

A DC Power System for the Amateur Radio Station

The Requirements

I had the usual stack of 12 volt power supplies - one generic linear Astron, an Icom that matched the rig, and the occasional Astron switcher supply. My station is somewhat cramped for space, and I needed more DC power to run an HF Amplifier that requires up to 100A of 12V current. I also wanted to be able to operate without mains power for awhile, which means I needed a storage battery integrated in with the power supply. I have several rigs plus the amp, so it needed to be able to supply about 150A at 12V. I wanted the battery to be happy, and the radios to be happy. The battery must be sealed, and not Gel - no liquid acid in the shack, and Gel batteries are too easily damaged.

The Search

I looked at the West Mountain Radio Powergate and the Astron battery-friendly supplies (special versions). I considered building my own similar power control device. I looked at putting batteries across switcher power supplies. I considered diodes, VMos PowerFETs, and microprocessors. I wanted something simple and reliable. There are a lot of ways to solve this problem, but most of them are compromises, or they are complex or they are not known to be within manufacturer's ratings. A particular problem is when the AC is removed from the power supply, but the DC remains from the battery. Does the power supply self destruct? When the AC is returned, does the power supply charge the battery so heavily that it overheats, boils the battery, etc??

Batteries are not so difficult to specify. The available Absorbed Glass Mat (AGM) sealed lead acid (SLA) batteries meet my requirements for avoiding liquid acid in the station, and have exceedingly low impedance to handle the load and also recharge quickly. These are pricey but are often available surplus as pullouts from large Uninterruptible Power Supplies (UPS). (For more info on AGM batteries see [AgmBatteries](#)). Gel batteries are less desirable as they cannot handle the high charge or discharge currents.

A Solution

A simple solution that is frequently used in Amateur Radio stations is an RV battery with a charger floating across it. This is fine for low current applications, but the 100 amps for the amplifier really puts a load on the battery. So a high current charger is needed to offset this. However the high current chargers are expensive and often subject the battery to voltages too high for electronics equipment, as well as noise that creates interference in receivers. So the charger has to be chosen carefully.

Another common solution is a regulated power supply with an isolation diode to the battery. It is difficult to obtain the proper voltage for the battery with this setup as the diode drop varies with current. A discharged battery also presents a heavy load to the supply which can cause problems with the supply. Some switching power supplies can safely be connected across batteries, but again they are not designed for this service and some can be damaged if the AC is removed.

A variation on that solution is a charger/power supply made for the Recreational Vehicle (RV) industry. They call these RV Converters. They are designed to power the 12 volt equipment in a trailer or motorhome, as well as charging the house batteries. The better quality units have the proper charge regimen for bulk boost, normal and storage voltages, and they put out clean DC that is electronics equipment and battery friendly. Some of these converters are RF noisy,

so we need to select a quality unit that is AGM battery friendly and RF quiet.

So I set out to choose one of these supplies. There are a few reviews on www.eHam.net. They are sparse but show that some brands are RF quiet, and that the larger converters (over 70 amps) tend to be more troublesome from a noise standpoint. I also noted that the higher current models require 20 amp 120 volt outlets, so another requirement was to stay with standard 15A AC plugs, which limits the 12V output to approximately 60 amps.

The particular unit I chose is made by Progressive Dynamics (www.progressivedyn.com). They seemed to have expertise in producing low noise power supplies and high quality RV converters. They were also available at good prices on the internet. I purchased one to evaluate, a model 9260C. This unit produces 60 amps of 12 volt power. It has a built in "Charge Wizard" that manages the voltage for proper battery charging. It charges at 14.4 volts during the bulk/boost phase, then drops to 13.6, and finally drops to 13.2 volts as the current demands fall off. It weighs under six pounds, is less than 4" by 8" by 9" and has a large heatsink and speed controlled fan. It comes with a short AC cord, no power switch, and connectors to take two sets of heavy DC cabling up to 2 gauge (and down to 14 gauge).

