

PRODUCT REVIEW

Monarchy Audio SM-70 and SE-100 Delux Power Amplifiers

Reviewed by Gary Galo

Monarchy Audio SM-70 and SE-100 Delux Power Amplifiers. Monarchy Audio, 380 Swift Ave., #21, South San Francisco, CA 94080, 650-873-3055, FAX: 650-588-0335, monarchy@earthlink.net, www.monarchyaudio.com. SM-70: \$719 ea., SE-100 Delux: \$1179.

Monarchy Audio is best known for its excellent D/A converters (AE 2/99) and cost-effective DIP clock-jitter suppressors (TAA 4/94 and 3/95). The SM-70 and SE-100 are Monarchy's first entries into the crowded field of audio power amplifiers. The SM-70 is billed as a "zero feedback" amplifier, and the SE-100 is described as being "single-ended." Both descriptions require a bit of clarification.

SM-70 Circuitry

The SM-70 is a low-power stereo amplifier rated at 25W RMS per channel, or 75W bridged as a monoblock. The amp is a hybrid IC op-amp/discrete MOSFET design. Each channel of the stereo amplifier uses half of a Burr-Brown OPA2604 dual FET-input, low-distortion op amp to provide the voltage gain. The op amp is operated in the noninverting mode using the conventional feedback technique.

The OPA2604, a dual version of the OPA604, is one of the finest dual op amps available. The excellent performance of the OPA2604 has already been demonstrated in the Monarchy Model 22C and 33 D/A converters. The OPA2604 is a FET-input device designed specifically for high-performance audio applications.

The Burr-Brown data sheet notes, "New circuit techniques and special laser trimming of dynamic circuit performance yield very low harmonic distortion. The result is an op amp with exceptional sound quality." Burr-Brown claims THD + noise of 0.0003% at 1kHz when you operate the device at unity gain. At the voltage gain Monarchy chose, the THD + noise should be less than 0.03% at 20kHz and less than 0.005% below 1kHz.



PHOTO 1: Front views of the Monarchy SE-100 Delux and SM-70 power amps.

Output

Other critical specifications for the OPA2604 include a slew rate of 25V/ μ S, a gain-bandwidth product of 20MHz, and a noise figure of 10nV/Hz, which is quite low for a FET-input device. The OPA2604 will operate over an unusually wide supply range, ± 4.5 to ± 24 V. This makes the OPA2604 an excellent choice for a power-amp gain stage, due to the increased output voltage swing the high maximum rail voltages make possible (most op amps have an absolute maximum supply rating of ± 18 V).

Although the OPA2604 has low enough DC offset to allow DC coupling of both the input and the output, Monarchy has taken steps to ensure that external factors do not drive the amplifier's output offset to unsafe levels. The input

is capacitor-coupled with a parallel polypropylene pair—0.1 μ F bypassed by 6N8. There is also a 470 μ F electrolytic capacitor in series with 1k resistor in the feedback loop, keeping the op amp's DC gain at unity.

The op amp's output is polypropylene capacitor-coupled to a discrete pair of complementary MOSFET output transistors operated as source-followers. The devices in this design are the 2SK1058 P-channel and the 2SJ162 N-channel transistors, biased for pure Class-A operation, and mounted on a substantial heatsink. Monarchy's claim of "zero-feedback" refers to the fact that MOSFET output stage is an open-loop configuration.

Although the op amp is configured in a conventional, noninverting feedback arrangement, there is no global feedback



PHOTO 2: Rear views of the amplifiers. The SE-100 Delux is a monoblock. You can configure the SM-70 as a stereo amp or bridged monoblock.

from the output stage back to the input. As a result, the output stages of each amplifier are hand-trimmed at the factory for minimal DC offset.

The SM-70 power supply consists of a 140VA toroidal transformer and 20,000 μ F capacitors across the \pm 30V rails. These raw DC rails are regulated to \pm 24V by way of a pair of LM317/337 three-terminal adjustable IC regulators, which provide power to the op amp. A trimpot on the PC board is provided for adjustment of the regulated voltage. Regulating the voltage gain stage of a power amplifier is an excellent design approach, since this is where the integrity of the DC supply rails is most critical.

