

QST Compares: Switching Power Supplies

Reviewed by Joe Bottiglieri, AA1GW

Do you occasionally enjoy taking your dc-powered transceiver along on your vacation or out into the field for generator-powered operations—such as Field Day? Are you tired of hauling around that bulky transformer-based power supply?

If this sounds familiar, you've probably noticed the wide selection of switching dc power supplies that have hit the Amateur Radio market over the last few years. Their compact size and light weight, fractions of that of the more conventional alternatives, would seem to make them the perfect traveling companion—particularly for use in conjunction with those subcompact multi-band wonders that have become the radios of choice for squeezing into suitcases and backpacks.

This time around we'll have a look at the Astron SS-30M, the ICOM PS-85, the Kenwood PS-40, the MFJ-4225MV, the Samlex SEC 1223 and the Yaesu FP-1023. Each of these dc switching power supplies carries continuous output current ratings that make them suitable for use with any of the currently available 100 W transceivers.

About the time that we were finalizing this review, Alinco announced the release of a switching supply of their own—the DM-330MV. ICOM has also redesigned and re-released an updated version of the PS-85. We'll keep these two in mind as possible subjects for a future column.

The Battery of Tests

The lab tests run on each of the units began with measurements of the actual dc output voltage at loads of 1.1 A and 21 A. Next, a Variac was inserted in the ac line and the minimum ac voltage input required to retain proper regulation of the dc output was determined. (This value is recorded in the tables as the low line drop out voltage.)

The amount of ripple on the dc output, and the presence—or absence—of any high

frequency ringing spikes while under load was also investigated. The resulting oscilloscope traces appear in the figures.

A “dynamic test” was set up using an HF transceiver. In this test, each supply was subjected to a pulsed load that rapidly alternated between approximately 1.1 and 21 A. The resulting variation in the supplied dc voltage appears in the tables.

In the final lab test, the supplies were set to 13.8 V (if adjustable) and a load that drew about 20 A was connected. The dc output of the supplies was ac-coupled to a spectrum analyzer and the analyzer was swept from 1.5 to 100 MHz. These spectral plots are also included as figures.

Each of the supplies—of course—was also subjected to on-the-air testing in different locations and station configurations. More on those results later...

Astron SS-30M

The Astron SS-30M sports the largest cabinet in this group. Generously sized dual voltage and current meters take up nearly the entire front panel. A lighted rocker style power switch is located in the lower left hand corner.



The dc connection points are located on the back panel and consist of two 1/4-20 threaded studs about 3/4-inch long with hex nuts and washers. The polarity labeling for these can be difficult to see—the + and – symbols are

Table 2

Astron SS-30M, serial number 98080024

Manufacturer's specifications

Power requirement: 90-132 V ac or 180-264 V ac at 50/60 Hz (switch selectable).

Output voltage: 13.8 V dc.

Output current (continuous): 25 A.

Size (hwd): 3.75×7×8.63 inches; weight, 5 pounds.

Lab Measurements

Output voltage, no load: 13.83 V dc.

Output voltage, 21 A load: 13.66 V dc.

Low line drop out voltage: 94 V ac.

Dc variation during dynamic testing: ≈150 mV.

embossed into the metal and the terminals are not color-coded. You'll want to pay close attention when hooking up your radios and accessories. The power cord is removable and—as is the case with most of these supplies—is the same type that's typically used on computer equipment. A recessed switch allows selection of 110 or 220 V ac operation.

A large temperature-controlled external cooling fan protrudes from the center of the rear panel. It only activates after extended operation under load. Once running, the sound level generated by the fan is low to moderate and the case temperature remains low even after 1/2 hour of continuous operation under a 21 A load.

The documentation that's packed with the SS-30M includes a sheet with a listing of the specifications of their entire line of switching supplies and a second sheet with information on their other power supply products.

Manufacturer: Astron Corp, 9 Autry, Irvine CA 92618; 949-458-7277; fax 949-458-0826; <http://www.astroncorp.com>.

