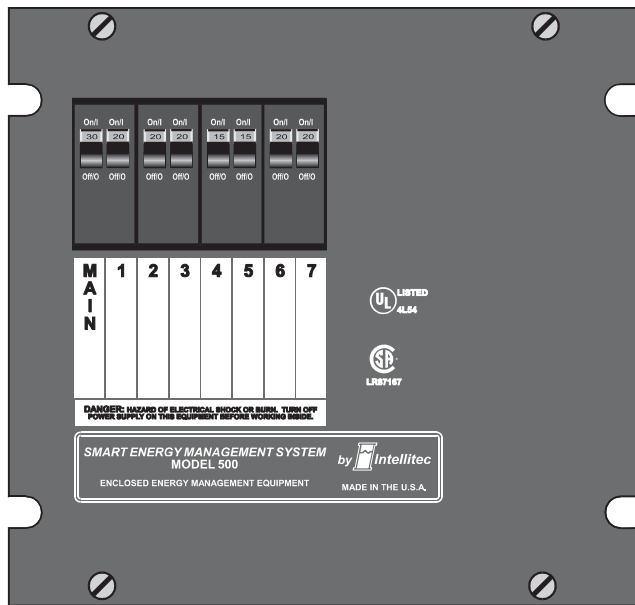


SMART EMS

OWNERS GUIDE

The Smart EMS (Energy Management System) is a fully automatic system that oversees the usage of 120 volt electric power, and controls up to four major appliances in the RV, minimizing the nuisance of circuit breaker tripping. It will not require much attention from you, but you may want to know what it is doing and how it works. If you do, please read on to become fully familiar with its operation.

The EMS is the main 120 volt power distribution panel. This panel may be located beneath the refrigerator or under the bed. It can be identified by the array of circuit breakers on its front panel. These breakers are for all 120 volt appliances in the RV. It also includes electronically operated switching of certain selected appliances, such as the air conditioner/s.



In an RV, the amount of 120 volt electric power is limited by the shore power cord and the outlet into which it is plugged. The most popular campground outlet size is 30 Amps; some campground sites have only 20 Amps available. (In a typical home 200 Amps is available.) If more than 30 Amps is drawn, the circuit breakers in the RV or the campground circuit breakers will trip.

This limited amount of power is usually enough for an RV when averaged over a long period; although, it falls short of being able to supply enough current if too many appliances are operated at one time. The EMS "manages" the amount of current being drawn, at any one time, by delaying the usage of certain "postpone-able" appliances until the use of "on-demand" appliances is complete. Examples of postpone-able loads are air conditioners, electric water heaters, washer/dryers, etc. Usage of these appliances is important, but can be delayed while other more important (on-demand) appliances are being used. "On-demand" appliances are those you want to use "immediately", such as the microwave, toaster, or hair dryer. All this usually happens so automatically you won't notice that it is working.

The EMS constantly monitors the total amount of current being drawn by all the loads in the RV. If the value exceeds 30 Amps, the EMS begins to turn off the postpone-able loads, one at a time, until the total current draw is less than 30 Amps. When the current drops below a point that would allow another appliance to operate, the EMS will turn that appliance on again.

The following table lists some major appliances found in an RV, and the approximate amount of current they draw.

13,000 BTU roof-top air	14 Amps
11,000 BTU roof-top air	11 Amps
Electric water heater	11.5 Amps
Microwave oven	10 Amps
Coffee Maker	11 Amps
Hair Dryer	10 Amps
Toaster	9 Amps
Popcorn Maker	10 Amps
Washer/Dryer	13 Amps
Converter	4 Amps
Refrigerator	2 Amps

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Typical Example

Let's consider an example:
It's a warm day and you have your air conditioner on.
The converter and refrigerator are also on. The total current being drawn is then:

13,000 BTU roof-top air	14 Amps
Converter	4 Amps
Refrigerator	<u>2 Amps</u>
Total	20 Amps

At this point, there is 10 Amps of current ($30 - 20 = 10$) remaining to operate other appliances. Now you turn on the microwave to heat some coffee. This adds 10 Amps more to the load, bringing the current up to the limit of 30 Amps.

13,000 BTU roof-top air	14 Amps
Converter	4 Amps
Refrigerator	2 Amps
Microwave Oven	<u>10 Amps</u>
Total	30 Amps

Adding any additional draw will overload the circuit breakers normally causing them to trip. Since you are heating the last cup of coffee, you decide to make another pot. You turn the coffee maker on and it draws an additional 11 Amps. This makes the total load 41 Amps, exceeding the trip point of the circuit breaker.

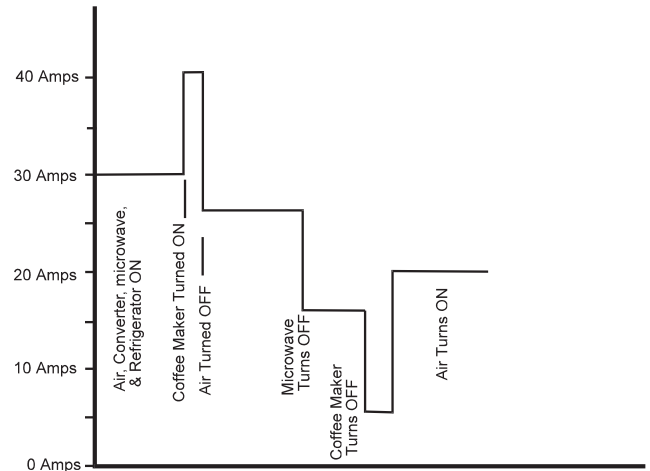
At this point, the EMS senses this overload. Before the breakers trip, the EMS will turn off a controlled appliance (usually the air conditioner) to bring the total current below the 30 Amp limit. In this example turning off the air conditioner will remove 14 Amps of draw, dropping the total draw to 26 Amps ($40 - 14 = 26$). If this did not reduce the current enough, the EMS would turn off the next appliance in the series.

