TODD ENGINEERING SALES, INC.

Power Source™
Battery Charger/Power Supply
Owner's Instructions

Models PC20B, PC30B, PC40B, PC45B, PC55B, PC75B

45 amp model shown

Product Overview

The Power Source™ Battery Charger/ Power Supply is designed to convert 120 VAC (household electrical energy) into nominal 12 VDC (automotive electrical energy). Its primary application is for recreation vehicles. It provides exceptionally clean low voltage power for charging on-board batteries and for operating RV appliances. Low voltage output is filtered, and output voltage remains constant in the face of varying input levels from RV parks. Output is dual voltage, allowing the operator to select either 13.2 VDC or 14.2 VDC. This feature allows for stable battery maintenance when supplied for extended periods of time by RV park power, or rapid battery charging when connected only occasionally to external power. It is a *switch mode* type supply; its high frequency electronic design provides superior performance with smaller size and lighter weight. It has an internal monitoring circuit which shuts down operation if the input voltage drops below 90 volts or internal temperature rises above safe levels. Operation resumes automatically when conditions return to normal. LED lights are provided for diagnostic purposes which indicate 120 VAC input (normal operation) and temporary shutdown (abnormal conditions). It comes with a lifetime warranty certificate.

Installation

I. DISCONNECT POWER- Disconnect RV battery HOT wire at battery before connecting Power Source™ Battery Charger/Power Supply.

II. LOCATION- Power Source™ mounting location may be on any interior (out of direct weather) surface. Location chosen must be accessible after installation. Typical locations include

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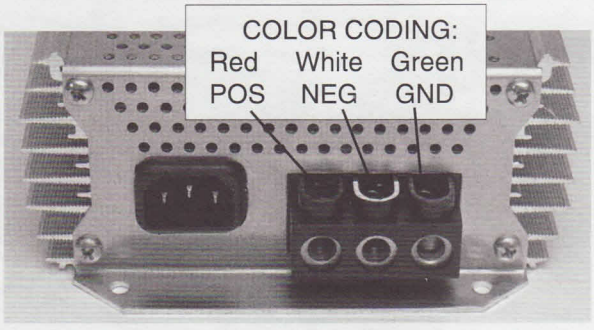
under counter cabinets, below closet compartments, inside bed cabinets, overhead cabinets, under floor storage compartments accessed from the vehicle exterior, etc. When mounted inside a cabinet, the cabinet must be large enough to allow dissipation of heated air. Care should be taken that the unit is not mounted in a location where other storage is likely to cover the unit and allow overheating during operation. Make sure that there is a minimum of 1" free air space at each end of the unit so that cooling air can move through the unit properly. Do not mount in a location where unit may be subjected to water, such as in an engine compartment, or under a kitchen sink drain. Reminder: Electronic devices do not like foreign contaminants such as dirt, metal particles, or moisture. Do not mount the unit in a compartment designed for the storage of flammable liquids, such as gasoline (see CAUTION).

III. ELECTRICAL REQUIREMENTS- Location chosen needs a 120 volt receptacle to supply power to the converter. This receptacle may be on a general use branch circuit. Electrical consideration should also be given to mounting the Power Source™ where possible near the locations of the RV batteries and the 12 volt distribution panel.

IV. MOUNTING- Mount Power Source™ with screws through holes provided. Unit should be screwed to a solid surface firmly enough to hold its weight during vehicle operation.

