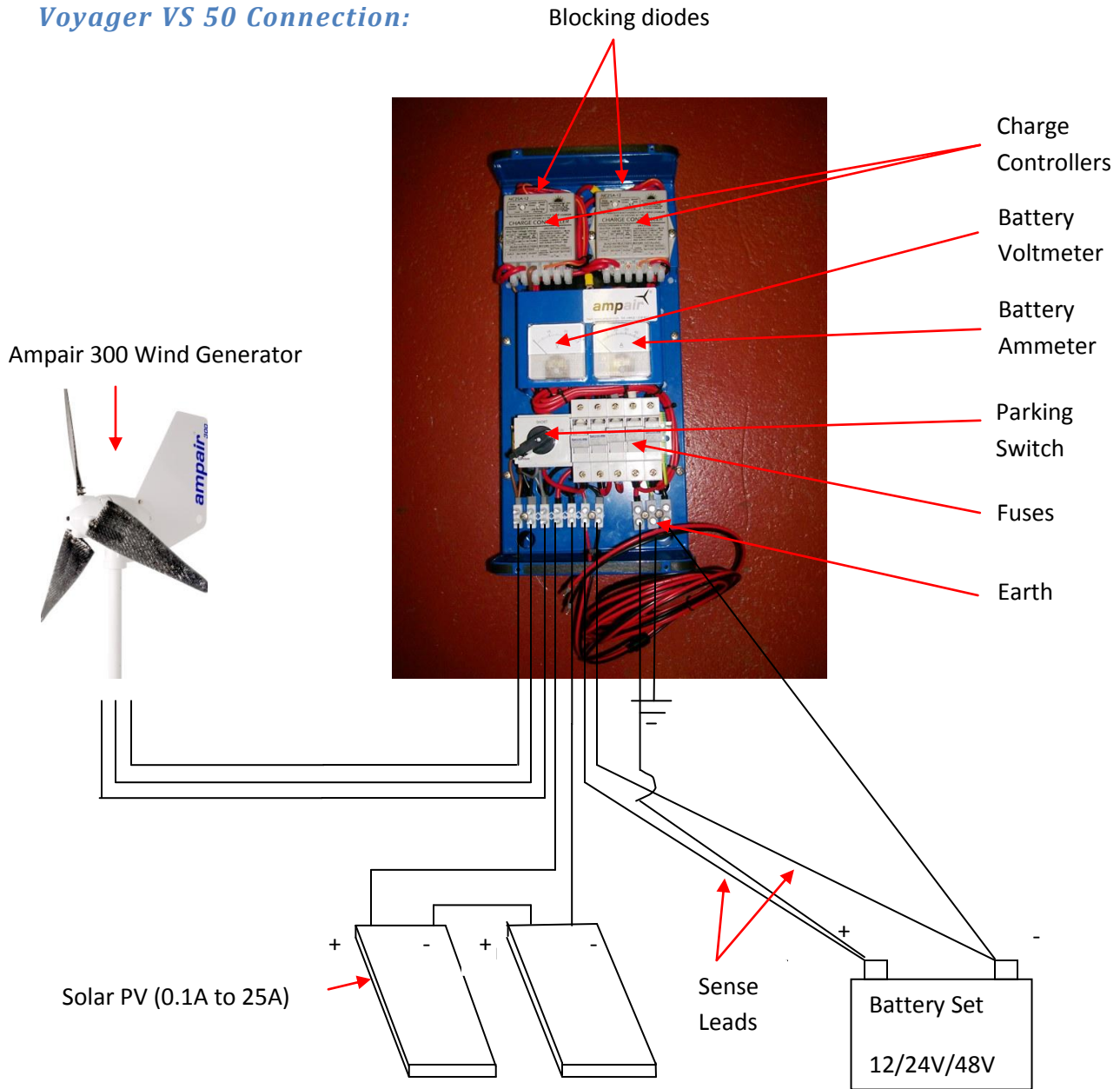
Operation

With the park switch in the "STOP" position untie the wind generator. Ensure that the generator is clear to run, close the fuses and turn the park switch to "RUN". Enjoy many years of free electricity!