Although the SM-70 is a stereo amplifier, it is really designed to be used as a fully balanced amplifier in the bridged mono mode. In addition to the stereo RCA inputs, there is a single XLR connector on the rear panel. If the amp is driven from a balanced source (such as the Monarchy D/A converters via their built-in, balanced-out line stages), the XLR connector routes the positive and negative legs to the left- and right-channel inputs. The loudspeaker is then connected across the positive loudspeaker terminals.

A switch on the rear panel also allows mono operation from unbalanced sources. In this case, the mono source is connected to the left-channel RCA input jack. The switch routes the output of the left op amp through a 33k resistor to the inverting input of the right-channel op amp. Since the feedback resistor of the op amp is 33k, the right-channel op amp now operates at unity gain—all voltage gain is provided by the left op amp.

SE-100 Delux Circuitry

The SE-100 Delux is a monoblock rated at 100W into 8 Ω and 200W into 4 Ω . It's a completely discrete design—no op amps are used in this amplifier. Monarchy describes this amp as "single-ended," but this description refers to the differential input and driver stages. The amplifier's output stage is a pure Class-A complementary MOSFET design.

The SE-100 uses the same 2SK1058/2SJ162 complementary pair as the SM-70, but a total of four P-channel and four N-channel devices are used in each mono amplifier. The output stage is conservative—the eight matched power MOSFETs are rated at 150W each, for a total power dissipation of 1200W. This, combined with the robust heatsinking, should ensure long amplifier life. Only the output stage is MOSFET—the rest of

the circuitry uses bipolar transistors. Monarchy claims that all transistors are "mil spec."

The amplifier's differential input features a current mirror load, providing extremely high gain for this stage. The differential input allows the amplifier to be fed by either balanced or unbalanced sources. Unbalanced sources are connected to the noninverting input of the differential pair via an RCA connector.

The XLR connector feeds the positive and negative legs of balanced sources to the noninverting and inverting inputs of the differential pair. A differential amplifier with a current mirror load will perform best if the next stage is a high-impedance load. Monarchy has achieved this by making the driver a cascode.

The SE-100 Delux is DC-coupled from input to output—an electrolytic capacitor in the feedback loop ensures that the amplifier operates unity gain at DC. A 450VA toroidal power transformer and a total of 60,000 μ F of filter capacitance supplies the \pm 50V raw supply rails. Like the SM-70, the supply rails to the input and driver stages are regulated with LM317/337 IC regulators.

Construction

Both amplifiers are superbly constructed on black-anodized, all-aluminum chassis. The heatsinks are 3/8" aluminum extrusion, bolted to the chassis with thermal compound. The front panels are also anodized aluminum, 3/4" thick on the SE-100 Delux and 1/2" thick on the SM-70. The chassis, heatsinking, and power transformers combine to produce a pair of hefty, yet surprisingly compact, amplifiers. The SM-70 weighs in at 22 lbs, and the SE-100 Delux is only slightly heavier at 26 lbs.

Like the Monarchy D/A converters, the passive parts are high quality, but not exotic—metal film resistors, polypropylene capacitors where larger values are needed, and silver micas for smaller values. RCA input jacks are Teflon-insulated, gold-plated types, and the five-way speaker binding posts also feature gold-plated contacts.

Monarchy also makes a lower-current version of the SE-100, called the SE-100 Basic. The Basic version has the same circuitry as the Delux—only the power supply and heatsinking are less robust, so the amp will supply only 160W to 4 Ω loads (the SE-100 Basic is the same size physically as the SM-70). I did not evaluate the Basic version for this review.

Since both amps have pure Class-A output stages, they run very warm. The

SM-70s run even hotter than the SE-100 Delux. Adequate ventilation is a must!

Measurements

My SM-70 samples blew the AC supply fuse after a couple of turn-on cycles. As it turns out, the 2A value originally supplied is a bit too low. If you turn the amp on at the point where the AC line is at a peak, the currents charging the power-supply capacitors can blow the fuse. Increasing the AC fuse to 2.5A solved the problem.

When I first checked the power output on the SM-70 amplifiers, they failed to deliver the claimed power output. I investigated the source of the problem and found that it wasn't an output stage limitation—the OPA2604 op amp was clipping. The regulated DC rail voltages, which are adjustable, determine the maximum output from the op amp. There is a limit to how high you can set the rails, for two reasons: First, the OPA2604 op amps have an absolute maximum rating of \pm 24V DC; second the unregulated DC voltage should be 3 to 4V higher than the regulator outputs to ensure low regulator dropout voltage.