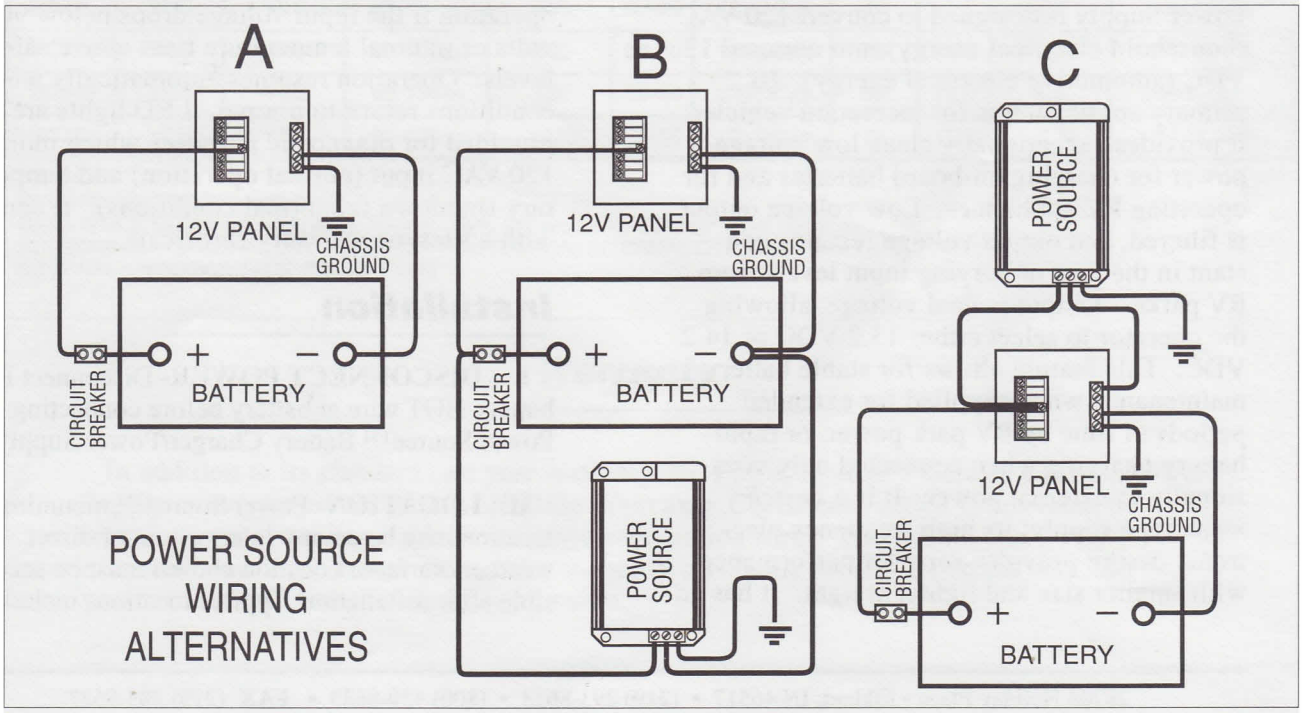
V. ELECTRICAL CONNECTIONS- See drawing. Circuit A shows a basic electrical loop between the RV battery and the 12 volt distribution panel where power is divided into smaller circuits and distributed throughout the coach. Circuit B shows this basic loop with the Power Source™ installed at the battery. Circuit C shows the Power Source™ installed at the panel. Both installations work equally well to provide power to charge the battery and to operate the 12V load. Determine which installation to use and proceed. In installations where the battery and the converter are separated from each other by some distance, it is preferable to use the vehicle chassis as the ground conductor rather than running a wire for the return ground. As the chassis has an unlimited current carrying capacity, this will reduce or eliminate the voltage drop through the return wire.



120V cord connector and 12V terminals

A. 12 VOLT- Note: Use the proper size wire for the Power Source™ model selected. Example: The PC30B is a 30 amp converter, and should be installed with 10 gauge wiring. Tighten all connections securely. Loose connections can quickly cause overheated terminals and wires, melted insulators, and hazard of fire.

1. An eight gauge copper wire from the vehicle chassis must be connected to the terminal on the Power Source™ color coded green and marked GND.



2. The negative wire from the battery or the panel is connected to the terminal color coded white and marked NEG.

3. The positive wire is connected to the remaining terminal color coded red and marked POS.

4. Visually verify that the 12 volt wires from the battery are not reversed. The positive wire from the battery should be attached to the positive terminal of the converter. (If they are accidentally reversed, damage to the converter will result.)

5. The Power Source™ is *current limiting* by design, and therefore the output wiring does not require overcurrent protection. However, an RV battery has a tremendous current capacity, and the positive battery wire needs to be protected by a fuse or a breaker. This protection must be installed within 18" of the battery. When protecting the battery by a circuit breaker, always connect the Power Source™ to the *load* side of the breaker and the battery to its *line* side.

