



PFC-20
PFC-30
&
PFC-40
Series Chargers

Owner's Manual
Rev 0.5

PFC-20/30/40 SERIES BATTERY CHARGER MANUAL rev 0.5



General Overview

The Manzanita Micro PFC-## chargers are a unique group of powerful, efficient battery chargers. The chargers will run off of any voltage from 100 up to 240V AC. These chargers can be set to run automatically when plugged in yet they also have far more user adjustable functions than other electric vehicle chargers. Every model is user adjustable to charge batteries from 12 to 450 Volts. All the chargers are power factor corrected and are available with enhanced options such as an AC input current display. With so much flexibility and models from 20 to 75amps your PFC charger may be the last charger you ever need to buy.

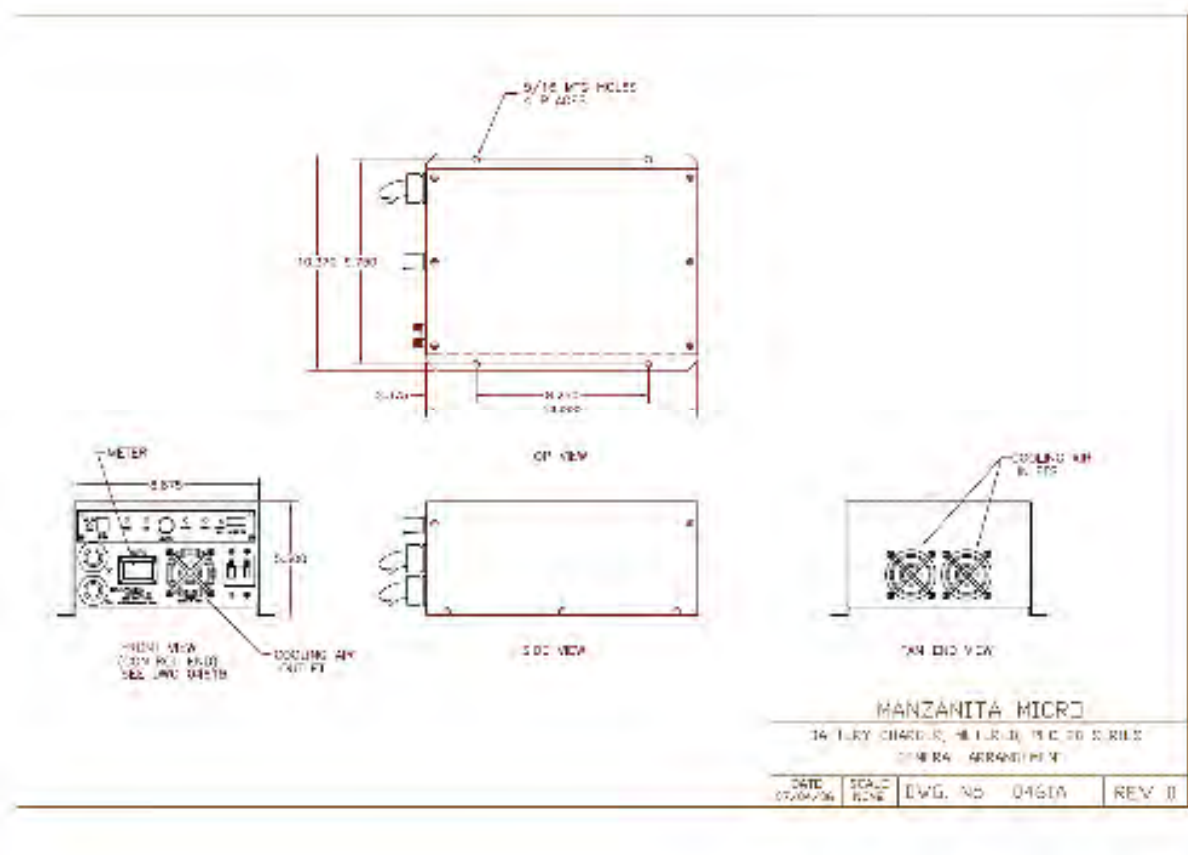
Speed and Efficiency

The essential ingredient for fast recharge times is to deliver high power to the battery. The key to polite opportunity charging is to be able to share outlets with other equipment and make efficient use of limited current. The PFC line of chargers have an adjustable throttle knob to allow the chargers to be turned down to operate on very limited power sources. Efficiency and power factor are both better than 0.9.