Preliminary Testing

I took this supply and added an Anderson Powerpole 30 amp connector. I put some heavy resistive loads on it courtesy of Eric WD6CMU and we measured voltage. It was well behaved. The fan does not run until the load exceeds about 15 amps. Then it comes on so quietly at low speed you can hardly hear it, and ramps up depending on temperature and load current.

I took it to the field and used it to power a Yaesu FT897 both with and without a battery across the 12V line. We could not find any power supply RF noise in field conditions. I have not tried wrapping the antenna around the supply, but in actual use we have not found any noise thus far.

On Field Day 2007 I decided to try the amplifier on the supply with a pair of 49 amp hour AGM batteries - one for the rig, and one for the amp. I also added a 1 Farad capacitor to the amp battery. It all worked quite well. The converter was powered by a Honda EU2000i generator set in ECO mode. On CW the generator really was modulated by the heavy on-off load, but it kept working and the amp put out 500 watts of RF. Success!

Temporary Home Installation

I put together a temporary installation at home to continue the testing after Field Day 2007. This setup includes a single 49 amp hour AGM Lifeline battery, the Converter/Power Supply, and some heavy cabling to the amp with 6 gauge wire and Anderson SB50 connectors. It seems to work quite well, though for the final system even lower loss cable is planned. Testing continues..

The Final System

I am still designing the final system (7/2007), but the present plan is to recycle a computer case to contain the battery, converter and various bits of switching gear. I plan to use a 100 amp hour AGM battery that I obtained at a flea market, a Dynasty group 27 size unit. The computer cabinet will contain all the proper fuses and AC and DC switching. Since we discarded our old computers I have to find a suitable case to recycle...

The cable is an important part of the plan. 6 Gauge wire is rated for about 40 amps of continuous current, but the amplifier can draw more than this in key down service like RTTY.

So I plan to use 2 gauge cable and Anderson SB120 connectors for the amplifier in the final system. This cable is rated for about 95A in a multiwire cable, and it is the largest cable that will fit the SB120's. The SB120's are rated for 120 amps. This cable will carry only power for the amp, separate cables will be provided for an SB50 outlet (6 gauge) and a few [PowerPole 30's](#) (10 gauge cable on them). In each case I am planning to use the largest cable size recommended for the connectors to minimize voltage drops.

For fuses I plan to use Mega Fuses for the 2 gauge at 100 amps, Maxi Fuses at 60A for the 6 gauge, and 30 amp ATC fuses for the 10 gauge [PowerPole 30](#) wiring. Two switches will be provided, one for the AC to the converter/charger, and one high current DC separating the battery from the rest of the system. This will allow me to run from AC or DC or both, and to remove power from the rigs. A little known fact is that most radios and amplifiers leave power on the final transistors even when turned off. It is a good idea to remove DC entirely when equipment is not in use. I will also put casters on the case, and connectors on the back panel for all input and output power. Some accessory [PowerPole 30's](#) and an SB50 will be available in the front of the case as well, and possibly a voltmeter. Some handles may be added for moving it, the battery weighs about 70 pounds so the whole box will approach 100. I plan to use some form of secondary containment on the battery (a battery box), and make it somewhat easy to change the battery by minimizing the quantity of connections that bolt to the battery directly.

More later as it develops..

For those not requiring High Current

For those stations not requiring power for an amplifier, the RV converters come in 25 to 45 amp versions that would handle the station load with or without a float battery. Models without Charge Wizards will also work, they just do not charge the battery as quickly or do the periodic equalization cycle. They also do not drop to the lower voltage when idle, so the battery life may be slightly reduced. If you turn the converter / power supply off when not in use, the batteries will use less water and last longer (as long as you don't let them run down and sit). If your batteries are located in a vented area you can also consider the most cost effective battery setup - a pair of 6V Golf Car batteries in series. These batteries are available new at about \$60 each from places like Sam's Club and some WalMart stores. They are rated about 200 amp hours, so you will have a very capable system. The water level must be periodically checked and ventilation is important. Make sure there is a fuse within a foot or so of the battery for safety's sake with any battery.