As supplied, the SM-70 regulated rails were set to \pm 24V. Since the raw supply rails are \pm 26V, the regulators are perilously close to dropout. Running the amps with a Variac®, I found that the regulators dropped out at a line voltage of about 112V AC. I reset the regulator voltages to \pm 22V, so they now drop out at a line voltage of 102V AC, which I consider acceptable. At these regulated rail voltages, with an 8 Ω load, both samples measured 17.5W RMS per channel in the stereo mode, and 55W in the bridged mono mode.

I raised these issues with Mr. C.C. Poon of Monarchy International, who agreed with my findings. He promptly sent me a second pair of SM-70 amplifiers with new power transformers, which yield unregulated rail voltages of \pm 30V. With the regulated voltages set to \pm 23.5V, the new samples clip at 20W RMS per channel stereo and 60W bridged mono into 8 Ω . I prefer not to push any op amp to its absolute maximum rating, so I believe \pm 23.5V is a safe maximum regulated voltage.

I wouldn't become too excited about the power output being below Monarchy's claim. The difference between the manufacturer's rating and the actual output before clipping is a mere 1.5dB for the first samples and 0.96dB for the second pair. These differences are simply not worth worrying about.

Ratings

Monarchy does not specify power into 4Ω loads for the SM-70; my measurements are shown in *Table 1*. The SE-100 Delux amplifiers are rated at 100W into 8Ω and 200W into 4Ω. My samples clipped at 105W into 8Ω, but didn't quite make the manufacturer's 4Ω rating—clipping occurred at 182W into 4Ω. This is only 0.4dB lower than the manufacturer's rating of 200W, again insignificant.

Monarchy notes that these amplifiers will make their rated outputs at 20kHz. I verified clipping at 1kHz and 20kHz to be the same, which is quite impressive. Many amplifiers do not come close to making full output at 20kHz.

Distortion

Other than power output, Monarchy offers little else in the way of specifications, but I did conduct basic THD measurements. Using my Sound Technology 1700B analyzer, I had considerable difficulty arriving at a satisfactory grounding scheme for my measurements. These amplifiers seem fussier than most in this regard. I also found that they both generated a low-level hum through the loudspeakers even with no input connected. Lifting the ground pin on the power cords eliminated the hum, which is how I used them in listening.

Table 1 shows total harmonic distortion measurements. Monarchy claims that distortion for the “zero-feedback” SM-70 is less than 0.01%, but none of my measurements were this low. Nonetheless, I consider the THD for the SM-70 to be still quite low for an amplifier without global feedback.

In stereo mode, the SM-70 distortion products were primarily second harmonic at 1W, with the addition of some third harmonic components at 10W. As bridged monoblocks, second- and third-harmonic components were present at both 1W and 10W output. The feedback-based SE-100 Delux distortion measurements were dominated by noise at 1W, with some second harmonic present at 10W.

The SE-100 is designed for wide bandwidth. My samples were -1.0dB at 100kHz and -0.5dB at 10Hz. The SM-70 bandwidth is narrower. My samples were -3.0dB at 70kHz and 13.5Hz. Early samples of the SM-70 have wider high-frequency response, but Monarchy added 300pF caps across the input RCA jacks in the current production. Monarchy notes that some samples of the OPA2604 are sensitive to RFI, hence the intentional bandwidth limiting at the input.

TABLE 1: MEASURED PERFORMANCE

POWER OUTPUT

SM-70 Sample 1 (SN 06849) & Sample 2 (SN 06850):

| | | |
|--|----------|--------|
| (Unregulated rails ±26V; regulators set to ±22.5V) | | |
| L (A): | 17.5W/8Ω | 25W/4Ω |
| R (B): | 17.5W/8Ω | 25W/4Ω |
| Bridged mono: | 55W/8Ω | 60W/4Ω |

SM-70 Sample 3 (SN 06871) & Sample 4 (SN 06872):

| | | |
|--|--------|--------|
| (Unregulated rails ±30V; regulators set to ±23.5V) | | |
| L (A): | 20W/8Ω | 30W/4Ω |
| R (B): | 20W/8Ω | 30W/4Ω |
| Bridged mono: | 60W/8Ω | 70W/4Ω |

SE-100 Delux Sample 1 (SN 06878):

| | |
|---------|---------|
| 105W/8Ω | 182W/4Ω |
|---------|---------|

SE-100 Delux Sample 2 (SN 06879):

| | |
|---------|---------|
| 105W/8Ω | 182W/4Ω |
|---------|---------|

Note: All samples output full-measured power at both 1kHz and 20kHz.