Manufacturer's suggested price: \$172. Typical current street price: \$150.



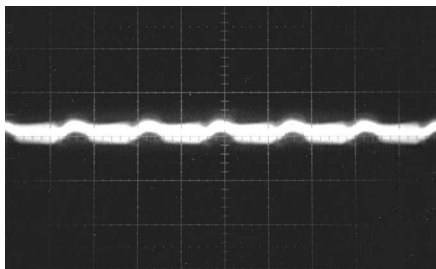


Figure 1—An oscilloscope trace of the dc output of the Astron SS-30M under load. The vertical scale is 50 mV/div, the horizontal scale is 5 ms/div. (Note: these scaling factors vary in some of the other figures.) The level of the dc ripple is very low, <20 mV p-p, and there are no discernible high frequency spikes.

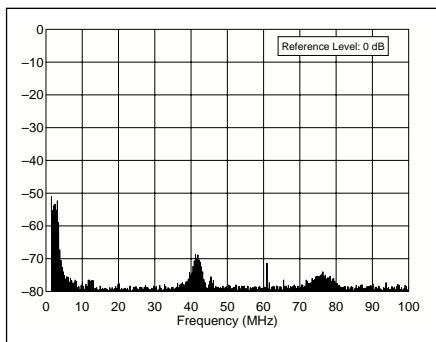


Figure 2—A spectral plot of the output of the Astron SS-30M under load. This supply exhibited very low levels of broadband noise, and the peaks that do appear fall outside of the US amateur bands above 160 meters.

ICOM PS-85

The ICOM PS-85 is designed to be the “matching supply” for a number of the HF and multiband transceivers in their line. The front panel is small—about 4 inches square—and the enclosure is rather deep. A rocker type power switch and a red LED power indicator are mounted on the front panel.

The ac power cord is removable. The dc power cord is about 18 inches long and is permanently attached. It terminates in a six-pin Molex connector that mates with most of the current 100 W transceivers. Separate terminals for powering additional station accessories are not provided.

The PS-85 is the only supply in this group that does not include the ability to convert it for 220 V ac operation.

An internal cooling fan is mounted just inside the back panel. The fan is not temperature controlled—it runs continuously when the supply is on. The sound level of the fan is moderate. The case temperature remained low even after 1/2 hour of continuous operation into a 21 A load.

ICOM includes a single *Instructions* sheet with operating instructions and specifications.

Manufacturer: ICOM America, 2380 116th Ave NE, Bellevue, WA 98004, 425-454-8155; fax: 425-454-1509; <http://www.icomamerica.com>. Manufacturer’s suggested retail price: \$406. Typical current street price: \$295.



Table 3
ICOM PS-85
serial number 01913

Manufacturer’s specifications
Power requirement: 100-120 V ac (fixed).
Output voltage 13.8 V dc $\pm 5\%$.
Output current (continuous): 20 A.
Size (hwd): 3.7×4.4×11.3 inches;
weight, 5.5 pounds.

Lab Measurements

Output voltage, no load: 13.9 V dc.
Output voltage, 21 A load: 13.6 V dc.
Low line drop out voltage: 80 V ac.
Dc variation during dynamic testing:
 ≈ 200 mV.

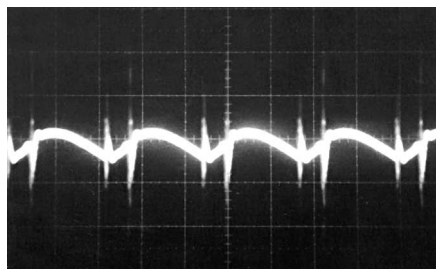


Figure 3—An oscilloscope trace of the dc output of the ICOM PS-85 under load. The vertical scale is 100 mV/div and the horizontal scale is 5 ms/div. The level of the dc ripple is about 100 mV p-p, and there are spikes due to switching that extend out to about 600 mV p-p.