[AlanB](#) – WB6ZQZ

The Progressive Dynamics 9200 Series INTELI-POWER converters are UL listed for the US and Canada. They provide safe, reliable, filtered DC power to all Recreational Vehicle 12-Volt lighting and appliance circuits. The Inteli-Power converter also safely recharges and maintains the RV battery and has a two-year limited warranty.



The built-in Charge Wizard is a microprocessor-controller that constantly monitors the RV battery voltage to determine if the battery requires a quick recharge, is fully charged and being used, or is fully charged and is in storage. The Charge Wizard then selects one of four operating modes (Boost, Normal, Storage, or Desulfation) to properly re-charge or maintain the battery. [Click here for more information on the Charge Wizard.](#)

Patent #'s: 6,184,649- 5,600,550- 5,687,066- 5,982,643

INTELI-POWER 9200 SERIES OPERATION

Progressive Dynamics 9200 Series Electronic Power Converters have several features that differ from other electronic power converters presently marketed to the RV industry. Reliability data over the past eight years on over 400,000 units in the field have proven that these design features increase our reliability and provide the following additional customer benefits.

1. ELECTRONIC CURRENT LIMITING – This safety feature will rapidly reduce the output current in case of an electrical short or overload condition. This rapid shutdown like the circuit breaker in your house prevents possible RV wiring and converter damage. The converter automatically returns to normal operation when the short or overload is corrected.

2. VARIABLE SPEED INTELLIGENT COOLING FAN – Solid state temperature sensing and control system automatically monitors converter temperature and activates the fan at speed required. Very slow, quiet speeds are used when demand is low, such as during sleeping hours. Some competitive converters use Electro-mechanical devices to provide temperature sensing and fan control. Electro-mechanical sensors are more subject to failure and may stick in the closed mode causing the fan to operate all the time, resulting in an irritating noise. They can also fail to close during high temperature conditions and prevent the fan from operating. This failure may cause over heating and possible converter failure.

3. AUTOMATIC THERMAL SHUTDOWN – This safety feature will shut the converter down in the unlikely event of a fan failure and prevent damage to the converter. This safety feature will also activate if the area where the converter is mounted is too small, has inadequate ventilation, or is accidentally covered by the customer. This Automatic Thermal Shutdown turns the converter off when unit temperature exceeds 150 degrees F. Please refer to the installation instructions for information regarding spacing and ventilation requirements.

4. LOW LINE VOLTAGE PROTECTION – The Progressive Dynamics 9200 Series Converters will operate at low AC line voltages without damage. This feature is especially important in RV campgrounds where AC line voltage can be as low as 90 volts. Low AC line voltages may damage competitive converters. Low Line Voltage Protection will automatically shut converter down if input voltage is insufficient. This also protects your 12-volt appliances from damaging low voltage irregularities. The converter will automatically return to normal operation when adequate line voltage is available.

5. HIGH VOLTAGE PROTECTION – All converters incorporate our patented High Voltage Shutdown circuitry. This feature automatically shuts the converter down to protect sensitive electronics in the event of high voltage transients on the AC power line, or if the RV generator regulator should momentarily fail. The converter will automatically return to normal operation when the high voltage transient is corrected.

6. REVERSE BATTERY PROTECTION – Our patented Reverse Battery circuitry prevents converter damage and unnecessary warranty calls in the event the customer or dealer accidentally connects the battery in reverse. Simple replacement of the fuse(s) located on the front of the converter restores the unit to normal operation. Some competitive converters can be damaged and require replacement if the battery leads are accidentally reversed.

7. BUILT-IN ACCESSORY PORT – All PD9200 Series Power Converters incorporate an accessory port for the optional [Converter Status Remote Pendant](#) which is used to monitor the Charge Wizard operating modes.

