

S-5 Electronics K-12M

Reviewed by Charles Hansen and Duncan and Nancy MacArthur

S-5 Electronics, 1625 Twin Acres, Chandler, AZ 85249, 480-895-2521, FAX 480-895-4164. Kit price \$140 or \$170 assembled/ tested; plus \$10 shipping. Dimensions: 9.5"W x 4.5"H x 7"D. Warranty 90 days.

The S-5 Electronics K-12M is a push-pull stereo power amplifier rated for 8W per channel. The review unit came fully assembled, but I did receive the three-page kit assembly instructions along with the one-page operating instructions. The assembly instructions were brief but thorough, and presume that you have had prior kit-building experience and understand electronic components.

CONSTRUCTION

The amplifier doesn't come with an enclosure. A 7" x 10.5" pine board is furnished, along with a mounting/drilling template. The finished "breadboard" is shown in

Photo 1. The PC board and transformers are mounted to the board with screws.

The front of the unit has two gold-plated phono jacks and a stereo volume control, both attached to the PC board. Two pairs of gold-plated speaker binding posts are located on the PC board just in front of the output transformers. These binding posts are spaced 3/4" apart, so you can use dual banana plugs.

The unit is furnished with a two-prong power cord, with a table-lamp-style in-line switch and an in-line fuse holder. One of the power-cord connections to the power transformer primary is made with a small wire nut. For safety's sake, I would pursue a metal enclosure for this amplifier. The tubes run very hot, and high voltages are present on the PC board.

The PC board is a very nice silkscreened double-sided glass epoxy board with a solder mask. It mounts to the pine board on four

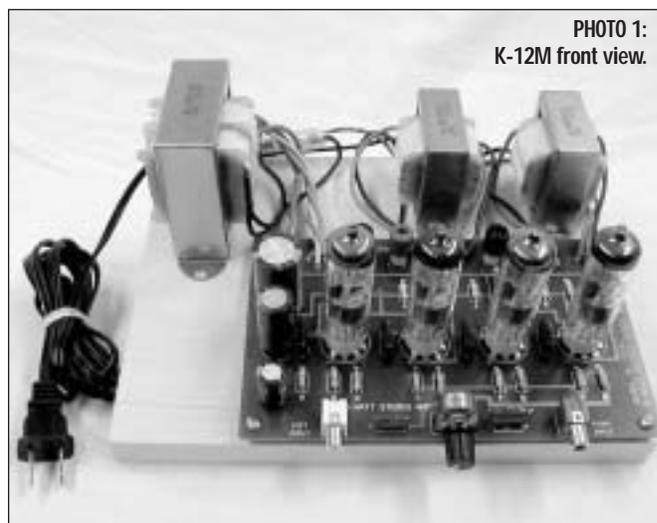


PHOTO 1:
K-12M front view.

6mm nylon spacers and the aforementioned screws. Ceramic tube sockets hold the four tubes.

TUBE-POLOGY

A schematic was supplied with both the operating and the assembly instructions. Two 11MS8 triode-pentode vertical deflection

amplifier tubes are used in each channel. The input signals are capacitively coupled to the 100k stereo pot.

The pot wiper connects to the grid of one of the triode sections used as a cascade amplifier. This triode drives the grid of the second triode, configured as a split-

load phase inverter. This stage is capacitively coupled to the two push-pull pentode sections. Feedback is taken from the 8Ω secondary of the output transformer (the only tap available) to the cathode of the input triode.

All the coupling caps are metallized polyester, and Samsung aluminum caps are used to filter the full-wave solid-state power supply. Resistors are carbon film and metal oxide types. The volume control is a dual 5/8" nondescript carbon pot. The three transformers are marked with a "UTK" logo.

S-5 Electronics supplied four 11MS8 "Made in Japan" tubes with this K-12M, packed as pairs in cardboard tubes. The 11.6V heaters are supplied from the "12V" AC winding of the power transformer. I measured an actual 11.5V AC at the heaters.

MEASUREMENTS

I operated the K-12M at 1W 1kHz into 8Ω for one hour to burn in the unit before measurements. The test data is summarized in Table 1. There was only a very low level of hum with my ear against the speaker, and no noise during power-up or shutdown.

Initially, the distortion (THD+N) in each channel measured 1.5%, but increased to 5% left and 2.9% right after the hour. I swapped tubes around to try to achieve a lower THD and settled on the "best" arrangement, which produced 1.6% left and 2.5% right after an additional hour of run-in.

The K-12M does not invert polarity. Input impedance at 1kHz was 81k left and 88k right, so this nominal 100k pot is on the low side. Volume control tracking was within 1dB from 10 o'clock to 3 o'clock, where it improved to less than 0.5dB up to full volume.