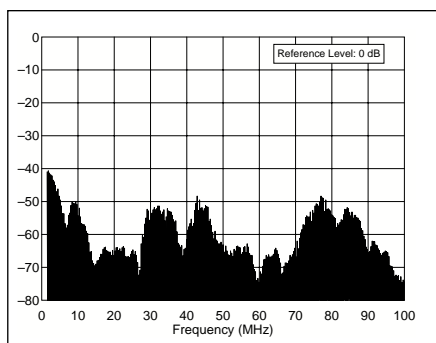


Figure 4—A spectral plot of the output of the ICOM PS-85 under load. This supply exhibited the highest levels of broadband noise of the group.

The Kenwood PS-40

The Kenwood PS-40 is approximately the same size as the TS-50 HF transceiver. A rocker type power switch is mounted on the front panel. A small red LED indicates when the supply is on.

The power cord is removable. Large color-coded dc power terminals are mounted on the rear panel. The PS-40 is



Table 4
Kenwood PS-40
serial number 80500885

Manufacturer’s specifications
Power requirement: 115/230 V ac $\pm 10\%$ at 50/60 Hz (switch selectable).
Output voltage: 13.8 V dc $\pm 5\%$.
Output current (continuous) 20 A.
Size (hwd): 2.5×7×8.9 inches;
weight, 4.4 pounds.

Lab Measurements

Output voltage, no load: 14.4 V dc.
Output voltage, 21 A load: 14.14 V dc.
Low line drop out voltage: 97 V ac.
Dc variation during dynamic testing:
 ≈ 200 mV.

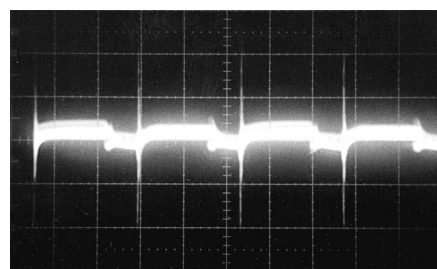


Figure 5—An oscilloscope trace of the dc output of the Kenwood PS-40 under load. The vertical scale is 50 mV/div and the horizontal scale is 5 ms/div. The level of the dc ripple is low, <20 mV p-p, but there are spikes due to switching that extend out to about 200 mV p-p.

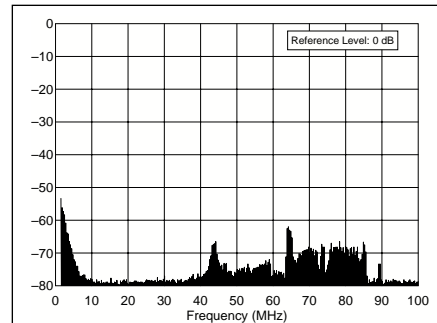


Figure 6—A spectral plot of the output of the Kenwood PS-40 under load. While there are some ranges where broadband noise is evident, the majority of these are outside of the US amateur bands.

the only supply in this group to include a separate connection point for chassis ground. A small recessed slide switch allows you to easily select between 110 and 220 V ac operation.

The cooling fan is mounted externally on the rear panel. It runs continuously when the power is on. The sound level of the fan is moderate to high—the loudest of the bunch. The supply remains cool even after 1/2 hour of continuous operation with a 21 A load.

Kenwood provides a 4-page *Instruction Manual* that includes sections on connection, operation, specifications and troubleshooting—including tips on reducing interference.

Manufacturer: Kenwood Communications Corp, 2201 E Dominguez St, Long Beach, CA 90801; 310-639-5300, fax 310-537-8235; <http://www.kenwood.net>. Manufacturer's suggested retail price: \$230. Typical current street price: \$225.

MFJ-4225MV

The MFJ-4225MV is shaped a bit like a cube—it's taller, narrower and shallower than most of the other supplies in this roundup. The front panel is busy—there are large backlit meters for current and voltage, a rocker type power switch, LED indicators for the power and fan and a cigarette-lighter type dc power jack. Five way binding posts for the dc output are provided on the front panel.