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Voyager VS 50 Connection:



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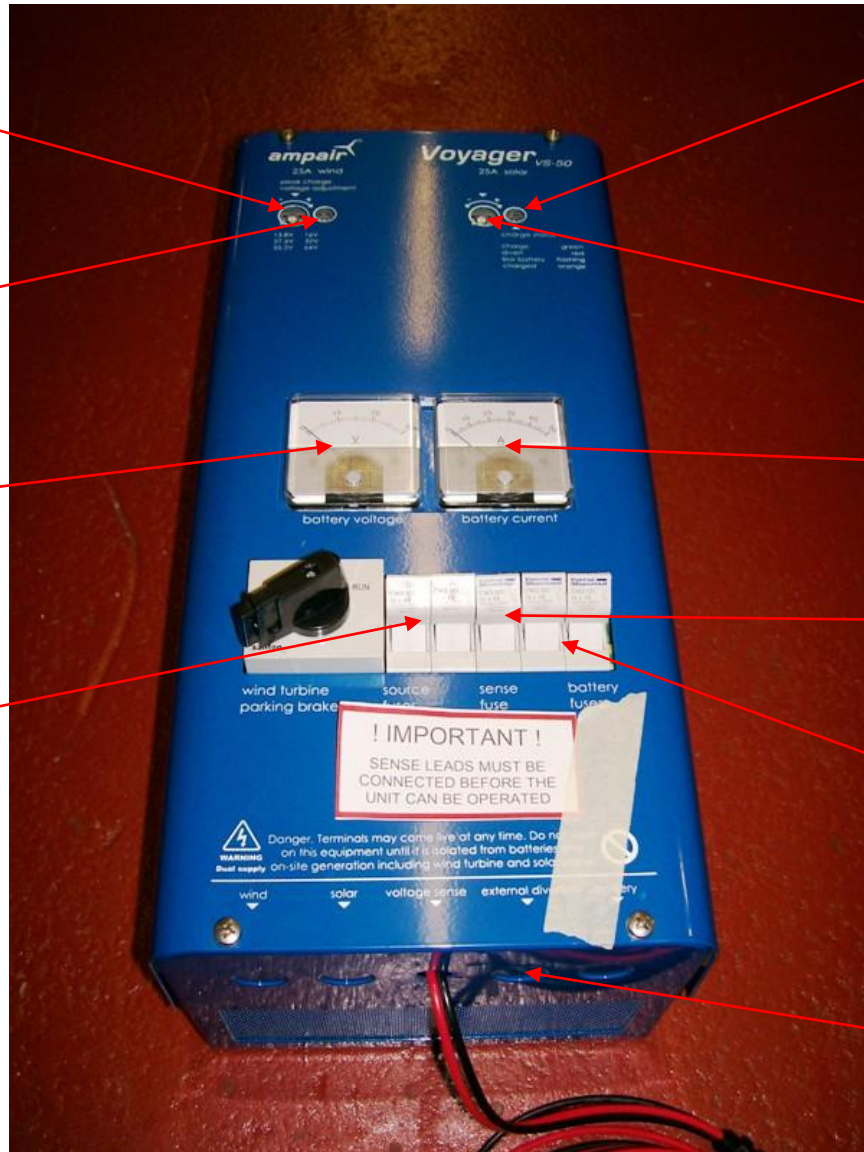
Voyager VS 50 front panel

Wind Peak
Charge
Voltage
Adjust

Wind Status
Indicator
Light

Battery
voltmeter

32A Source
Fuses



Solar Status
Indicator Light

Solar Peak
Charge Voltage
Adjust

Battery
Ammeter

2A Voltage
Sense Fuse

32A Battery
Fuses

Knockouts for
cable glands

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Rectifier Diagnostics

It is best to transmit electrical power as AC at as high a voltage and as low a current as possible so as to minimise losses due to the resistance of the wiring system. For this reason the rectifier of the Ampair 300 is not fitted inside the generator but is instead inside the Voyager cabinet with the regulator. The rectifier is a three way bridge rectifier mounted on a heat sink.