The full-volume gain at 2.83V RMS output into 4Ω and 8Ω loads was 25dB and 28dB, respectively. The output impedance was quite high: 6.6Ω at 1kHz and 5.5Ω at both 20Hz and 20kHz.

The frequency response for the K-12M was within -3dB from 14Hz to 58kHz, at an output of 1W at 1kHz into 8Ω. I measured -1dB at 20Hz and -2.8dB at 20kHz. This data, along with the response for 2W into 4Ω, and 8Ω paralleled

with 2μF, is shown in Fig. 1. The dashed line in the figure represents the response to an IHF speaker load, which has an impedance peak at 50Hz. This amplifier will be extremely sensitive to any variations in speaker impedance with frequency, and will color the sound accordingly.

Hum and noise (maximum volume, input shorted) measured 0.6mV left and 0.2mV right. Viewing the noise content on an osci-

loscope showed a 60Hz waveform with some noise, and obvious spikes near each power line zero-crossing, presumably due to rectification.

Crosstalk was noticeably higher L to R than R to L, as you can see in Table 2. The 100Hz levels are dominated by noise, while the fundamental test signal was predominant at 1kHz and higher due to capacitive coupling.

Figure 2 shows THD+N versus

output power for various loads and frequencies. Notice the vertical THD scale, which is an order of magnitude higher than I usually require. I engaged the test set 80kHz low-pass filter to limit the out-of-band noise.

The right channel distortion (the two dashed curves) was significantly higher than the left channel. I was only able to obtain the rated 8W power at 1kHz with a 4Ω load, this at 28% distortion. The

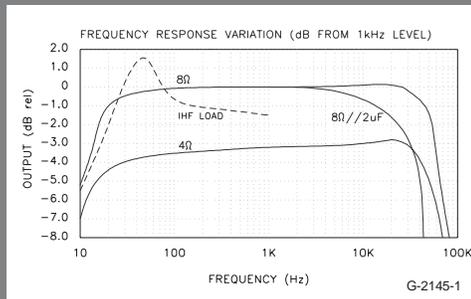


FIGURE 1: Frequency response.

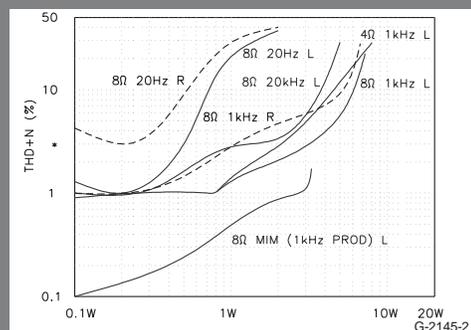


FIGURE 2: THD+N versus output power.

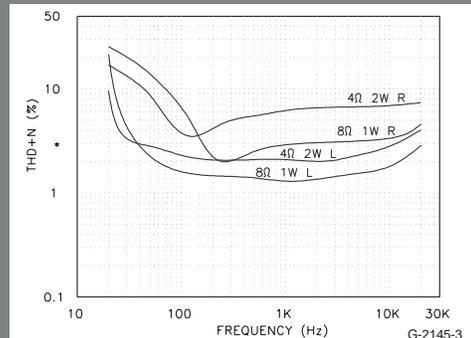


FIGURE 3: THD+N versus frequency.

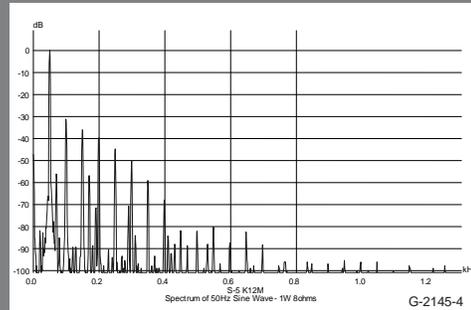


FIGURE 4: Spectrum of 50Hz sine wave.

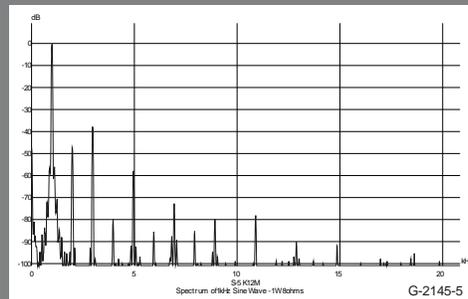


FIGURE 5: Spectrum of 1kHz sine wave.

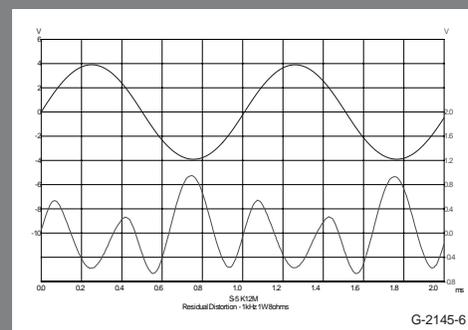


FIGURE 6: Residual distortion, 1kHz 1W 8Ω.