This supply is the only one in the group that offers an external control for the output voltage. The voltage is variable from



Table 5 MFJ-4225MV

Manufacturer's specifications

Power requirements: 85-135 V ac at 47-62 Hz or 170-260 V ac at 47-63 Hz (switch selectable).

Output voltage (variable): 9-15 V dc.
Output current (continuous): 22 A.
Size (hwd): 4.5×5.75×6 inches;
weight, 3.7 pounds.

Lab Measurements

Output voltage, no load: 14.4 V dc.
Output voltage, 21 A load: 14.14 V dc.
Low line drop out voltage: <85 V ac.
Dc variation during dynamic testing:
≈200 mV.

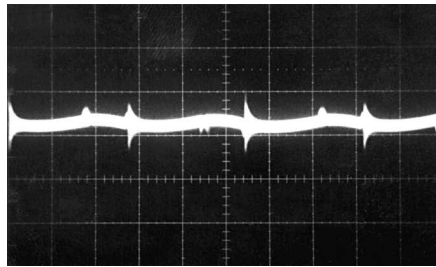


Figure 7—An oscilloscope trace of the dc output of the MFJ-4225MV under load. The vertical scale is 50 mV/div and the horizontal scale is 5 ms/div. The level of the dc ripple is low, <20 mV p-p. Spikes due to switching only measure about 70 mV p-p.

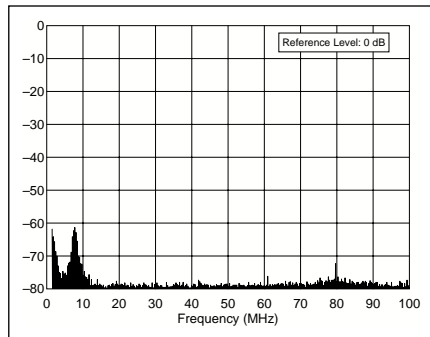


Figure 8—A spectral plot of the output of the MFJ-4225MV under load. Overall, the noise generated by this supply is very low, with the exception of the range of frequencies between about 7.5 and 10 MHz.

about 9 to 15 V dc—very handy for test bench applications.

The ac power cord is permanently attached to the cabinet. The back panel includes a recessed slide switch for easy selection of 110 or 220 V ac operation.

The cooling fan is mounted internally just inside the left panel of the cabinet. The fan is on continuously when power is supplied to the unit, but the fan speed (and the meter backlighting level) varies with the output voltage setting. The level of sound generated by the fan at the 13.8 V dc output setting is moderate.

The power supply is cool to the touch even after 1/2 hour of continuous operation connected to a 21 A load.

A 4-page *Instruction Manual* is provided and includes a table of specifications, installation and operating instructions and a detailed schematic.

Manufacturer: MFJ Enterprises, 300 Industrial Park Rd, Starkville, MS 39759; 800-647-1800; fax 662-323-6551; <http://www.mfjenterprises.com>. Manufacturer's suggested retail price: \$150. Typical current street price: \$140.

Samlex SEC 1223

The Samlex 1223 ties the Yaesu FP-1023 for "smallest enclosure" honors. A lighted

rocker style power switch is mounted on the front panel.

The power cord is removable. The dc connection points are large, color-coded 5-way binding posts. The supply can be eas-



Table 6 Samlex SEC 1223

Manufacturer's specifications

Power requirements: 100-130 V ac or 200-260 V ac at 50/60 Hz (jumper selectable).

Output voltage: 13.8 V dc.

Output current (continuous): 23 A.

Size (hwd): 2.2×7×8.25 inches;
weight, 3.5 pounds.

Lab Measurements

Output voltage, no load: 13.94 V dc.

Output voltage, 21 A load: 13.79 V dc.

Low line drop out voltage: 95 V ac.

Dc variation during dynamic testing:
≈200 mV.