Inteli-Power Specifications Table

| | PD9245C | PD9260C | PD9270 | PD9280 |
|---|--|----------------------|----------------------|-------------------------|
| Maximum DC Output Current | 45-AMPS | 60-AMPS | 70-AMPS | 80-AMPS |
| Maximum Continuous Input Power | 725 WATTS | 1,000 WATTS | 1,250 WATTS | 1,300 WATTS |
| No Load DC Output Voltage | 13.6 VDC | 13.6 VDC | 13.6 VDC | 13.6 VDC |
| No Load Voltage Tolerance | +/- .3 VDC | +/- .3 VDC | +/- .3 VDC | +/- .3 VDC |
| Full Load Output Voltage | > 12.6 VDC | > 12.6 VDC | > 12.6 VDC | > 12.6 VDC |
| Ripple and Noise Voltage | <50 MV RMS | <50 MV RMS | <50 MV RMS | <50 MV RMS |
| Input Voltage Tolerance | 105 - 130 VAC | 105 - 130 VAC | 105 - 130 VAC | 105 - 130 VAC |
| Input Voltage Frequency | 50-60 HZ | 50-60 HZ | 50-60 HZ | 50-60 HZ |
| Peak Inrush Current | 32-AMPS | 47-AMPS | 47-AMPS | 80-AMPS |
| Efficiency (Typical) | > 80% | > 80% | > 80% | > 80% |
| Reverse Battery Protection | YES | YES | YES | YES |
| Electronic Current Limiting | YES | YES | YES | YES |
| Variable speed Intelligent Cooling Fan* | Auto-speed | Auto-speed | Auto-speed | Auto-speed |
| Back Up Thermal Protection | YES | YES | YES | YES |
| Storage Temperature | 20-80C | 20-80C | 20-80C | 20-80C |
| Operating Temperature | 0-50C | 0-50C | 0-50C | 0-50C |
| Hipot Voltage Test | <----- 1240 V @ INPUT TERMINALS -----> | | | |
| Accessory Port for optional Pendant** | Standard | Standard | Standard | Standard |
| Weight | 4.5 LBS. | 5.8 LBS. | 5.8 LBS. | 7.5 LBS. |
| Dimensions | 8.25"L X 7.25"W X 4.5"H | 8"L X 9.00"W X 3.6"H | 8"L X 9.00"W X 3.6"H | 11.5"L X 9.00"W X 3.6"H |
| UL & c UL Listed | YES | YES | YES | YES |

* Fan speed automatically controlled according to converter temperature.

** Allows the customer to easily install the optional Pendant to monitor the built-in Charge Wizard and also allows manual mode selection.

[Click Here: For More Information Regarding Power Converters](#)

[View The Inteli-Power PD9200 Series Owners Manual \(PDF\)](#)

PD9260C

60 Amp RV Converter/Charger

The **PD9260C**, 60 amp power converter is designed to provide reliable filtered DC power to all recreational vehicle 12-volt lighting and appliance circuits. The **PD9260C** converter also provides safe and rapid recharging of RV batteries. Built-in features such as electronic current limiting, reverse battery protection, high voltage protection, low voltage operation, and over temperature shut down ensure long term reliability. The built-in Charge Wizard is a microprocessor-controlled system that constantly monitors the battery voltage and ensures a rapid; yet, safe, recharge. The Charge Wizard can select one of three charging



voltages and one of four operating modes depending on the condition and use of the battery. The built-in Accessory Port makes it easy to add the [Converter Status Remote Pendant](#) that shows the charger/converter status.

Specifications

| | |
|--------------------|--------------------------|
| Input: | 105-130 VAC, 1,000 Watts |
| Output: | 13.6 VDC, 60 Amps |
| Dimensions: | 3.6" x 8" x 9" |
| Weight: | 5.8 lbs. |

Features

- Built-in Charge Wizard.
- Reverse Battery Protection.
- Delivers filtered DC power to all 12 Volt lighting and appliance circuits, providing safe and reliable service.
- Electronic Current Limiting.
- Low line Voltage Protection.
- Variable speed intelligent Cooling Fan.
- High Voltage Protection.
- Automatic thermal shutdown.
- Built-in accessory port for the [Converter Status Remote Pendant](#).
- 2 year limited warranty.