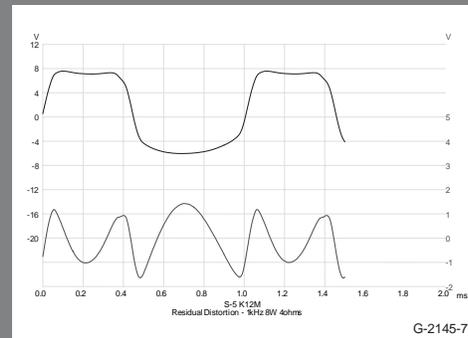


FIGURE 7: Residual distortion, 1kHz 8W 4Ω.

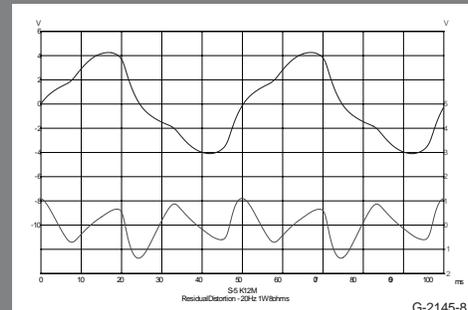


FIGURE 8: Residual distortion, 20Hz 1W 8Ω.

CRITIQUE

Reviewed by Duncan and Nancy MacArthur

What can you get for \$140 nowadays? If you're willing to play by the rules as defined by this integrated amplifier, the answer is quite a bit. The K-12M produces a smooth, musical sound that rarely offends. When coupled with appropriate components, it is a joy to hear. We have not heard a better-sounding amplifier in this price range.

GUIDELINES

Unfortunately, during the listening process we discovered a significant problem with this amplifier's construction. After about 75 hours of operation at moderate levels, all four of the tube sockets were scorched and slightly melted. We discussed this problem with Larry Stafford at S-5. He mentioned that this socket problem is not limited to our sample and that S-5 is investigating ceramic sockets. We would not recommend the K-12M amplifier unless these sockets are replaced. Once the sockets are replaced, we'd suggest the following guidelines for enjoying the K-12M amplifier:

1. The K-12M needs efficient speakers. Eight watts are only 8W. When paired with 91dB/W speakers, the K-12M played loudly enough to make conversation impossible in a small room but not loudly enough to move objects or hurt eardrums. When we switched to Genesis 400 speakers with an efficiency (on a good day) of 89dB/W, the K-12M amplifier played beautifully at lower levels. At higher levels the highs became hard and the midrange congested. Playing the K-12M loudly through our less-efficient speakers made our ears suffer (and not just from the volume).

2. Don't expect ultimate bass extension and dynamics. Although the K-12M's midrange was excellent and its highs extended, its deep bass, while present, was notably weak. We didn't notice this lack on many types of music (vocals, strings, piano, and so on). But the slam was missing from the bass drums, and the fundamentals were gone from the low organ notes, on any music that included these instruments.

3. The K-12M is not a complete amplifier. A kit including electrical parts and PCB is available for \$140, and

an "assembled" version costs \$170; however, neither version could be used in any but the most monastic environment without adding an enclosure, knobs, and connectors. This flaw isn't fatal in this price range, and the manufacturer prominently mentions the need for building an enclosure in the instructions. On the other hand, you should be aware that \$140 (or \$170) probably won't be the final price.

In fairness, the K-12M, as supplied, is a completely operational amplifier using only the parts included in the kit. As I write this, I am listening to a K-12M with the sole addition of an overturned milk crate to keep pets and children at bay. Although this combination sounds excellent playing Beethoven (Robert Silverman, pianist, *Ludwig Van Beethoven's Complete Piano Sonatas*, Stereophile KSP 830), its looks and long-term safety are not appropriate in a household with children, animals, or even other (non-fanatic) adults. The K-12M kit offers the opportunity to audition the sound before you spend more money on cosmetic and safety requirements.

Spousal note: Let me add another perspective on this issue: the K-12M as it stands is a circuit board and transformers on a raw pine board. Its appearance is unlikely to find favor with even an extremely tolerant spouse. To maintain domestic harmony, plan on building an enclosure. (S-5 has a good-looking example on their website at s5electronics.com.) Your loved ones will thank you.—NM

VOLUME MATTERS

Our sample of the K-12M arrived with a damaged volume control, which extends beyond both the PCB and the breadboard. According to S-5, this type of damage isn't uncommon. Replacing the pot isn't difficult given a little soldering skill, but in our case the pot had failed open—resulting in a full-power buzz through the offending channel. At this point we were glad that the K-12M only produced 8W per channel. Once we replaced the pot, we had no operational problems with the K-12M. (The melting tube sockets we mentioned earlier caused no operational problems, but left us wondering

about the longevity of the amplifier.)