TOTAL HARMONIC DISTORTION—8Ω LOAD

| | SM-70 #1 Left—1W | SM-70 #1 Right—1W | SM-70 #2 Left—1W | SM-70 #2 Right—1W | SM-70 Mono—1W | SM-70 #2 Mono—1W |
|-------|---------------------|----------------------|---------------------|----------------------|------------------|---------------------|
| 20Hz | 0.11% | 0.11% | 0.12% | 0.12% | 0.1% | 0.12% |
| 1kHz | 0.072% | 0.082% | 0.08% | 0.085% | 0.027% | 0.03% |
| 10kHz | 0.067% | 0.076% | 0.075% | 0.078% | 0.028% | 0.03% |
| 20kHz | 0.06% | 0.064% | 0.069% | 0.071% | 0.0265% | 0.028% |

| | SM-70 #1 Left—10W | SM-70 #1 Right—10W | SM-70 #2 Left—10W | SM-70 #2 Right—10W | SM-70 #1 Mono—10W | SM-70 #2 Mono—10W |
|-------|----------------------|-----------------------|----------------------|-----------------------|----------------------|----------------------|
| 20Hz | 0.25% | 0.27% | 0.3% | 0.3% | 0.25% | 0.25% |
| 1kHz | 0.46% | 0.48% | 0.55% | 0.55% | 0.46% | 0.52% |
| 10kHz | 0.42% | 0.45% | 0.5% | 0.51% | 0.43% | 0.49% |
| 20kHz | 0.37% | 0.39% | 0.45% | 0.45% | 0.38% | 0.42% |

| | SE-100 #1 1W | SE-100 #1 10W | SE-100 #2 1W | SE-100 #2 10W |
|-------|-----------------|------------------|-----------------|------------------|
| 20Hz | 0.0054% | 0.0038% | 0.0052% | 0.003% |
| 1kHz | 0.0038% | 0.0038% | 0.0041% | 0.003% |
| 10kHz | 0.006% | 0.011% | 0.008% | 0.009% |
| 20kHz | 0.0086% | 0.022% | 0.0052% | 0.016% |

In stereo mode the SM-70 voltage gain measured 30.8, or 29dB. As bridge monoblocks, the voltage gain nearly doubles, measuring 57.5, or 35dB. The SE-100's voltage gain is lower, measuring 23, or 27dB. I wish the SM-70 gain was lower. During my SM-70 listening evaluations, I was constantly running my preamp volume control down around 9:00. I find the factory gain setting of the SE-100 to be more sensible.

Jumper Addition

If you use the SE-100 Delux with an unbalanced input, the output DC offset may be higher than desirable. One of my samples measured over 100mV, which is caused by unequal source impedances across the noninverting and inverting inputs. Theoretically, the lowest offset will

be achieved if a fixed resistor, equal to the preamp's output impedance, is connected across the inverting input (i.e., across pins 1 and 3 of the XLR connector). In most cases, however, a short across the inverting input will suffice.

The source impedance of my preamp is 100W. I installed a jumper from pins 1 and 3 of an XLR connector, which brought the output offset to less than 20mV in each amp.

The SE-100 has a 3k9 resistor in series with the inverting input. Adding the jumper puts this resistance in parallel with the resistance to ground in the feedback loop, increasing the amplifier gain by 1dB. The SE-100 produces a hefty, but benign, turn-on thump—the output offset settles extremely quickly after turn-on, however. The SM-70 turn-on is silent.

