

# FAQ GUIDE

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## WS500



# WAKESPEED

CHARGE  SMARTER



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## WHERE DO I GET MY WAKESPEED WS500 INSTALLED?



Depending on your application (RV or marine) Wakespeed has an extensive list of dealers in most areas of the U.S. and internationally. Visit our website for a directory. If there's not an installer in your area, call our support team for recommendations.

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## CAN I INSTALL THIS MYSELF?



The Wakespeed regulator is part of a fairly complex system of charging and battery components. While there is a significant amount of documentation available on our website, we recommend using a trained technician for system installation. In marine installations, we suggest finding a qualified ABYC technician, as most are well trained on systems installation and management.

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## CAN THE WAKESPEED WS500 REGULATOR BE USED FOR DIFFERENT SYSTEM VOLTAGES?



Yes. The WS500 can be configured for any system voltage between 12 volts and 54 volts. In 12, 24 and 48-volt systems, the WS500 will auto-detect and set the charging voltage values for correct levels based on the system voltage.

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## WHAT IF MY SYSTEM IS DIFFERENT FROM THE VOLTAGES THAT THE REGULATOR CAN AUTO-DETECT?



There are many older electrical systems (and special use battery banks dedicated to loads like thrusters and trolling motors) that may require that the WS500 support unusual alternator voltage ratings; 32-volt systems, for example. The WS500 can be custom configured using the configuration utility available on the [wakespeed.com](http://wakespeed.com) technical page, or the Wakespeed Configuration App, to support system voltages other than 12, 24, or 48-volt systems.

The WS500 uses a multiplier, based on a 12-volt default standard, to determine charging voltages. In a 32-volt system, the installer would divide the system voltage by the 12-volt default to determine the multiplier needed to add to the configuration profile. That multiplier would be 2.6666666666666666, or more simply, 2.67. This value would be changed in the \$SCO line of the profile in the Windows utility. In the Wakespeed smartphone app, the installer would simply pick 32 volts as the system voltage.

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## DO I NEED A SECONDARY ALTERNATOR?



This depends, to a great extent, on the application. In most automotive applications, like RV and commercial truck installations, the alternator is an integrated part of the engine computer control. In most cases, the internal regulator is communicating with the engine computer, and the addition of a smart regulator will not comply to emission system demands. In that case, the addition of a secondary alternator that's dedicated to the house battery loads will be a better option. That alternator will be able to take its charging direction from the WS500. The same holds true in the marine side, where some "electronic" engines are using information from the standard alternator to control emissions and output. In that case, a second alternator may be the best solution.

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## DO I STILL NEED AN ALTERNATOR PROTECTION DEVICE?



With any battery that has the potential to self-disconnect from its charge source, there needs to be some level of mitigation to protect the alternator and other sensitive electronics from a disconnect/load dump event. We recommend, above all, that the alternator used is equipped with avalanche diodes. These diodes are uniquely capable of withstanding and dissipating voltage spikes created by uncontrolled disconnects. Additional protection devices designed to augment the alternator's ability to deal with voltage spikes will add to the ability to mitigate spikes and protect the vehicle or vessel from damaging load dumps.



## HOW BIG DOES MY ALTERNATOR HAVE TO BE?



The capacity of the alternator is dependent on both the size and the chemistry of the batteries being charged. A rule of thumb that's been long used with lead acid batteries is that the alternator should be capable of producing output that's roughly 25 percent of the capacity of the batteries being charged. With LiFePO<sub>4</sub> batteries, that ratio is a bit low. Lithium batteries, by nature, offer literally no resistance for the majority of the charge cycle, so the batteries are going to demand just about everything the alternator is capable of for extended time periods. As a result, alternator temperature becomes an issue. In most cases, lithium batteries are limited to a 0.5C-rate, so, in an ideal situation, the alternator will be rated at about half of the overall capacity of the batteries. With large battery banks, that's not always a viable option, so one of the important features of the Wakespeed regulator is the ability to control how much output the alternator is allowed to deliver, and the regulator can also control output to maintain optimal temperature at the alternator. Both of these functions will profoundly affect the health and life span of the alternator.