B. 120 VOLT- Plug the cord into the recessed plug on the converter and into the 120 volt receptacle.

C. DUAL VOLTAGE OUTPUT- The Power Source™ is equipped with the capacity to operate at two different output voltage levels, approximately one volt apart. The voltage setting chosen at this point depends primarily on how the RV is used:

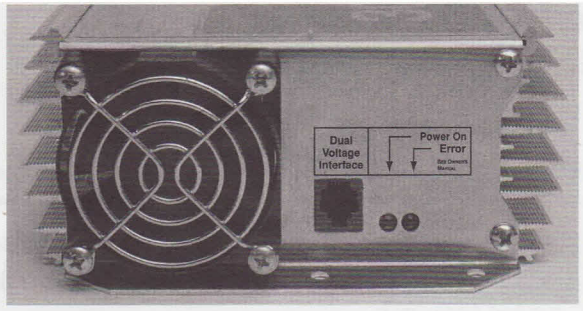
1. If the RV is plugged in full time at a park (or elsewhere), then the recommended voltage setting is 13.2 volts. This will avoid the frequent battery maintenance normally associated with 14 volt charge levels.

2. If the RV is only plugged in occasionally, then the recommended voltage level is 14.2 volts. This will allow rapid and powerful battery charging; however when plugged in the battery should be checked for routine maintenance.

3. Gel cell batteries- Gel cells are sensitive to charging. Leaving a gel cell at the 14.2 volt setting for more than four hours is not recommended. Damage to the battery could result. Therefore, connect one of the voltage control switches listed in paragraphs C or D below so that the gel cell battery is protected from extended periods of excessive voltage. In the absence of a voltage control switch, select the 13.2 volt setting as in paragraph four below.

After selecting the voltage level preferred, connect in the following manner:

a) For permanent single output voltage operation, at 13.2 VDC, verify the dual voltage plug is removed from the RJ11 jack on the converter (it looks like a modular phone jack). With the jack empty, the output voltage is set at 13.2 VDC.



Dual voltage jack and LED indicators

b) For permanent single output voltage operation, at 14.2 VDC, insert the dual voltage plug (provided) into the RJ11 jack. Voltage is now increased by one volt.

c) For manual voltage control, when and as desired, insert the plug from the Todd OS-2 Output Selector Switch into the RJ11 jack. Install the switch in a convenient location, and follow its operating instructions.

d) For maximum peace of mind and *automatic* voltage control, insert the plug from the Todd ADV2 Automatic Dual Voltage Control into the RJ11 jack and mount the control on a nearby surface. The ADV2 continually senses the battery voltage level. Anytime the battery drops below 12.6 VDC, it will shift the converter voltage to the higher setting and hold it there until the battery has recovered, plus an additional four hours. Then it will drop back to the lower setting. It will automatically repeat this cycle whenever necessary.

VI. TEST- Energize the converter circuit. Notice the LED indicators. The green LED signifies that 120 VAC power is present and that the input fuse is intact. The converter should be operating normally. The red LED signifies that the converter has temporarily shut down due to an internal over-temperature situation, or an input under-voltage (brownout) situation. Normal operation will automatically resume when the abnormal condition ends. To test for proper output power, using a multimeter, measure output voltage from the positive and negative terminals. Voltage should read 13.2 or 14.2 volts DC. Turn on load to about 2/3 of rated capacity of converter. Recheck voltage, which should remain approximately the same as at no load.

VII. BATTERY- Reconnect the positive terminal to the battery. With converter energized, measure voltage at converter and at battery. Voltage should be about the same in both locations.

HI-POT Testing

(MANUFACTURING COMPANIES ONLY)

RV hi-pot testing should be done in the following manner:

1. Unplug the Power Source™ 120 VAC input cord.
2. Disconnect the positive wire from the red coded terminal.
3. Hi-pot the coach.
4. Reconnect the positive wire and plug in the cord.

Medical Appliances

Todd Engineering will not knowingly sell its products for any life support applications. It is strongly recommended that you do not operate, either directly or indirectly, any 12 volt life support equipment from a Power Source™. If the Power Source™ should malfunction, or fail to operate due to other conditions, with or without a battery in the system, it is presumed that all low voltage appliances including any connected life support equipment would also eventually shut down, resulting in a potential risk of medical complications and loss of life.