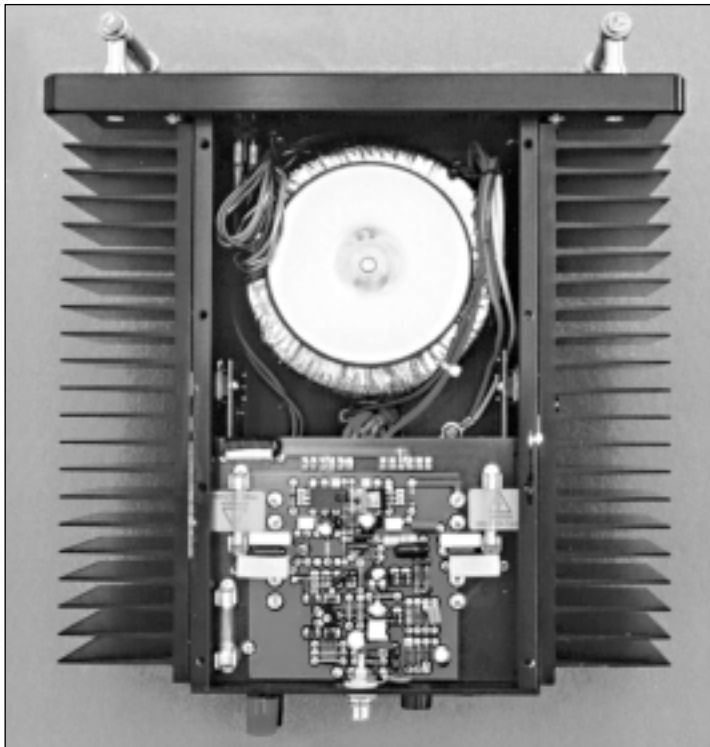


PHOTO 3: Inside the SE-100 Delux. All amplification circuitry is discrete, with single-ended front end and gain stages.



PHOTO 4: Inside the SM-70. Gain is provided by a dual op amp using the conventional feedback technique. The output stage is operated in a zero-feedback, open-loop configuration.

Sonic Performance

I evaluated the SE-100 and SM-70 amps with my ACI Sapphire III/Sub I loudspeaker system using my custom-built, all-polypropylene passive crossover as the high-pass filter for the Sapphire III satellites. The SM-70 amps were configured as bridged monoblocks. Since these amplifiers are rather different designs, it's not surprising that they don't sound identical. Nonetheless, they do have much in common, so I'll describe them together, noting differences where they exist.

The new Monarchy amplifiers are among the very best I've auditioned. Audiophiles who have used a conventional stereo power amplifier are in for a big surprise when they convert to a pair of monoblocks. These amplifiers deliver the best soundstaging I've yet heard from my system—wider, deeper, and with more precise localization than before. The SE-100 Delux is the winner in this regard, but the SM-70 is not far behind.

The SM-70 is one of the punchiest amplifiers I've heard. Dynamics and bass performance belie the modest power output of these little amplifiers. In this regard, the SM-70s remind me of my old Nelson Pass A40 Class-A power amp (TAA 4/78). Monarchy claims that the absence of global feedback gives the SM-70 a sense of unrestrained dynamics, and I don't disagree with this.

But, my previous experiences with the much older Pass A40 also led me to conclude that the robust power supplies required to run a pure Class-A amplifier were extremely beneficial to dynamics and bass. The SE-100 is certainly equal to the SM-70 in dynamic performance, but I didn't find it superior, despite the higher power output. If anything, the SM-70 is marginally superior to the SE-100 in low-frequency weight and impact, but the difference is quite small.

Many audiophiles and designers complain that MOSFET output stages are inferior to bipolar in low-frequency performance, and I admit that I have generally held this view. My previous reference amplifiers, the all-bipolar Adcom GFA-585s, are exceptional in their low-frequency reproduction. When called upon, these amps deliver unusually powerful and clean bass.

When I first switched to the Monarchy amps I noticed a slight decrease in low-frequency heft. But, after living with these amps for a time, I became accustomed to the character of the low end, to the point where I no longer miss the Adcom amps.

Comparison

Both amps are exceptionally detailed and articulate. Monarchy products are famous for individual detailing of instruments within complex scoring, and

these amplifiers follow that tradition. The SM-70 and SE-100 Delux are among the smoothest- and cleanest-sounding amps I've heard, without a trace of midrange grunge or treble hardness.

The reproduction of air and space on recordings, whether analog or digital, is superb, aided by a sense of effortlessness in the treble region. The critical mid-range reproduction is exceptional, with voices and individual instrumental timbres reproduced with uncanny naturalness and transparency. These are among the most musically satisfying amps you are likely to find anywhere.

The tonal characters of these amps are not identical. The SM-70 produces a rich harmonic palate, similar to a really fine tube amplifier. This is not surprising, since the lack of global feedback results in a rather large quantity of low-order harmonic distortion.