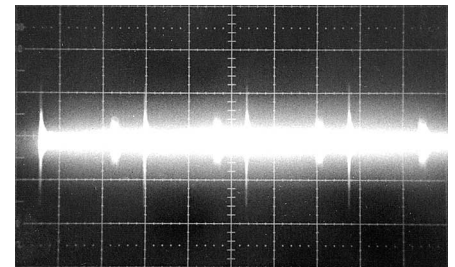


Figure 9—An oscilloscope trace of the dc output of the Samlex 1223 under load. The vertical scale is 200 mV/div and the horizontal scale is 10 ms/div. The level of the dc ripple is low, <30 mV p-p, but there are spikes due to switching that extend out to about 600 mV p-p.

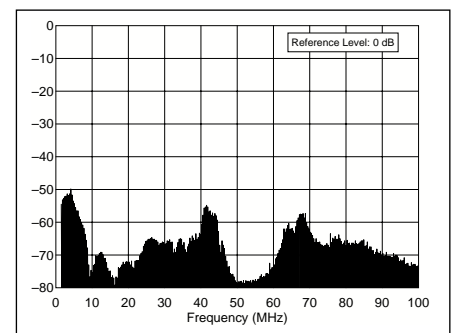


Figure 10—A spectral plot of the output of the Samlex 1223 under load. There are several ranges—including several within the US amateur bands, where the broadband noise is moderate.

ily converted for 220 V operation by removing an internal jumper.

The cooling fan is temperature controlled. It's mounted internally and forces air out through a grill on the bottom of the cabinet. Once activated, the sound level of the fan noise is moderate. The enclosure, particularly the front panel, warms up considerably after 1/2 hour of continuous operation powering a 21 A load.

A small 6-page *User Manual*, with installation and operating instructions, a specifications table, a troubleshooting guide and details on removing the jumper for 220 V ac operation, is included.

Manufacturer: Samlex America, 110-17 Fawcett Rd, Port Coquitlam BC, Canada V3K 6V2; 800-561-5885; fax 604-525-5221; <http://www.samlexamerica.com>. Manufacturer's suggested retail price: \$100. Typical current street price, \$100.

The Yaesu FP-1023

The Yaesu FP-1023 and the Samlex are very similar. The enclosure is small and seems well suited for portable operation where luggage space is at a premium. A lighted rocker style power switch is mounted on the front panel.

The power cord is removable. The dc connection points are large, color-coded 5-way binding posts. Conversion for 220 V ac operation is easy—simply remove an internal jumper.

The cooling fan is temperature controlled. It's mounted internally and forces air out through a grill on the bottom of the cabinet. Once activated, the sound level of the fan noise is moderate. The supply en-

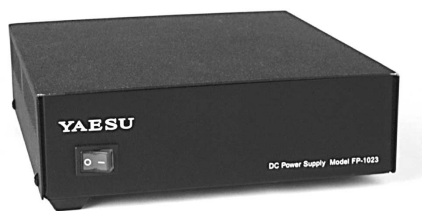


Table 7
Yaesu FP-1023

Manufacturer's specifications
Power requirements: 100-130 V ac or 200-260 V ac at 50/60 Hz (jumper selectable).
Output voltage: 13.8 V dc.
Output Current (continuous) 23 A.
Size (hwd): 2.2x7x8.25 inches;
weight, 3.5 pounds.

Lab Measurements

Output voltage, no load: 13.9 V dc.
Output voltage, 21 A load: 13.75 V dc.
Low line drop out voltage: 90 V ac.
Dc variation during dynamic testing:
≈200 mV.

