

## AN1013: MG Master LV and WS500

### 1 General

The Wakespeed WS500 Advanced External Alternator Regulator provides for well managed control of the charging and DC Energy system. MG Energy Systems has worked with Wakespeed to assure a highly integrated, simple to install solution which will result in quick and safe charging of your battery.

By leveraging the power and simplicity of CAN based communications, the WS500 combined with the MG Master LV BMS offers several key advantages:

- BMS directed charge cycle, the WS500 will follow directions for charge voltage goals and current limits
- Aggregation of BMSs: The WS500 is able to aggregate up to 10x BMS's in a system; automatically adjusting charging goals to the size of the installed batteries with no need to manually configure. More so, in the event of one or more BMS/batteries systems being taken offline, the WS500 will automatically adjust to account for this change.
- 'Zero-Output' Technology: Allows the alternator to safely support ongoing loads when the batteries reach their full SOC level, and without depleting the SOC of the batteries while doing so.
- Automatic adjustment for 12v, 24v, or 48v systems.
- Safe handling of warning and alarms, no system damaging 'Load-Dump's

#### 1.1 Why the need of an alternator controller?

With the more widespread use of Lithium based batteries monitoring and controlling the alternator has become more and more critical. The combination of high battery currents and low engine RPMs can quickly result in overheating of many alternators – resulting in internal damage to the coils and/or diode packs. To overcome this problem, MG and Wakespeed offers a solution to monitor and manage not only the battery needs, but the alternators as well. For example by proactively regulating the alternators temperature vs. the reactive already-overheating pullbacks approach used by many of today's solutions.

#### 1.2 Functional description

By building upon proven CAN (Control Area Network) based communications, the Master LV is able to provide detailed real-time charging directions and status to the WS500, including:

- Charge voltage limit;
- Charge current limit;

Upon the lithium-ion battery reaching its fully charged SOC the Master LV BMS will send revised voltage goals to the WS500. In the same way, the WS500 will listen to current limits provided by the BMS, assuring the batteries needs are always met, but not exceeded. This allows the Master LV BMS to fully direct the charge cycle, taking into account not only the overall battery status, but also

considering needs down to the individual cell level. As an example, if the battery temperature is -5c, the BMS will direct the WS500 to not provide any charging current to the battery until it warms up. Likewise, in the event of a needed battery safety disconnect, the BMS is able to forewarn the WS500 allowing for safe and controlled shutdown of the alternator, preventing a 'Load-Dump' situation.

Another unique capability of the WS500 is its ability to regulate current in addition to voltage. 'Zero-output' technology is one example of this capability, whereas the battery reaches its fully charged state battery current is then actively regulate to 0A. Doing so prevents the battery from becoming overcharged, but because the alternator is still active (as opposed to simply shutting down the alternator), ongoing house or chassis demands continue to be supported by the alternator without lowering the battery SOC.

### 1.3 Installation

The installation of an MG Lithium-ion battery system in combination with the Wakespeed WS500 alternator regulator requires the following components:

- MG Lithium-ion battery system, including MG Master LV and an MG Lithium-ion battery;
- Wakespeed WS500, including wire harness (select P-type or N-type alternator harness);
- Fuses: 1x 10 A and 1x 3 A;
- A CAN Cross-over cable and associated CAN bus terminators. These are included in the WS500 delivery.

#### 1.3.1 Scope of supply ordering WS500

You can order the WS500 pre-configured and with a kit containing needed CAN cables, this will greatly simplify installation as in most cases no additional configuration steps are needed; the MG Master LV and WS500 will automatically adjust to the insulation for battery capacity and voltage. However, if you have special needs or special alternators to support – contact MG Energy for additional assistance.

- The WS500.
- A CAN Cross-over cable and associated CAN bus terminators.



### 1.3.2 Installation process

The installation process is performed by the steps below:

- Install the MG lithium-ion battery system according to the manuals;
- Install the WS500 and connect it to the MG Master LV;
- Commissioning and testing of the installation;

Figure 1 shows the complete schematic of the WS500 connections.