Yet, the SM-70 combines this quality with the superior detail and resolution which the best solid-state amps can provide. The SE-100 Delux is more harmonically neutral, and is slightly softer in the treble region. Personal taste may partly determine your choice of amplifiers. Those desiring the greatest harmonic accuracy will prefer the SE-100 Delux, while listeners in search of a bit of euphonic coloration may find the SM-70 more to their liking.

Most of my evaluations of these ampli-

fiers were with my own unbalanced pre-amp, an extensively modified Adcom GFP-565 equipped with Walt Jung's AD744/AD811 line stage and Jung/Didden power-supply regulators. I also evaluated both amplifiers using Monarchy's Model 22C D/A converter with built-in line stage. Readers will recall, from my review in 2/99, that the line stages in Monarchy's Model 33 and 22C D/A converters have both balanced and unbalanced outputs.

I compared the performance of these amplifiers with both the balanced and unbalanced connections, using DH Lab's BL-1 interconnect cables fitted with Canare F-10 RCA connectors and Neutrik XLR connectors with gold-plated pins. With the SE-100 Delux, the difference between a balanced and an unbalanced input connection is negligible. This is not surprising, since the front end of the amplifier is single-ended.

With the SM-70s configured as monoblocks, the difference was dramatic. As fine as the SM-70s are with unbalanced inputs, they really shine when used with balanced sources, taking on a new level of transparency. The famous Monarchy detailing and delineation of individual instruments is improved even further.

Summary

Until now, my reference loudspeakers have been passively biamped using a pair of Adcom GFA-585 amplifiers (the passive biamp arrangement was described in *Speaker Builder* 3/92). Although I have evaluated a number of other power amps with these loudspeakers, with my outboard all-polypropylene high-pass filters, I have always returned to the Adcom amps in the passive biamp arrangement.

No more. The SE-100 Delux amps have found a permanent home in my system. I have purchased the review samples, which are now my reference amplifiers.

Monarchy's SM-70 and SE-100 Delux amplifiers are refined audiophile products, which should compete favorably with all but the most expensive amplifiers currently available. At Monarchy's factory-direct prices, these amps are a real bargain.

Manufacturer's Comments:

As always, Gary Galo's comments are most fair and accurate. However, there are a number of points we wish to address. The samples were submitted to Gary over a year ago.

We have since (the beginning of 2000) been shipping products with a much larger toroid transformer in both models. This allows both

models to meet our published specs: i.e., 25W × 2 for the SM-70, on 8Ω loads; 200W on 4Ω load with the SE-100 Delux. These newer versions are identified by a laser engraved front panel. All panels are now 3/4" thick.

A turn-on delay circuitry and an output relay have been added to the SE-100 Delux. The circuitry also senses the DC components at the speaker terminals and automatically cuts off the output if over 1V of DC is detected. The turn-on thump no longer exists.

The SE-100 Delux won the "Best Buy of the Year" award from the Hong Kong audio journal, *Hi Fi Review*. This year, the SM-70 was favorably compared to the Pass Labs' X-1000, which retails for 30 times(!) the SM-70's price. A translation can be found at our Website: <http://www.monarchyaudio.com>

Beginning in July of this year, we will have an upgrade version of the SM-70, called SM-70 PRO. In bridged mode, the PRO version puts out 80W on 8Ω, and 120W on 4Ω. The PRO version has the same dimensions as our SE-100 Delux, and retails for \$980. The production of the original version continues. The PRO version features a double-up of almost everything, such as double drivers, double output MOSFETS, and double bridge rectifiers.

Perhaps Gary Galo could have explored the SM-70 as a "True Balanced" power amp, when used with an XLR input. There are very few commercially available power amps with "True Balanced" signal handling—most so-called balanced inputs, including our SE-100 Delux, route the balanced signals into just one single amp for amplification. The SM-70 (as well as the PRO version) devotes one amp for each of the positive and negative signals.

Then the amplified signals are summed at the outputs. This allows the signal to swing much wider (4 times) than is possible with a single amp in balanced mode. The perceived power output is significantly higher than its modest power rating would indicate. All this is achieved with zero feedback! Users should take special care with the speaker connections, though; the speaker wires should go the "Positive Node" of each output. The ground terminals at the output are left open.

For users who experience hum problems, a simple solution is to use a "cheater plug," available from most hardware stores. The safety issue will not be compromised. ■

C.C. Poon
President
Monarchy Audio