Caution

Do not install this or any electrical accessory in a compartment intended for storing flammable liquids such as gasoline, etc. whose fumes are explosive and can cause injury and death. There are no components in the Power Source™ which in their normal operation cause arcs or sparks (such as in the operation of a relay). However, the simple act of turning on or off a light switch, whether 12 or 120 volt, or unplugging the cord on an electrical appliance can cause a spark, and consequently an explosion from gasoline or other vapor. **Therefore do not install a converter in a compartment intended for storing flammable liquids, and never store flammable liquids inside a compartment containing *any* electrical device.**

FCC Requirements

This device complies with Part 15 of the FCC rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

CONVERTER SPECIFICATIONS

MODEL	Dual Voltage Output	LED Indicator Lights	INPUT			OUTPUT		FAN	WEIGHT LBS.	SIZE (LxWxH)
			VOLTS AC	WATTS(A)	Hz	VOLTS DC	AMPS			
PC20B	YES	YES	90-130	277	50-60	12VDC(C)	20	YES	3.7	7 5/8 x 6 x 2 3/4
PC30B	YES	YES	90-130(B)	415	50-60	12VDC(C)	30	YES	4.7	9 5/8 x 6 x 2 3/4
PC40B	YES	YES	90-130(B)	565	50-60	12VDC(C)	40	YES	4.7	9 5/8 x 6 x 2 3/4
PC45B	YES	YES	90-130(B)	635	50-60	12VDC(C)	45	YES	4.7	9 5/8 x 6 x 2 3/4
PC55B	YES	YES	90-130(B)	780	50-60	12VDC(C)	55	YES	5.6	9 5/8 x 6 1/8 x 3 5/8
PC75B	YES	YES	90-130(B)	1070	50-60	12VDC(C)	75	YES	7.1	11 5/8 x 6 1/8 x 3 5/8

A) .7 PF
B) Optionally 180-260 Volt Input
C) 13.2/14.2 VDC from no load to approx. 95% full load. 12 VDC @ rated capacity
ALL MODELS: INTEGRAL OVERCURRENT PROTECTION; INTERNAL OVERTEMPERATURE PROTECTION; INTERNAL UNDERVOLTAGE PROTECTION

Warranty

In addition to its standard two year warranty, the Power Source™ Battery Charger/Power Supply converter comes with a **Lifetime Warranty Certificate** which is activated by completing and mailing back the attached registration form. There is no charge for this extended warranty. Please refer to the warranty certificate for details on the standard two year warranty and on the lifetime extension.

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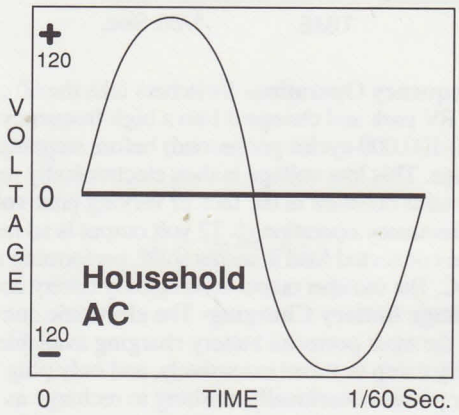
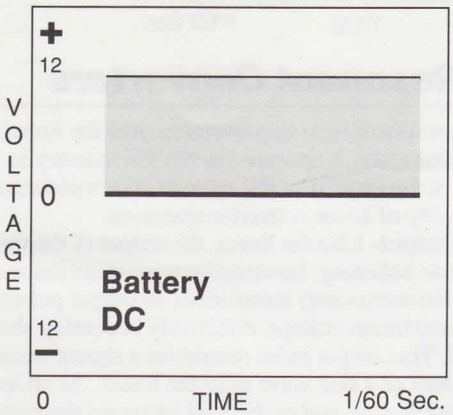
Major RV Converter Types

There are three converter designs used by RV manufacturers to change 120 VAC to 12 VDC. These three designs are called linear converters, ferro-resonant converters, and electronic converters (sometimes called *switchers*). The following is a brief description of the three types based on their *operative* characteristics. No reference is made to a specific brand.



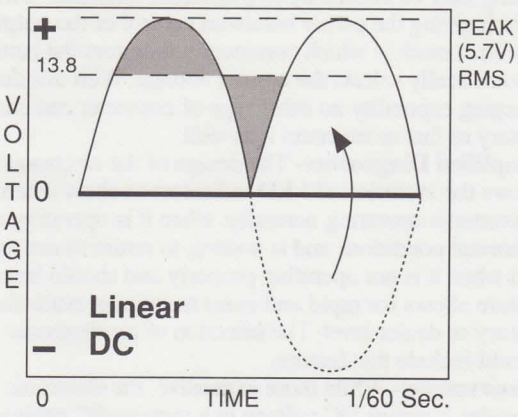
Reference Illustrations



Linear Converters

The linear is the original, simplest, and least expensive converter design.