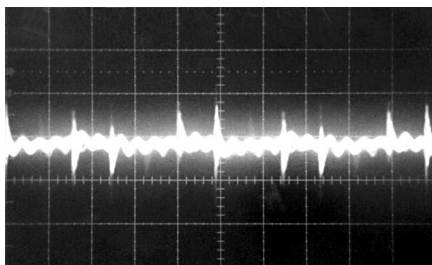


Figure 11—An oscilloscope trace of the dc output of the Yaesu FP-1023 under load. The vertical scale is 200 mV/div and the horizontal scale is 10 ms/div. The level of the dc ripple is low, <30 mV p-p, but there are spikes due to switching that extend out to about 600 mV p-p.

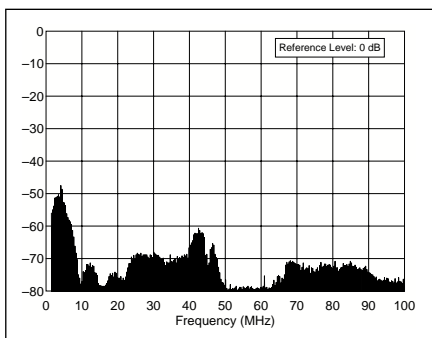


Figure 12—A spectral plot of the output of the Yaesu FP-1023 under load. There are several ranges—including several within the US amateur bands, where the broadband noise is moderate.

closure, especially the front panel, gets considerably warm after about 1/2 hour of continuous operation connected to a 21 A load.

A small 6-page *User Manual*, with installation and operating instructions, a specification table, a troubleshooting guide and details on removing the jumper for 220 V ac operation, is included.

Manufacturer: Yaesu USA, 17210 Edwards Rd, Cerritos, CA 90703; 562-404-2700, fax 562-404-1210 <http://www.yaesu.com>. Manufacturer's suggested retail price: \$169. Typical current street price, \$149.

Operational Impressions and Considerations

A quick glance through this collection of oscilloscope traces and spectral plots indicates—at least as far as the overall purity of the supplied dc power is concerned—that the clear choices here are the Astron SS-30M or the MFJ-4225. These exhibit admirable performance and deserve praise for their superior design. Before you pull out your credit card and dial up your favorite Amateur Radio products dealer, however, let's consider the actual implications of selecting one of the runners up.

On-the-air tests helped to shed some

light on a very important consideration: the level of the broadband RF noise that's generated by these supplies is proportional to the load. The oscilloscope traces and the spectral plots represent the characteristics of the supplied dc power at loads that simulate *transmit* conditions. Since, under the majority of operating conditions, transmission and reception will not be occurring simultaneously, the levels of RF noise experienced during receive—when the load is typically only about 5% that of transmit—are considerably smaller.

This was verified in the field testing. Each of the six power supplies was substituted for the existing conventional dc supplies in three typical HF station configurations. Five of the six supplies tested did not generate any perceivable interference in the station receivers—even when these were tuned to the frequencies outside of the ham bands where the spectral plots indicated elevated levels of RF noise. This is certainly good news for 160-meter operators and those who enjoy exploring the shortwave bands occasionally!

"How does this one sound?"-type transmit quality testing using SSB, FM and CW also revealed no noticeable difference in the quality of the transmitted signals when powering the transceivers using either the conventional or the switching supplies.

The only supply that resulted in any interference in typical transceive operation was the ICOM PS-85. This supply generated a series of spurious signals about 85 kHz apart that slowly drifted across the entire 10-meter band in one receiver, and even affected reception on some of the lower bands on the others. Ferrite material installed on the ac and dc power cords did not seem to reduce the interference. Hopefully ICOM has been able to address these problems in their recently released updated version.

There are a few instances where the level of broadband RF noise generated by a supply under load could create interference problems. Multi-radio operations where several transceivers are set up in close proximity, contest stations where a second receiver is sharing the same supply with a transceiver or "mode A" full-duplex satellite operation are some examples.

For the majority of the casual fixed station and portable operators, nearly any of the currently available switching power supplies should provide acceptable performance. Carefully consider your operating requirements and "weigh" your options.

We would like to thank Rudy Severns, N6LF, for his help in preparing this review. Rudy provided the majority of the laboratory measurement data that appears in the tables and figures.