What does the PFC mean?

In the Manzanita Micro chargers PFC stands for Power Factor Corrected. This means that current and voltage are drawn in unity, (ie: current is drawn with unity to the incoming line voltage).

Dimensions and Model Ratings



The PFC-20, PFC-30 and PFC-40 series chargers weigh in at approximately 18 pounds and reside in a box that is 13 x 9 x 5.5 inches.

The 20, 30 or 40 nomenclature is indicative of how many amps that charger is rated to draw from the AC line. Unlike some other chargers this is the rated continuous load and all the chargers are thoroughly tested to their rated limits before leaving Manzanita Micro. An optional panel mount current meter is available which displays the amount of current (amps) that the charger is drawing off of the AC line. This allows the user to tune the charger precisely for the maximum allowable amps for the outlet they are plugged into.

Charger Operation

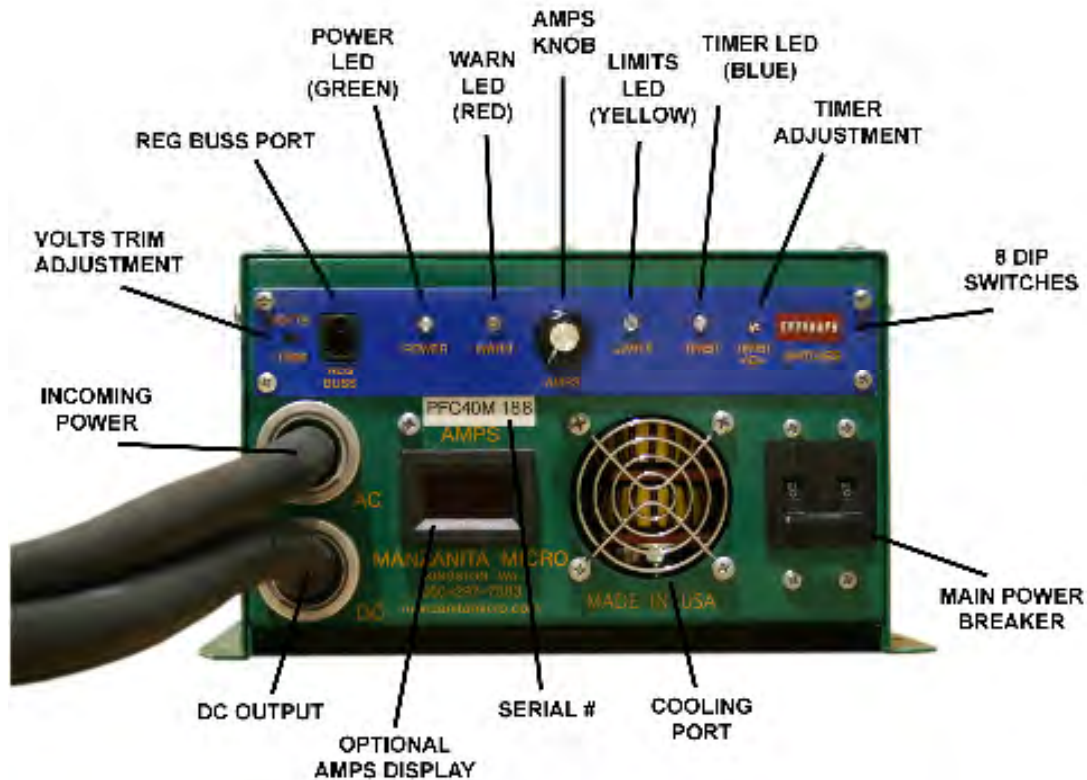


figure 02: PFC-##M Layout

Turning the Charger On and Off

There is an ON/OFF Breaker to the right of the cooling fan (or coolant fittings on liquid cooled models). This breaker is the main switch to turn the charger on or off. If ever there is a concern while charging *first* shut off this breaker switch.