## DO I NEED AN N TYPE OR P TYPE HARNESS?



The vast majority of the time, a P-type harness will work — although there are some regions like Europe, where externally regulated alternators are more commonplace. In most situations where an alternator is being modified to support external regulation, the technician making the modification has the option to set up the alternator for P-type regulation. This is by far the most commonly chosen field excitation route. Just about all of the aftermarket externally regulated alternators available in the U.S. will be configured to be excited on the positive brush. If you are not familiar with the modification process, we do recommend having a competent alternator technician modify your alternator for you.



## WHAT ARE THE APPROVED BATTERY TYPES? AND WHAT IF MY BATTERY IS NOT ON THIS LIST?



The Wakespeed WS500 is well equipped to support just about any lead acid based marine or automotive battery, and can be configured using onboard DIP switches, a Windows-based computer utility, or the Wakespeed smartphone app. Due to the specialized demands of newer lithium battery chemistry batteries, there is inherently more concern about proper regulation due to the battery's ability to self-disconnect from its charge source. As a result, Wakespeed invests a sizable amount of time in developing special configurations for LiFePO<sub>4</sub> batteries — particularly those with internal BMS systems that don't communicate outside of the battery. As such, the only available configurations are with battery/BMS brands where Wakespeed's engineering team has had sufficient time to create and test safe profiles based on specific battery characteristics. As such, Wakespeed can't guarantee results with batteries that haven't gone through our extensive proofing protocols.







## IS MY SHUNT COMPATIBLE?



The WS500 is compatible with most analog shunts, and can be configured in the Wakespeed app to support a wide range of available shunts. Some smart shunts, however, may not be compatible. The rule of thumb is that if the shunt provides access to the two small machine screws in the side of the shunt's magnetic resistive blocks, the shunt should work. On the other hand, if there are no screws on the side of the shunt, or if they are covered up with a circuit board, the shunt will probably not work with the WS500. Wakespeed offers simple, analog shunts that are configured for a 500A/50mV capacity and resistance value.



## CAN THE WS500 REGULATOR BE USED WITH MY FACTORY ALTERNATOR?



Yes, but only if the alternator is modified to disable the internal regulator and diode trio. In many cases, this can be done quite easily by the user, but we recommend using a qualified alternator technician, if possible, to modify and test the alternator prior to installation.



## HOW MANY ALTERNATORS CAN MY WAKESPEED REGULATOR CONTROL?



Due to their ability to connect regulators via CANbus, it's possible to control multiple alternators on more than one engine to support a large battery bank. Because each WS500 remains responsible for supplying field output to its own dedicated alternator or alternators, it's possible to combine the output from three or more alternators to support a large house bank, or even multiple house banks if the batteries are linked by CANbus enabled BMS units.



## WHAT VENUS OS VERSION DO I NEED WITH WAKESPEED 2.50 FIRMWARE?



Victron's current Venus OS 2.90 revision is compatible with the WS500 regulator equipped with Wakespeed's 2.5.0 firmware. This combination will allow the Cerbo to display much of the WS500 regulator's CANbus output on the Color GX display.



## WHAT DO I NEED TO HAVE IN ORDER TO PROGRAM MY REGULATOR?



There are multiple options for programming the WS500 regulator, including onboard DIP switches, Windows-based configuration utilities available on the Wakespeed website, and configuration via the smartphone app, which is available through the Google Play store for Android and the Apple App Store for iPhone platforms. At present, the WS500 requires a wired connection through a USB printer-style cable, which limits actual direct configuration to the Windows and Android platforms. A wireless communication module, expected to be available in 2023, will allow direct connection and configuration via both Android and Apple iOS devices.