As it does this, the system detects the amount of current turned off and records this amount in its memory. In this way, it "learns" the amount of current each appliance needs to operate.

Now the EMS waits until the current draw drops below the point that will allow the air conditioner to

operate again. In this example, that point would be 16 Amps. since the system "knows" the air conditioner draws 14 Amps.

Sequence of events as described above.



Two Minute Timer

The EMS also includes a timer to prevent appliances from turning off and then immediately back on again. This timer will prevent any of the controlled appliances from being turned back on in less than two minutes from the time it was shut off.

Three Hour Averaging

To minimize the possibility of over heating the electrical equipment, the EMS also includes a long term current *averaging* feature. This feature continuously monitors the total amount of current drawn by all the appliances in the RV and calculates an average value. If the average current after any three hour period exceeds 80% of the 30 Amp service (24 Amps), the system will automatically shut down appliances until the three hour average current is less than 24 Amps. The system indicates it switched to this mode by showing a decimal point after the second digit. It will then switch back to the normal 30 Amp limit and the decimal point on the display will turn off.

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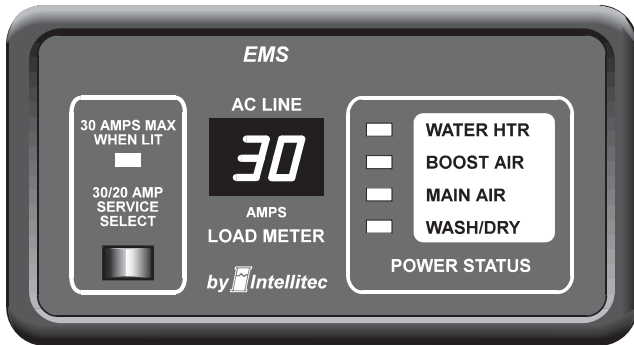
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Optional Display Panel

The optional display panel is available to indicate the functions of the system.



It includes a digital display of the total amount of current being drawn by all the appliances, a series of LED's which indicate power being applied to the particular appliances, and an electrical service, power selector switch.

Digital Display

The digital display indicates the total amount of current being drawn by all the appliances in the RV. This display will help you understand the amount of current drawn by each appliance and why certain ones cannot be operated simultaneously.

This display can also be used to show the amount of current stored in the memory for each of the learned loads. To do this, press and hold the Service Selector button until only the top Power Status indicator LED turns on. The number in the digital display is the value of current held in the memory of the system for that load. Releasing the button and pressing it again will light the next LED and the display will show the amount of current in the memory for that load. Repeating this will show the values for the other two loads. If the system has not shut a load down since it had power applied, the value in the memory will be zero. If the system is in the Three Hour Averaging Mode (a fifth reading) the calculated average is displayed.

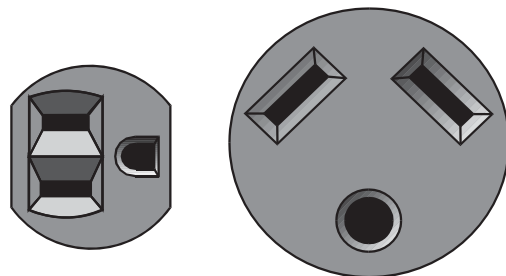
After reading all the loads, or not pressing the button for five seconds the display will return back to normal operation.

Power Status Indicators

The Power Status LEDs indicate when the system is applying power to those appliances. When the power is first applied to the RV, the Power Status LEDs will begin to turn on from the bottom to the top, indicating power is being applied to each of the loads. The digital display indicates the total amount of current being drawn by all the loads. If this total goes above 30 Amps, the system will shut down the last load that was turned on. If any of these indicators are not lit, that appliance is not being powered. To get power to any of those appliances, other appliances will have to be turned off.

Electrical Service Selector

The electrical service selector allows you to set the system to operate from a 20 Amp service, when a 30 Amp is not available. This might happen at some camp sites or when parked at home.



20 Amp Outlet

30 Amp Outlet

To "tell" the system you are connected to 20 Amp service, momentarily press the selector button. When the button is released, the 30 Amp indicator LED will go out. When the system is set in this mode, it will begin to turn off appliances if the total current exceeds 20 Amps.

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Trouble Shooting

Should you incur any troubles with the system - the following should be checked before contacting a qualified Service Technician for help.

Air conditioners and other appliances won't operate.

- Be sure RV is plugged into "live" outlet.
- Check all circuit breakers and reset if necessary.
- Wait for two minute time delay.
- Check 12 volt fuse feeding EMS & fuse on EMS printed circuit board. If either is open, replace.

Some or one of the appliances/air conditioners won't operate.

- Check control settings of those appliances. Be sure they are turned on.
- Check all circuit breakers, reset if necessary.
- There may not be enough current available. Turn off other appliances. (If a monitor panel is included, check Power Status LEDs.)
- Less than two minutes since the appliance/air conditioner was shut off. Wait two minutes.