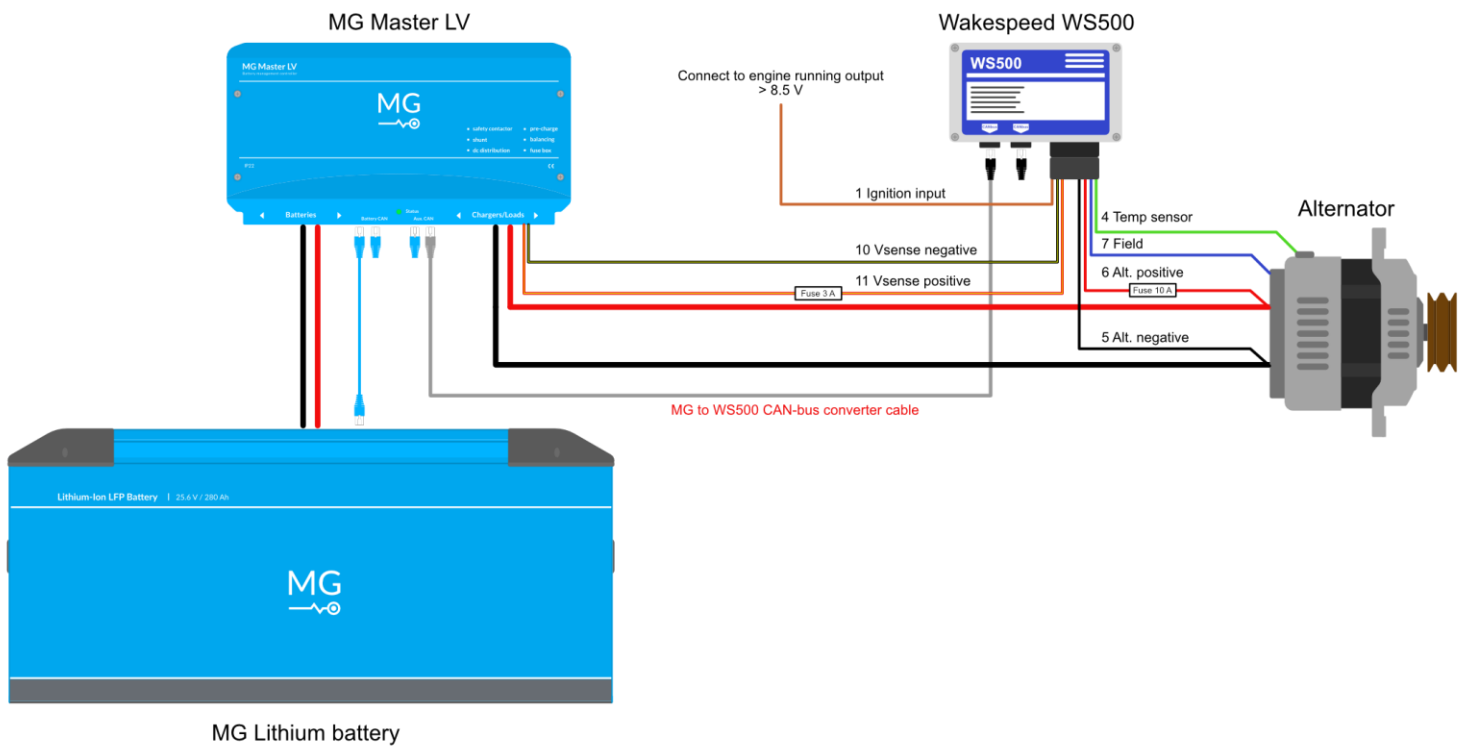


Figure 1 - Complete connection schematic

### 1.3.3 Connect the WS500

A wire harness is used to connect the WS500 to the alternator. Either P or N type alternators may be supported by selecting the appropriate wiring harness. The choice depends on the type of alternator used. Be aware you have the right type of harness.



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**NOTICE:**

Always check the manufacturer's manual before connecting the WS500.