NOTICE! DO NOT unplug the gray SB-50 Anderson connectors (DC line) from your charger *while it is charging!* If the battery pack is disconnected while the charger is putting out power the charger can be damaged. **Failure to heed these warnings may result in significant internal damage to the charger which is not covered under your warranty!**

User Control Panel

The user interface panel is the long blue panel with yellow text near the top of the PFC-XX charger. The only thing most users need be concerned with are the LED indicators, the VOLTS TRIM and the adjustable AMPS knob. Below are explanations of each feature in order from left to right. Refer to *figure 02* for specific locations.

“VOLTS TRIM”

This controls the peak DC voltage ceiling that the charger will allow the batteries to reach before limiting the current. Unless specified otherwise, the voltage limit is specifically calibrated and set by Manzanita Micro to 191 Volts (for a 156V nominal pack.) In the event that adjustment is desired, please follow the instructions below. Starting in September of 2009, a special insulated screw driver for adjusting the volts trim is shipped with each new Manzanita PFC charger.

NOTICE! Always use an appropriately sized insulated screw driver when adjusting the voltage trim potentiometer. Suitable drivers are available for purchase from Manzanita Micro or other electronics components manufacturers. (Mouser part #: 594-8T000, Vishay/Spectrol Adjust Tool, www.mouser.com)



figure 03: Adjustment Tool # 008T000

VOLTS TRIM CALIBRATION:

Try to make sure your battery pack is fully charged before adjusting (or else you will have to continually monitor it and make more adjustments).

1. Turn the amps knob all the way down (full counterclockwise).
2. Make sure the charger is plugged into the battery pack and that there are no open breakers or open fuses in the DC battery circuit.
3. With the charger's AC breaker switch in the **OFF** position, plug the charger into the AC power outlet.

4. Now turn **ON** the charger's AC breaker switch. The fans should come on.
5. Using an appropriate insulated screw driver, stick it into the VOLTS TRIM access hole (see figure 04) and turn the internal adjustment potentiometer until you find the threshold where the yellow LIMITS LED changes state. If the yellow LED is off, turn the trim pot counterclockwise to get it to go on. If the yellow LED is on, turn the trim pot clockwise to get it to go off. Once you find the threshold where the LED changes states, the cutoff voltage is set to the actual battery voltage and the charger will not charge the pack above this voltage. Therefore, when you are ready to charge you will need to turn the trim pot clockwise to raise this voltage ceiling. Then turn the AMPS knob up until you can put the amount of amps you want into the battery pack while not letting the batteries go over their peak voltage limit according to their manufacturer's data.

While charging, when the battery pack voltage hits the peak limit the yellow LIMITS LED will come on along with the flashing blue TIMER LED.



figure 04: VOLTS TRIM Adjustment

“REG BUSS”

This is the 6 pin RJ jack where the BMS communication line plugs into the charger. This port allows the individual battery regulators to communicate with the charger.

NOTICE! If your vehicle is equipped with a Battery Management System, Ensure that the reg buss data cable is fully plugged into the charger whenever the vehicle is charging. The communication data cables are hooked to the regulators in a daisy chain fashion. Make sure that each of the smaller data cables are all plugged in where they should be before charging. **If there is an unplugged portion of the reg buss, the charger cannot communicate with the regs and this could lead to potentially damaging situation if there is an un-matched battery cell in the pack!** The RJ connectors are similar to phone cord connectors and they are designed to snap into place and stay connected. If a cable is disconnected insure that it is fully reconnected. An audible *click* should be heard when the RJ plug is fully inserted and it should not be able to be pulled out without first pinching the small plastic tab underneath the plug.

“POWER” - Green LED

The bright green POWER LED indicates when the charger is on. Input power coming in and the main breaker is in the ON position.

“WARN” - Red LED

The red WARN LED should blink briefly when the charger is first powered up and then remain off for the duration of the charge. If ever this indicator is on, turn down the AMPS knob immediately, turn off the charger’s breaker switch and consult Manzanita Micro or a qualified service technician. This LED could indicate an over voltage or over temperature condition. It could also be indicative of an open in the pack. Turn down the AMPS knob and check to make sure there is no open in the battery pack circuit. Check the gray SB-50 Anderson connector to insure that it is connected and look for other disconnected battery cables. If the charger will not work

NOTICE! DO NOT let the charger try to put current into the battery pack if there is an open in the circuit. Never unplug the gray SB-50 Anderson connectors (DC line) from your charger *while it is charging!* If the battery pack is disconnected while the charger is putting out power the charger can be damaged. **Failure to heed these warnings may result in significant internal damage to the charger which is not covered under your warranty!**