## WHAT DOES ERROR CODE 44 MEAN?



The WS500 is capable of providing a broad range of error and advisory codes, which are displayed by the LED that's exposed via the jewel on the lid of the regulator. Error codes are preceded by two red "bursts" of flashes, followed by a two-digit display of flashes. In the case of an error code 44 (indicated by four flashes, a space, and four more flashes), the regulator has monitored an excessive voltage difference of greater than 2.5VDC between the regulator's positive voltage sense (red w/yellow tracer) wire and positive power (solid red) wires. This may indicate excessive voltage drop between the two wires, or the existence of a damaged fuse in one or the other wire. A full list of error/advisory codes is available in the WS500 Communications and Programming Guide, available on our website.



## HOW CAN I COMBINE THE OUTPUT FROM MY PORT AND STARBOARD ALTERNATORS TO SUPPORT A LARGE HOUSE BATTERY BANK?



Wakespeed WS500 regulators can be connected via a CAT5 or CAT6 cable to create their own CANbus network, to allow alternators on twin engines to work together to support a large house battery bank. When only one engine is running, only the regulator controlling the spinning alternator will be active. When the second engine starts, and both alternators are running, one of the regulators will become dominant, and the second regulator will receive charging instruction from the first. Both alternators will provide balanced charging output for the house battery bank.



## HOW MUCH FIELD CURRENT CAN THE WS500 DELIVER?



The WS500 regulator can provide up to 15 amps of field current to control just about any high-output alternator. The limiting factor is actually the wiring harness. If using the regulator to control a single alternator that requires more than 15A of field current, or two alternators that require more than 7A of field current each, the installer or user can use a high-current variant of the WS500/PH harness, which offers secondary power and ground wires, and a second field wire which can be doubled up on an extra-large alternator, or can be used to support the second alternator being controlled, as long as both alternators are installed on the same engine.



## CAN I EXTEND THE LENGTH OF MY WIRING HARNESS?



Wakespeed's standard wiring harnesses measure about five feet in length. In many cases, one or more of the wires included in the harness may need to be extended. This can be done by butt connecting 16 gauge or larger wire to the circuit being extended. Typically, most of the wires in the harness can be extended to 12-15 feet without any excessive power loss. If extending wires that are carrying substantial current (RED power, BLACK ground, or BLUE field) it's best to increase the wiring size as close to the regulator as possible.



## DO I HAVE TO DO ANYTHING SPECIAL IF MY SHUNT IS FAR FROM THE LOCATION OF MY REGULATOR?



If it's necessary to extend the regulator's current sense wires, it's important to use twisted wire. The current sense circuit can pick up RF noise which can affect the regulator's ability to get accurate information from the shunt. Twisting the Current High (Purple) wire, and Current Low (Grey) wire will shield the circuit from picking up noise. You can buy pre-twisted wire from a wiring supplier, or make.



your own by placing the ends of two wire lengths (preferably purple and grey) into the chuck of a cordless drill and (slowly) twist the two wires until there's a twist about every three inches.

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### **CAN I JUST ATTACH THE CURRENT SENSE WIRES TO THE BIG STUDS THAT HOLD THE POWER OR GROUND CABLES ONTO THE SHUNT?**



Nope. That will give errant readings and may introduce damaging current into the circuitry inside the regulator. Don't do that. The current sense wires are designed to be connected to the small machine screws on the side of the current shunt, as they are intended to measure a tiny fraction on the power being passed through the shunt. You will need a shunt that has those two machine screws. Some of the "smart" shunts on the market have proprietary connection terminals on a circuit board mounted on the side of the shunt, but have no screw terminals on the side. If your existing shunt does not have the machine screws on its side, you'll probably need to install a shunt that does. Our default shunt ratio is 500A/50mV.

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### **CAN I USE THE 100A/100MV SHUNT I'VE ALREADY GOT WITH MY WS500 REGULATOR?**



You bet. You'll just need to make sure that you specify that shunt ratio when you're configuring your regulator with the Windows configuration utility or your Smartphone app.