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1. Connect the Vsense negative and alternator negative wires first. The Vsense negative must be connected to the minus bus-bar of the MG Master LV Load/Chargers side.
2. Connect the temperature sensor to the casing of the alternator – take care to not put mechanical strain on the temperature sensor wire, it should be free floating and able to flex as needed;



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**CAUTION:**

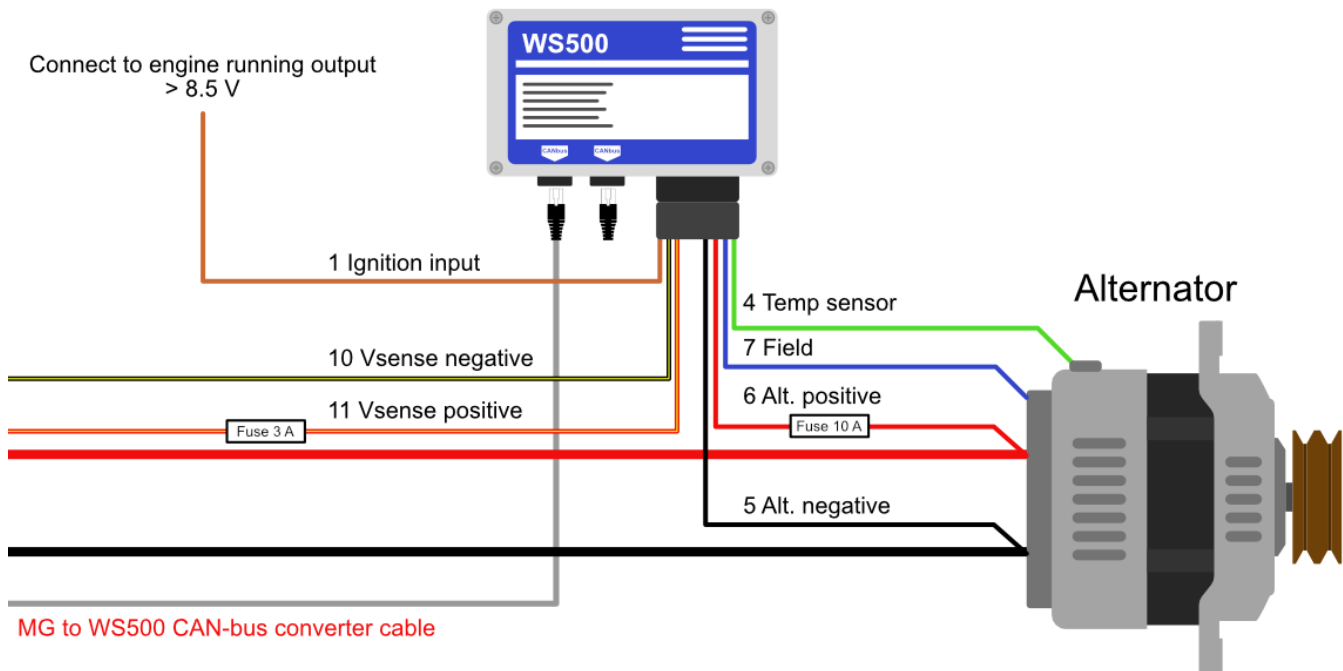
Place the temperature sensor at the alternator on the spot where the highest temperature occurs.

When this is not possible, the threshold temperature might need to be adjusted depending on the alternator temperature specifications.

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3. Connect the Alternator positive wire with a 10 A fuse to the alternator – leaving the 10A fuse uninstalled until all wiring is completed;
4. Connect the Field wire to the alternator;
5. Connect the Vsense positive to the plus bus-bar of the MG Master LV Load/Chargers side with a 3 A fuse in between – again do not install the fuse until all wiring is completed and verified.
6. Connect the Ignition input to the engines ignition wire or other wire that indicates that the engine is running. This voltage must be > 8.5 V to enable the WS500.
7. Connect the CAN bus with appropriate terminators and cables. See paragraph 1.3.4 for details.
8. Once all wiring is completed and the WS500 harness is fully seated into its connector (Listen for the Click), you may install the 10A and 3A fuses and move on to the next steps.