Linear Operation- The linear derives its name because there is a direct, or linear, relationship between AC in and DC out. As the RV park power varies up and down, the DC output from the converter varies up and down in exactly the same manner. When the converter output voltage drops, the performance of the 12 volt load (lights, fans, pump, etc.) drops correspondingly. Lights get dimmer; the fans run slower; and the water pump runs weaker. During peak camping season when electrical power in the park is needed the most, it is often at its lowest; and the linear converter is well known for causing the performance of 12 volt loads to suffer significantly.



Pulsating DC- Because of its simplicity, the linear produces *pulsating* DC (the top half of an AC sine wave). Because the pulse is positive only, it is still termed DC (direct current); but it does not resemble battery current which is like a straight line. (See reference illustration.)

This pulsating DC alternates between 0 volts and approximately 20 volts (peak).

Meters- Meters will read the voltage as an average voltage (RMS), showing for example, 13.8 volts, rather than 19.5 volts peak. The peak voltage remains unseen, and to many people, unknown. To test this for yourself, momentarily add a capacitor across the DC output and the meter will now read peak voltage instead of RMS. (Make sure that the capacitor is properly rated for this.)

Electrical Loads- 12 volt loads operate on this power by averaging the content of the positive pulses and the spaces in between them. Because of this pulsating output the load must turn on and off 120 times a second, which builds up additional heat in pump and fan motors, and causes greater wear and premature failure in many 12 volt appliances.

Batteries- However, batteries float at peak voltage (the top of the pulse), and cannot survive at these elevated levels. Therefore in order to protect the battery *all linear converters switch off the battery when they turn on.* In an effort to provide a measure of battery charging, the linear may have an optional charge module which will slow charge the battery from a small portion of the converter output, and also provide one or more filtered circuits for radios, etc. which cannot accept pulsating DC. Sensitive electronic accessories such as monitor panels and gas detectors, TVs, and VCRs, very much like the radio, cannot operate from the pulsating DC voltage, and must be powered from the filtered circuits, usually overloading them and nullifying any charging capabilities of the converter. In addition to being known for low voltage output, and poor performance in 12 volt loads, the linear is also well known for ineffective charging.

Observations- While having the simplest and least expensive design, the linear converter causes 12 volt loads to run hot and to suffer from low voltage, and it provides minimal battery charging. It is also noticeably heavy, produces a significant heat byproduct, and sometimes has an audible hum emanating from its transformer.

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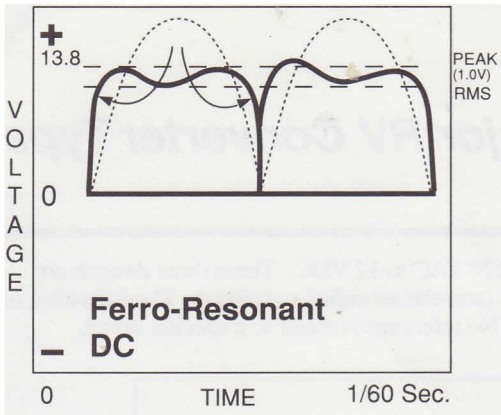

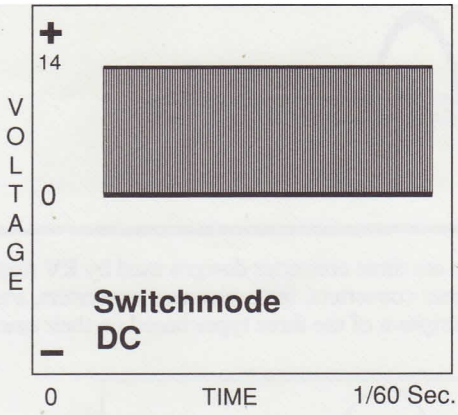

Ferro-Resonant Converters

The ferro-resonant is an improvement over the linear, and costs somewhat more. It appeared in the RV industry in the early 1970's at the request of RV manufacturers concerned about the quality of linear converter operation.