“AMPS” Knob

The AMPS knob allows the user to adjust how much current the charger will move. If the vehicle is always plugged in to the same circuit this shouldn’t need any adjusting but if the user were to have it set at 35 amps and then plug into a 15 amp 110V outlet it will quickly open a circuit breaker or fuse on the AC line. The vehicle operator may wish to adjust this knob when plugged in to a public outlet especially if there is no easy access to the electrical panel for that circuit. Additionally, the user

might need to turn down the charger if there are other loads on the branch circuit (example: A stereo and a computer are running on the same 15 amp circuit). If using a charger equipped with the panel mount meter, the user can check the digital current meter on the front of the PFC-XXM unit and see exactly how many amps the charger is drawing off of the AC line.

“LIMITS” - Yellow LED

The yellow LIMITS LED indicates that the charger has reached its peak voltage limit. This should happen only at the end of the charge cycle when all the batteries are fully charged. The LIMITS indicator should be accompanied by the blinking blue TIMER LED which indicates that the charger is in current cutback mode and the timer is counting down to the end of charge.

If the yellow LIMITS LED is blinking, then it is indicating that there is an over temperature condition and the charger is in thermal cutback mode.

NOTE: When using regulators, the blue TIMER LED will often come on before the LIMITS LED because the battery regulators let the charger know when the batteries are getting full before the voltage limit is reached. If the LIMITS light is coming on frequently or before most of the regs are blinking, this could be indicative of a few batteries whose voltages are getting too high. It could also mean that someone has improperly adjusted the VOLTS TRIM. Consult your Battery Regulator user's manual or recalibrate the VOLTS TRIM setting on the charger.

“TIMER” - Blue LED

The blue TIMER LED indicates that the charge is complete or near completion. If it is flashing it means that charging is almost finished and the charger is backing off the current and counting down the timeout timer.. When the blue LED is steady, it means that the timeout timer has ended and the charger has finished charging the pack. At this point the charger should be putting out no power and drawing less than an amp off the input line.

“TIMER ADJ”

This stands for timer adjustment. This is a small 16 position rotary switch which allows the user to adjust the amount of time that the charger takes in constant voltage mode, while cutting back current at the end of a charge cycle before it shuts off completely.

If the timer is ever to be changed, adjustments are as follows. If the switch is at '0' then the timer will time out instantly - do not use this setting. ('0' is the 3-o-clock position when viewed from the front). If the switch is at '1' it will go for 15 minutes before completely cutting back power. Each additional tick after '1' adds 10 more minutes to the charge cutback time. Turning the switch clockwise all the way around to the 2:30 position will give the maximum amount of time (about 255 minutes) before timeout.

To reset the timer, turn off the power to the charger and then turn it on again.

“SWITCHES”

The red and white dip switch module is on the upper right end of the charger. This is a bank of 8 switches and they are numbered starting with #1 on the far right.

NOTICE! Adjusting these switches can cause the charger to perform in an undesirable manner. Please be sure you understand these switch features before changing them.

Dip Switch Guide:

1. Engages timer at peak voltage limit set point. This switch should be **ON**
2. Starts timer as soon as the charger is turned on. This can be used for timed charging. This switch should be **OFF**
3. Starts timer when the reg buss commands. This switch should be **ON**
4. Reg buss latch disable. As soon as a reg trips it will start the timer and the charger will back down until timeout. This should be **ON**
5. Low battery detection on specially equipped chargers. This switch should be **OFF**
6. AGM battery equalization. When using Mk2 series battery regulators, this will allow the batteries to climb to a slightly higher voltage for equalization at the end of charge. It also commands the yellow LEDs on each reg to turn on. This switch should be **OFF**
7. As soon as the high voltage limit is set the charger goes off. This should be **OFF**
8. Auto restart function. This allows the charger to restart charging when the battery pack reaches a certain set low voltage point. This switch should be **OFF** unless using the auto restart feature.

NOTE: Dip switch #6 can be useful if you have battery regulators because you can momentarily switch it on and the yellow lights on all the regs should come on. If any don't, you can use this feature to narrow down which reg(s) are not communicating with the charger. This feature does not work with the LT-5 Lithium regulators.