### Wakespeed WS500



#### 1.3.4 Connect the CAN-Bus of the WS500 to the Master LV CAN-Bus

Data communication between the Master LV and WS500 is done via CAN. Both devices are equipped with RJ45 connectors for this, but the pinning is different. Therefore a special conversion cable is needed. You can purchase a pre-made cross over cable (buying the WS500 from MG already includes this cross over cable and appropriate terminators), or make one up yourself using the following guide:

Description	RJ45 MG	RJ45 WS500	RJ45 pinning - Front view	
CAN_H	7	1		
CAN_L	8	2	Socket	Plug

Table 1 - WS500 to MG Energy Systems CAN-Bus cable

**CAUTION:**

- The CAN-Bus pinning from the WS500 and MG Master LV is different. A special converter cable is needed.
- The MG Energy Systems CAN-Bus terminator delivered with the MG Master LV must not be plugged in the WS500. This can damage the product. Make sure to use Black body terminators on the WS500 RJ45 connector, and Blue body terminators on the MG Master LV RJ45 connectors.



Figure 2 shows the CAN-Bus connection schematic of two WS500s.

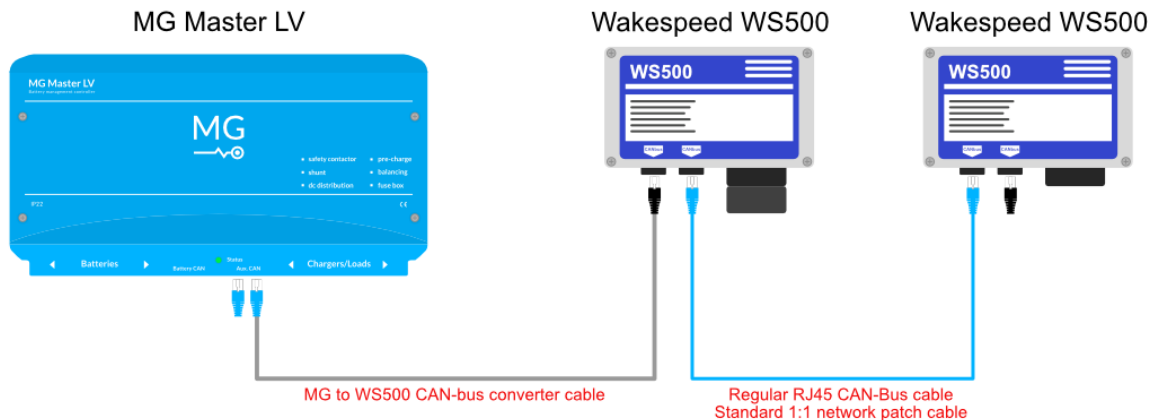


Figure 2 - WS500 CAN-Bus connection schematic

### 1.3.5 Commissioning and testing

After completing installation and configuring the MG Master LV you will be ready for the initial test. Start the engine, as power is applied to the WS500's 'Ignition' wire it will start operating and look to lock onto the MG Master LV via the CAN bus. You will be able to see this as the blinking LED will change from GREEN to an Orangish/Amber color indication the WS500 is in slave mode. Actual charging should begin soon after.

Check the MG Diagnostic Tool or MG Energy Monitor (or other monitoring equipment) for charging voltage and current to the batteries.

The WS500 is shipped with DIP #8 turned on which will select 'Small Alternator Mode'. This has the effect of limiting alternator drive to 75%.

If after a few runs it appears there is no significant issue with alternator overheating, you can turn DIP #8 off and test your system using full alternator drive. Once you are comfortable that the system behaves well and the temperature stays within the specification of the alternator, you can continue to run in this mode, but if any instability is noted, or worst fault conditions occurs (the WS500 LED starts to blink a RED FAULT condition), return DIP #8 back to On. And if desired address the alternator cooling and/or perform an alternator upgrade.

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**CAUTION:**



Always check the alternator temperature during full load to be sure there will be no hotspots which exceed the alternators temperature specifications. To have a clear view of the alternator temperature the recommendation is to use a thermal Imaging camera.

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**CAUTION:**



For safety reasons, only change Dip #8 while the engine is off.

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## 1.4 Ordering information

MG Article number	Description
MGWS0100500	Wakespeed WS500 MG Energy Systems Pack.  Includes: <ul style="list-style-type: none"> <li>▪ WS to MG CAN-Bus cable</li> <li>▪ Termination resistor (black body)</li> <li>▪ Pre-configuration for MG systems</li> </ul>
MG5000277	WS500/NH N-Type wiring harness
MG5000278	WS500/PH P-Type wiring harness