Faulty rectifiers: The rectifiers should last the life of the machine. However, in the unlikely event that the turbine stops producing electricity the following diagnostic test can be performed to identify the condition of your rectifier:

Diode Test: This test will show if the rectifier diodes are either open or short circuit. If your multimeter has a diode check feature, select this (if not select the highest resistance range) and, after removing the connecting wires apply the red meter lead to the red rectifier lead (disconnected from battery positive), black meter lead to thick black lead (disconnected from battery minus), and note the reading. Now reverse the connections.

METER POSITION	LEAD	MULTIMETER SETTING		CONCLUSION
		DIODE TEST	OHMS x 100	
Red to Red and		No reading	or many Megohms	OK
Black to Black		Reading	or low resistance	Not OK
Black to Red and		0.5 to 1 volt (two diode drops)	or markedly less*	OK
Red to Black		No reading	or high resistance	Not OK

* This test is not as conclusive as the diode test method however, provided the first reading is a very high resistance and the second reading far lower, then the test is valid. Actual values will depend on the voltage supplied by the particular meter for its resistance ranges.

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Blocking Diodes

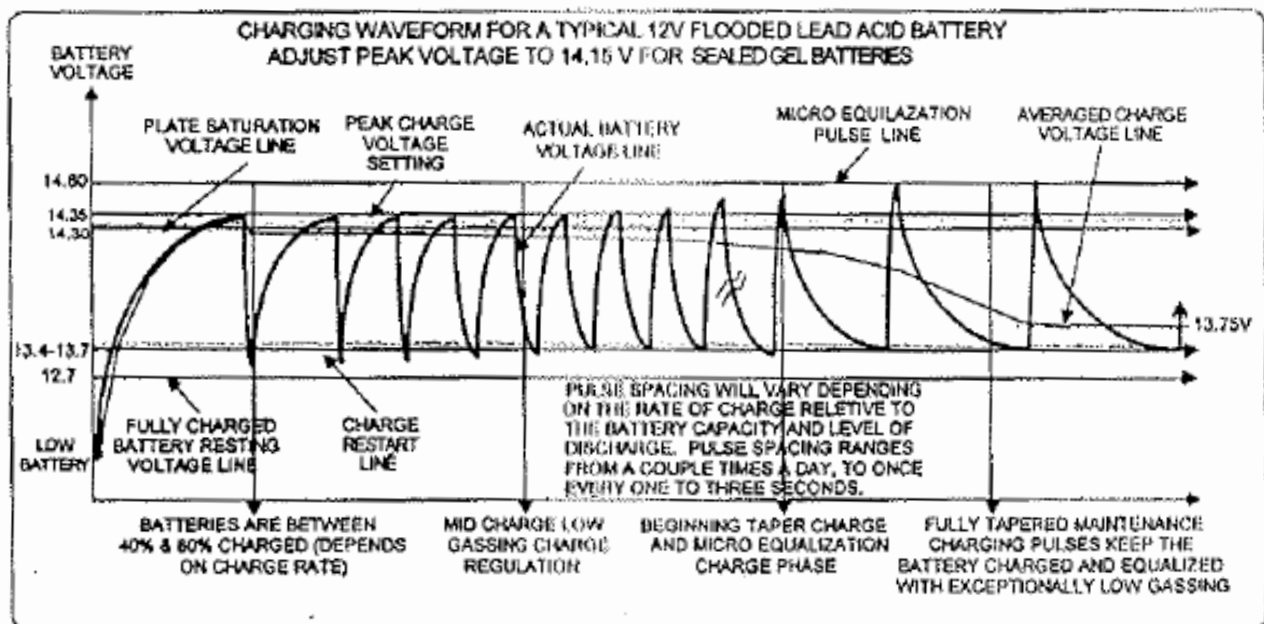
Blocking diodes have been fitted in the Voyager regulator for four main reasons:

1. To prevent the discharge of current from the batteries into the PV panels when the cells are generating no electricity.
2. To prevent a damaged PV panel from draining the battery and drawing power from the remaining good panels.
3. To prevent the wind generator from charging across the solar PV
4. To prevent the solar PV from charging across the wind generator

A diode is a one-way electronic valve that allows current to flow in one direction but not the other. This is indicated by the band on one end of the diode that marks the output. As current flows from negative to positive the band should be connected in the positive direction to allow current to flow.

The energy state taper charge method

The Voyager VS 50 uses a state of the art energy state taper charge method. This results in zero overcharging as the battery state determines the amount of charge accepted, exceptionally low gassing, non-destructive micro equalization at each full charge and no Radio Frequency Interference (RFI) or Electro-Magnetic Interference (EMI). The following chart illustrates a typical charge cycle.



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Trouble Shooting Guide

SYMPTOM	SOLUTION
The Divert Indicator does not light up	<p>The controller must first reach the peak charge voltage before Divert will engage. This Indicator will only illuminate while the battery voltage is between the peak charge voltage and reconnect voltage (factory set at 14.25V/13.6V, but is adjustable).</p> <p>Check ALL the wire connections</p> <p>Check the Battery Sense Wires for a good connection. These wires are the only way the controller can determine battery voltage and control charging. A poor connection here could cause SERIOUS DAMAGE to your battery bank and other electronics connected to it.</p>
The controller does not switch to FLOAT/DIVERT when the battery voltage is equal to, or above the Peak Charge Point	<p>Ensure the Battery Sense Wires are making a good connection. These wires are the only way the controller can determine battery voltage and control charging. A poor connection here could cause SERIOUS DAMAGE to your battery bank and other electronics connected to it.</p> <p>Check the position of the Peak Charge Adjustment. Unless you have custom set this adjustment, it should be set to the dot on the case.</p>
The battery is being overcharged	<p>Check the position of the Peak Charge Adjustment. It should be set at the small calibration dot on the case, unless you have custom set your peak charge voltage. DO NOT MOVE THE ADJUSTMENT unless you have calibrated test equipment and a fully charged battery bank to re-calibrate the controller. MIS-ADJUSTMENT COULD DO SERIOUS DAMAGE TO YOUR EXPENSIVE BATTERY BANK. If it is not at the dot see the instruction manual for the calibration procedure or call Ampair.</p> <p>Check the Battery Sense Wires for a good connection. These wires are the only way the controller can determine battery voltage and control charging.</p>
Controller makes a Buzzing sound	<p>This will happen when the charging source is charging while the wire from the Controller's Battery positive terminal and the sensing positive terminal wire are connected together but removed from the battery terminal. If left in this state for even a few minutes the controller will be damaged.</p> <p>Disconnect the charging source, or separate the Controller's battery positive terminal and the Sense positive wires until the installation is completed. Removing one of the fuses will also stop this from occurring.</p>

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Wire sizing tables

Minimum three core AC cable size for 12 volt wind turbine:

Total AC section length	Up to 8 m	8 - 12 m	12 - 18 m	18 - 30 m	30 - 50 m	30 - 76 m	76 - 100 m
	Up to 27 ft	27 - 40 ft	40 - 60 ft	60 - 100 ft	100 - 166 ft	166 - 253 ft	253 - 333 ft
Minimum cross sectional area per cable	2.5 mm ²	4 mm ²	6 mm ²	10 mm ²	16 mm ²	25 mm ²	35 mm ²
	14 AWG	12 AWG	10 AWG	8 AWG	6 AWG	4 AWG	2 AWG

Minimum three core AC cable size for 24 volt wind turbine:

Total AC section length	Up to 8 m	8 - 12 m	12 - 18 m	18 - 30 m	30 - 50 m	30 - 76 m	76 - 100 m
	Up to 27 ft	27 - 40 ft	40 - 60 ft	60 - 100 ft	100 - 166 ft	166 - 253 ft	253 - 333 ft
Minimum cross sectional area per cable	1.5 mm ²	2.5 mm ²	4 mm ²	6 mm ²	10 mm ²	16 mm ²	25 mm ²
	16 AWG	14 AWG	12 AWG	10 AWG	8 AWG	6 AWG	4 AWG

Minimum three core AC cable size for 48 volt turbine

Total AC section length	Up to 8 m	8 - 12 m	12 - 18 m	18 - 30 m	30 - 50 m	30 - 76 m	76 - 100 m
	Up to 27 ft	27 - 40 ft	40 - 60 ft	60 - 100 ft	100 - 166 ft	166 - 253 ft	253 - 333 ft
Minimum cross sectional area per cable	1.5 mm ²	1.5 mm ²	2.5 mm ²	4 mm ²	6 mm ²	10 mm ²	16 mm ²
	16 AWG	16 AWG	14 AWG	12 AWG	10 AWG	8 AWG	6 AWG

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Maximum DC cable length 12 volt solar panels 300Wp

Maximum section length	Up to 5.5m	5.5 - 8m	8 - 14m	14 - 22m	22 - 35m
	Up to 18 ft	18 - 27 ft	27 - 46 ft	46 - 73 ft	73 - 116 ft
Cross sectional area per cable	4mm ²	6mm ²	10mm ²	16mm ²	25mm ²
	12 AWG	10 AWG	8 AWG	6 AWG	4 AWG

Maximum DC cable length 24 volt solar panels 600WP

Maximum section length	Up to 11m	11 - 16m	16 - 28m	28 - 44m	44 - 70m
	Up to 36 ft	36 - 56 ft	56 - 92 ft	92 - 146 ft	146 - 232 ft
Cross sectional area per cable	4mm ²	6mm ²	10mm ²	16mm ²	25mm ²
	12 AWG	10 AWG	8 AWG	6 AWG	4 AWG