Wiring your Manzanita Micro Charger

Your PFC-20, 30 or 40 charger has two main power cables coming out of the front of the case. The top one is for the incoming power (usually AC from a wall outlet) and the lower one is the charger's DC output.

Connecting the Charger to the Battery Pack

Looking at the front of the charger, the lower DC output cable has a gray SB-50 Anderson connector on it. This SB-50 is quite common on EV chargers and we

recommend that you leave this plug on the cord. The SB-50 connector has clearly marked positive and negative sides. Measure the distance from your most positive battery terminal to your PFC charger's SB-50 connector. Cut a #6 AWG or thicker cable to the appropriate length and solder or crimp the appropriate size SB-50 pin onto one end of the cable. It is recommended to use bright orange cable with a good insulation and voltage rating in excess of your fully charged pack voltage (Bright orange Carol brand Super Vu-Tron welding cable is an excellent solution) Place red heatshrink or red electrical tape around the cable near each end to clearly designate it as the positive cable and then using a matching gray SB-50 connector, push the SB-50 pin end of the positive cable into the positive side of the SB-50 until it clicks and locks in place.

Measure the distance from your most negative battery terminal to your PFC charger's SB-50 connector. Cut a #6 AWG or thicker cable to the appropriate length and solder or crimp the appropriate size SB-50 pin onto one end of this cable. Place black heatshrink or black electrical tape around the cable near each end to clearly designate it as the negative cable and then push the SB-50 pin end of this negative cable into the negative side of the SB-50 until it clicks and locks in place.



figure 05

Now you should have gray SB-50 connector with a positive and negative wire coming out. (See *figure 05*) Use the appropriate lug or connector for your battery terminal and connect it onto the other end of each cable. Connect the positive cable to the most positive terminal of the battery pack. Connect the negative cable to the most negative terminal of the battery pack.

Double check that the polarity is correct and then plug the battery pack SB-50 into the DC output SB-50 coming from the PFC charger. Now the charger is connected to the pack and you are ready to hook up the charger's input power.