Regulated Output- Like the linear, the output of the ferro-resonant is also pulsating; however because of an innovative three stage (ferro-resonant) transformer its output pulses are limited to a maximum voltage, effectively becoming shortened and widened. This output pulse resembles a square wave more than the top half of a sine wave as in the linear. At no load the wave is almost square, and as the load increases the wave rounds downward to a smaller sine wave. Due to its maximum voltage limitation the ferro has a measure of mechanical regulation producing a more stable output voltage, even while the RV park voltage varies up or down.

Battery Charging- Because of this regulation the entire output of the ferro is compatible with the battery, and it functions as a real battery charger and also provides power to operate the 12 volt load. The ferro can be wired in parallel to the battery, and for best performance should be, as its RMS output voltage is approximately one volt lower when operating alone. Because the battery remains part of the system during converter operation, the converter and the battery operate as partners providing power to the 12 volt load. When additional power is needed for a limited time which the converter cannot provide, it is drawn from the battery. As load is later reduced, the battery is recharged by output from the converter not needed for the remaining load. The battery acts as a large filter for the squared off pulsating DC output of the ferro, reducing the 60 cycle noise which otherwise would be unacceptable on the radio (as with the linear).

Observations- While costing more, the ferro is an improvement on the linear converter, providing a level output voltage and increased battery charging. It is larger and heavier than a linear, and due to its ferro-resonant transformer it generates even more heat. The ferro has a constant obvious audible hum, even when enclosed inside a mounting cabinet. However it is a significant step forward in converter technology from the long-standing linear.

Electronic Converters

The electronic, or *switchmode*, converter is the most recent technological development in RV converter/battery charging, and is more expensive than the other two types. The switcher was introduced to this industry in the mid 1980's, again at the request of RV manufacturing companies concerned about the quality of converter operation and inherent side effects. The switcher is currently well into second generation models. It is the most efficient converter, providing the highest amperage output capacity in the smallest and lightest package. It is also the most powerful battery charger of the three types.

High Frequency Operation- Switchers take the 60 cycle input from the RV park and change it into a high frequency cycle (such as 50,000-100,000 cycles per second) before stepping it down to low voltage. This low voltage is then electronically regulated so that it remains constant in the face of varying park voltage. Due to its high frequency operation its 12 volt output is so fast and dense that to the connected load it seems solid, performing the same as battery DC. The switcher output is completely battery compatible.

Dual Voltage Battery Charging- The electronic converter provides the most powerful battery charging available. Some RV owners dry camp or travel extensively, and only plug into park or generator power occasionally, wishing to recharge as rapidly as possible. They have always pleaded for better and faster charging. Other owners go to an RV park, set up their vehicle and plug in for the season. They wish to relax and forget about electrical concerns. Battery characteristics, however, dictate certain charging rules. A 12 volt battery stands at 12.65 volts, but in order to overcome an internal resistance to change, it requires approximately 14 volts to fully charge. However with the presence of the electronic converter and its powerful charging capability, the same 14 volt level which a battery needs in order to charge, now may create additional battery maintenance when left for too long (such as plugging an RV into park power for an extended period). There are two different electrical needs, rapid charging and long term battery maintenance. A single output voltage level compromises these needs and meets neither situation well. However, some switcher models offer a *dual output voltage* choice, one selection for minimal battery maintenance, and a more powerful setting for rapid charging. This setting may be chosen by two different methods: a manual switch giving the owner hands-on control of the output voltage, or a control module which continually monitors the battery level and automatically selects the correct voltage. With this dual voltage charging capability no other type of converter can charge a battery as fast or maintain it as well.

Simplified Diagnostics- The design of the electronic converter allows the inclusion of LED indicators to show when the converter is operating normally, when it is operating under abnormal conditions and is waiting to return to active operation, and when it is not operating properly and should be repaired. This feature allows for rapid and exact technician evaluation at a factory or dealer level. The selection of an electronic converter should include this feature.

Observations- While more expensive, the electronic converter provides constant DC voltage in a varying AC environment. It is a powerful battery charger, and with a dual voltage output is unsurpassed in long term battery maintenance. It is significantly smaller and lighter, produces markedly reduced heat and due to extensive filtering, makes almost no noise. Because it is electronic its output can be factory adjusted for different applications, such as charging exotic battery types (like ni-cads). The switcher is the most advanced battery charger/power supply available.