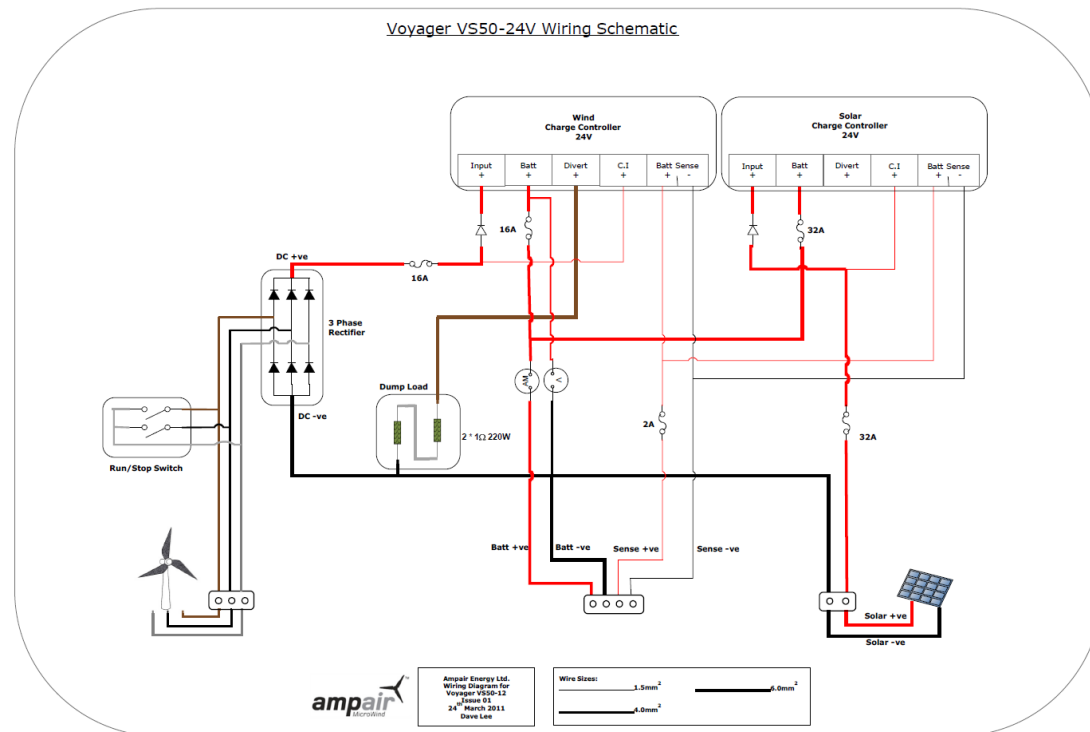
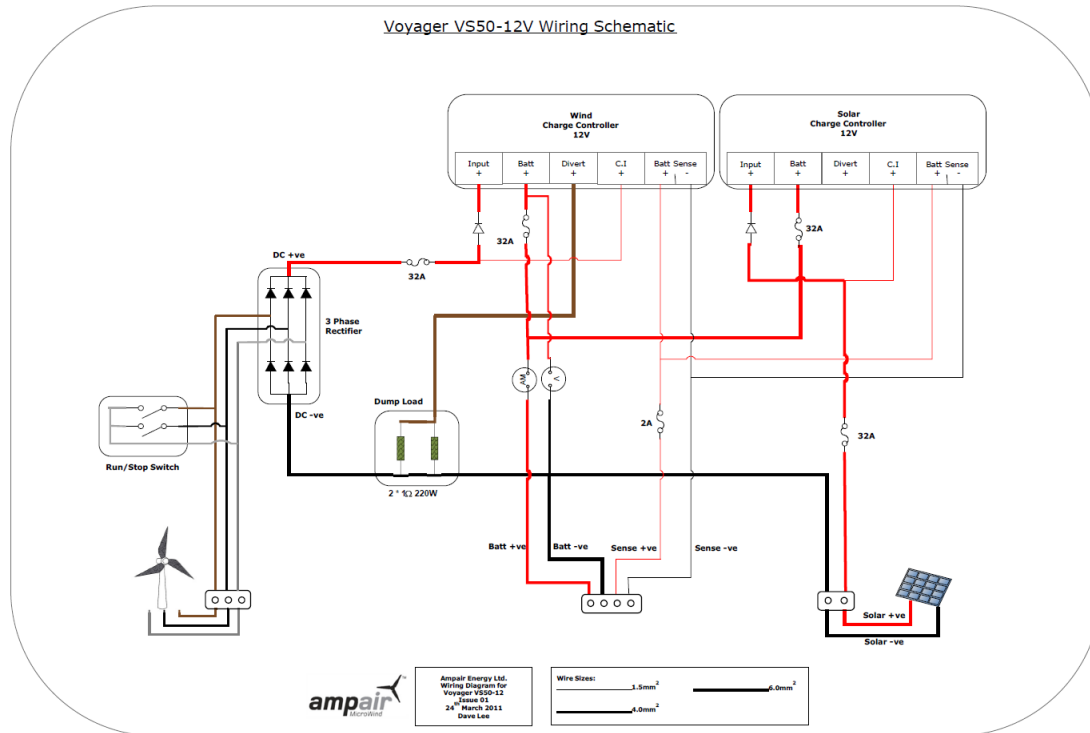
Maximum DC cable length 48 volt solar panels 1200WP

Maximum section length	Up to 22m	22 - 32m	32 - 56m	56 - 88m	88 - 140m
	Up to 72 ft	72 - 112 ft	112 - 184 ft	184 - 292 ft	292 - 464 ft
Cross sectional area per cable	4mm ²	6mm ²	10mm ²	16mm ²	25mm ²
	12 AWG	10 AWG	8 AWG	6 AWG	AWG

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Wiring schematic



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