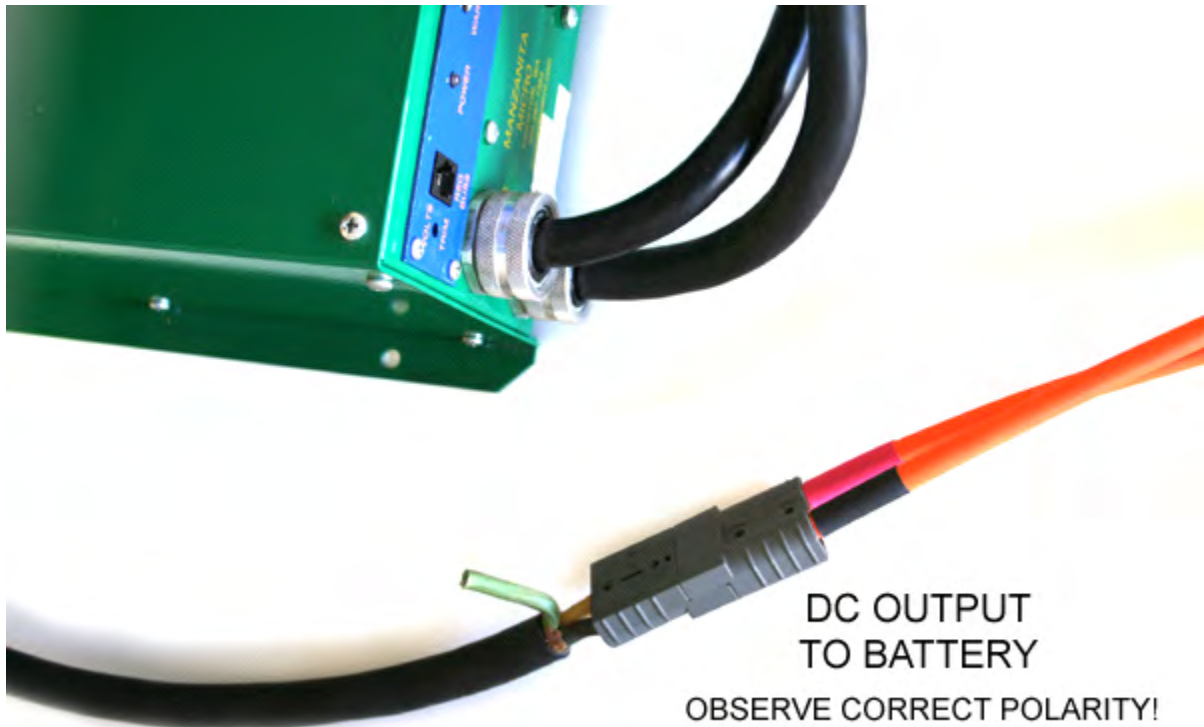


figure 06

Connecting the Charger to the Wall

Looking at the front of the charger the top cable is labeled AC and it is the incoming power for the charger. A great feature of the Manzanita Micro PFC line of chargers is that they are capable of operating easily off of 110, 120, 208, 220, 230 or 240 volts of single phase AC power. In fact they can even be run off of DC (this is done in the Manzanita Plug-in Prius kits) but most users are plugging them into an AC wall outlet of some sort.

Ohm's law states that $Volts \times Amps = Watts$ of power and there are a certain number of "Watt Hours" stored in your battery pack and available to power your electric vehicle. Based on the $V \times A = Watts$ equation it is easy to see that more volts or amps (or both) will give more total watts which equates to more electrical power moving and faster charging.

Your Manzanita Micro PFC charger can be powered by any voltage within the 100-240V range and there is no voltage adjustment or switches to move when changing between outlets of different voltages. The only thing which may need adjustment on the charger is the big "Amps" knob on the front. Turn this up or down depending on the amperage available from the outlet. With the "Amps" knob in the most clockwise position a PFC-20 can draw up to 20 amps, a PFC-30 up to 30A and a PFC-40 up to 40A.

EXAMPLE: A PFC-40 plugged into a standard 120V outlet at 15 amps would be able to draw about 1,800 watts ($120 \times 15 = 1,800$). The same PFC-40 plugged into a 240V outlet at 50 amps could draw up to 40A so that would be about 9,600 watts meaning a charge time of over 5 times faster than the previous scenario.

PFC-20 Wiring

The PFC-20 is shipped with no connector on the AC input cable. To attach the PFC-20's input cable to a common 110/120V three prong 5-15 or 5-20 plug run the green (GND) wire to the ground prong, the white (neutral) wire to the silver screw terminal of one of the straight prongs and the black (line) wire to the brass screw terminal of the other straight prong. If you want to connect your PFC-20's input cable to a 220/240V three prong plug like a NEMA 10-30, run the green wire to the ground prong and then the white and black wires to either of the two line (hot) prongs. You do not need a neutral wire so if you were to put another 220V plug on (such as a NEMA 14-30) you would simply connect the ground and both hot lines and disregard the neutral prong. (See *figure 07*)

PFC-30 Wiring

The PFC-30 is shipped with a NEMA 14-30 on the AC input cable. Please leave this attached and make adapter cords if you intend to change what it plugs in to. To attach the PFC-30's input cable to a common 110/120V three prong 5-15 or 5-20 plug purchase a 14-30 receptacle and make an adapter exactly as shown in figure 07. If you wish to make an adapter cord to connect your PFC-30's input cable to a 220/240V three prong plug (like a NEMA 10-30, 10-40 or 6-50), use a 14-30 receptacle and simply disregard the angled neutral prong. Run the green wire to the ground prong and then the white and black wires to either of the two line (hot) prongs. Since there is no neutral in the older 3 prong 220/240V plugs simply disregard the fact that your PFC charger has a 4 prong plug on it.

PFC-40 Wiring

The PFC-40 is shipped with a NEMA 14-50 on the AC input cable. Please leave this attached and make adapter cords if you intend to change what it plugs in to. The 14-50 outlet is very common at RV parks, electric ovens and some public charging stations.

To attach the PFC-40's input cable to a common 110/120V three prong 5-15 or 5-20 plug purchase a 14-50 receptacle and make an adapter exactly as shown in figure 08. If you wish to make an adapter cord to connect your PFC-40's input cable to a 220/240V three prong plug (like a NEMA 10-30, 10-40 or 6-50), use a 14-50 receptacle and simply disregard the middle straight neutral prong. Run the green wire to the ground prong and then the white and black wires to either of the two line (hot) prongs. Since there is no neutral in the older 3 prong 220/240V plugs simply disregard the fact that your PFC charger has a 4 prong plug on it.