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### **WHY DO I CARE ABOUT MEASURING CURRENT ANYWAY?**



The ability to measure current going into and out of the batteries is one of the key features that makes the WS500 different from all of the "smart" voltage regulators on the market. By defining the size of the battery bank (amp hour capacity) and monitoring the amount of amperage we're delivering to the batteries, we can be much more precise in knowing the battery's state of charge. Voltage only regulators can only guess at the condition of the battery by measuring the rise in voltage as the batteries charge — and determining the amount of resistance the battery exhibits. At best, that information provides a good guess. With traditional lead acid batteries, this method "kind of" works, and is usually used in conjunction with a timer that help to ensure that the battery isn't charged for too long at too high a voltage. In newer battery technologies (like LiFePO<sub>4</sub>) resistance no longer serves as a good indicator of available battery capacity, which makes voltage-only regulation not only ineffective, but potentially dangerous.

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### **HOW DOES THE WS500 REGULATOR USE THE SHUNT TO MEASURE WHEN BATTERIES ARE CLOSE TO BEING FULLY CHARGED?**



The WS500 actually uses a multi PID loop engine to determine what the batteries need; including system charging voltage, current, time, alternator temperature and battery temperature, to determine how to control alternator output to support the batteries being charged. In the case of LiFePO<sub>4</sub> batteries, we know that when the batteries reach a nearly full state, their ability to accept current from the alternator (or any other charge source) will drop significantly. This is known as the battery's tail current. By measuring the amount of current the batteries will accept, we can determine when the tail current is reached and modify current output from the alternator to make sure that the battery doesn't get overcharged.

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## **DOES IT MATTER WHERE I INSTALL THE SHUNT?**



Yes. For accurate measurement, we need to make sure that the shunt is located as close to the battery as possible. We want to ensure that we're only looking at amperage that's going directly into the battery and not into other system loads. This is another big advantage of the WS500. When a voltage regulator is measuring system voltage, it can't discriminate whether that output is going to the batteries or is being used by house loads. In other words, if the alternator is supplying power that's being used by a microwave or a washing machine, it doesn't know where that power is going. As a result, it's making decisions that could end in the batteries being overcharged. By installing the shunt on the battery side of the system loads, we can be sure that the regulator is only making decisions based on the actual condition of the batteries.



## **DO I NEED TO USE A SHUNT IF I HAVE A CANBUS CONNECTION BETWEEN THE WS500 AND MY BMS?**



In most cases, no, although there are some BMS units that broadcast CAN messages at a slower rate than the WS500 regulator prefers. Normally, that will manifest in "hunting" where the regulator output will begin to cycle. If that behavior is noted, the easiest response is to connect the regulator to a shunt.



## **WHAT OTHER INFORMATION IS SHARED VIA CANBUS?**



In addition to current information, the BMS can also share battery temperature, voltage, and — in some cases — actual charging direction with the regulator. In those instances, the BMS will determine what the cell condition is, and send messages via the CANbus to the regulator, telling it to charge, or not to charge, and how much current the batteries are capable of taking.



## **HOW DO I KNOW IF THE BMS AND WS500 REGULATOR ARE COMMUNICATING VIA CANBUS?**



The easiest way to know whether the BMS and the regulator are talking is to look at the LED flashing through the jewel mounted in the top of the regulator. If your regulator is flashing a normal pattern in green, the regulator is acting on its own, without a CANbus connection. If the LED is flashing a normal pattern in an orangish yellow color, that indicates that the regulator is communicating with another component on the CAN network (either a BMS or another WS500 regulator).



## **WHAT IF I SEE A RED FLASHING LED ON THE WS500?**



If the regulator is flashing a normal operational pattern but the LED looks red, it may be that the LED coloring may be indicating CANbus connection — and the color you're seeing may be a dark, orangish color. If the regulator is flashing bright, deep red, watch the LED for two rapid bursts, followed by a numeric code. This will indicate that the regulator is issuing an advisory code. For example, if the regulator emits two rapid bursts, followed by a group of four slower, single flashes, followed by another group of three slower, single flashes. The advisory code would be 43, which would indicate low voltage on the regulator's power wire — which would typically be caused by a bad wiring connection or a damaged fuse on the power wire.