Note: Any Manzanita Micro PFC-20,30 or 40 charger can be plugged into a NEMA 14-50 outlet. The 50 amp rating is just what the outlet is capable of and the charger will only draw as much as it is designed to use.

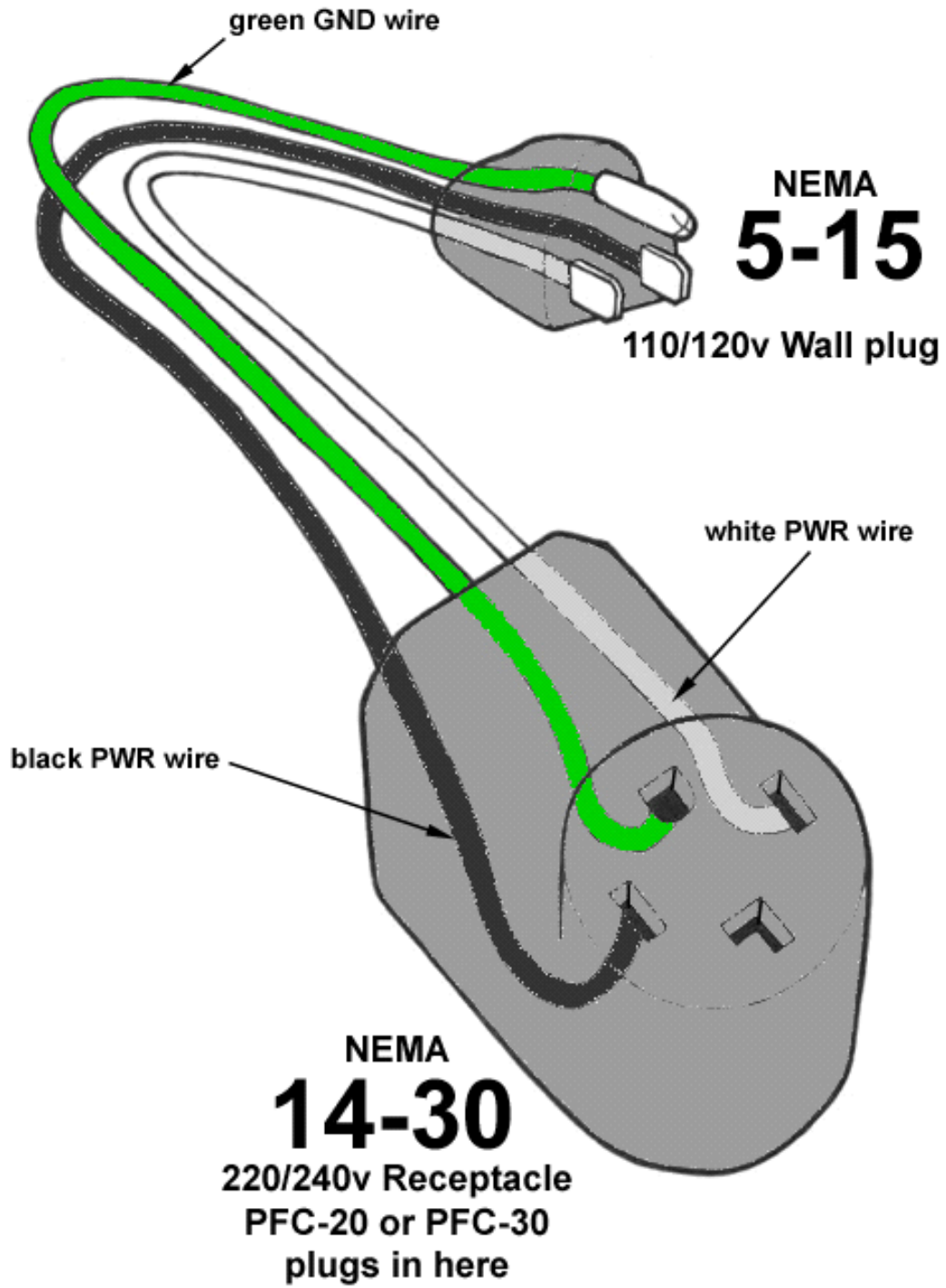


figure 07: PFC-20/30 Adapter Wiring

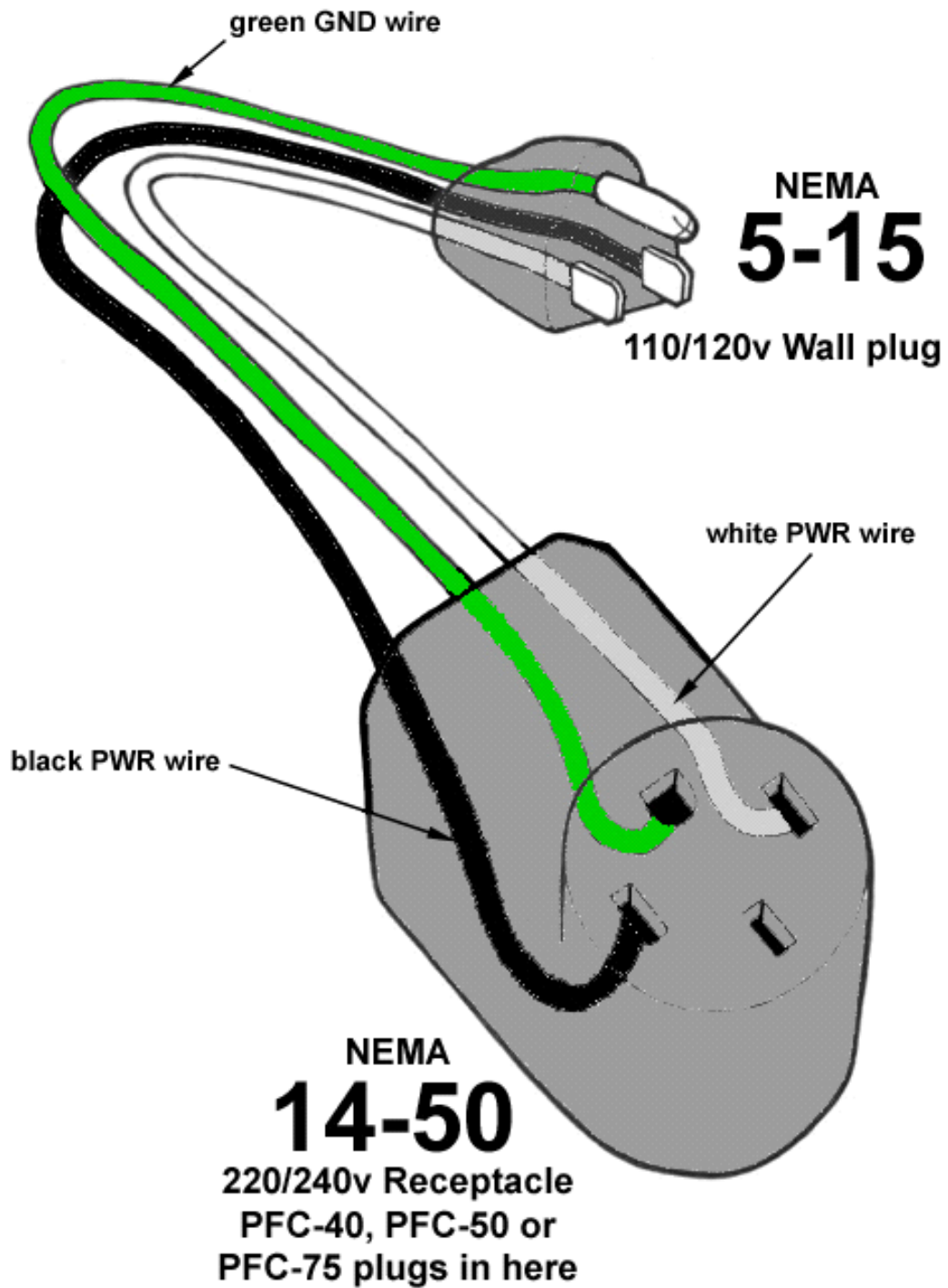


figure 08: PFC-40 Adapter Wiring

For more information visit: www.manzanitamicro.com

Or for technical questions or other inquiries:

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