The volume pot on the K-12M appears to have a linear taper rather than the more common logarithmic taper. The linear taper makes the channel-to-channel tracking better but caused most of our listening to take place below "9 o'clock" on the pot. Using this type of pot probably represents a reasonable compromise in an inexpensive amplifier.

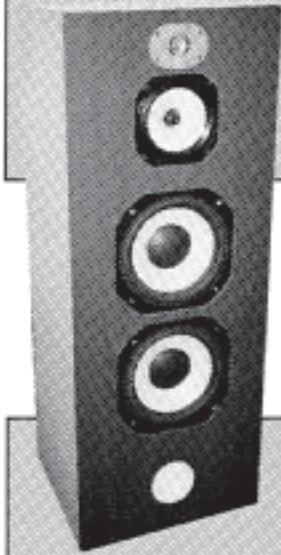
The lack of a "power on" indicator occasionally became confusing. Several times we resorted to resistance measurements to check the position of the (unmarked) AC switch before inserting the plug. Although the K-12M's speaker connectors are typical "5-way" terminals, they are mounted in such a way that banana plugs are the only easy way to connect your speaker cables.

DETAILED LISTENING RESULTS

We auditioned the K-12M using Genesis 400 and Audax A-652 speaker systems. Following our standard 50-hour break-in period (during which we observed little change), we did most of our serious listening with the Genesis speakers. We briefly compared the K-12M directly with our reference tube integrated amplifier, the Manley Stingray. This comparison is absurd, as the sales tax on the Manley probably would be more than the cost of the entire K-12M. Suffice it to say that the Stingray sounds better, as well it should.

We also compared the K-12M with our son's solid-state (of course) boom box as well as with an older solid-state Audio Source AMP-1. The comparison with the boom box was again extremely one-sided, but this time in favor of the K-12M. Although the boom box has a solid-state amplifier "rated" at 72Wpc as opposed to the K-12M's 8Wpc, the K-12M's bass response was tighter, deeper, and better defined.

The K-12M's midrange was clearer, better defined, and more dynamic. The high-frequency response of the K-12M was more extended. In short, the K-12M integrated amplifier represents a sonically valid step up from the amplifier included in the all-in-one systems
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maximum power available at 20Hz was a meager 2W, with 20kHz producing almost 5W, both again at distortion levels above 25%. At full power the supply transformer and tubes audibly resonated at the test signal frequency.

The clipping level is normally defined as that power where THD+N reaches 1%. However, the baseline distortion in tube amplifiers is fairly high at low power levels, so the generally accepted practice is to use 3% THD+N as the clipping point. Even with that allowance, this little amplifier was well into clipping at 2W or less, depending on the test condition. I never saw less than 1% THD+N for any test condition except at 0.1W into 8Ω 1kHz. Swapping the tubes around also affects the distortion, even for a left-right swap in the same channel.

The THD+N versus frequency for 2W into 4Ω and 1W into 8Ω is shown in Fig. 3. Here you can see the high levels of distortion, especially at low frequencies (LF). The right channel produces noticeably more distortion than the left, but neither channel quite gets down to the 1% maximum listed in the specifications.

The spectrum of a 50Hz sine wave at 1W into 8Ω is shown in Fig. 4, from zero to 1.3kHz. The THD+N measures 2.2%, and the harmonics are distributed throughout the spectrum. The second, third, fourth, and fifth measure -31dB, -36dB, -37dB, and -45dB, respectively. You can also see -57dB power-supply artifacts at 60Hz and 180Hz.

I also recorded a 1W 1kHz 8Ω spectrum in Fig. 5 from zero to 20.8kHz, where fewer harmonics are present. This produces the lowest THD+N reading at 1.3%.

The left channel distortion waveform for 1W into 8Ω at 1kHz is shown in Fig. 6. The upper waveform is the amplifier output signal, and the lower waveform is the monitor output (after the THD test set notch filter), not to scale. The 1.3% distortion residual signal shows mainly the second and third harmonics, with no evidence of any noise or fuzz.

The clipping at maximum power (8W 1kHz 4Ω) shows a scooped-out positive half-cycle, and a noticeably asymmetrical negative

half-cycle (Fig. 7). However, the residual distortion waveform is still predominantly second and third harmonic.

In Fig. 8, I show the left channel response to a 20Hz sine wave, amplified to 1W with an 8Ω load. You can readily see the distortion in the fundamental signal (top), with the residual distortion waveform shown below. THD+N measures a high 21%. Since the LF power is quite limited, I assume this LF distortion is due to output transformer saturation. None of the coupling capacitor -3dB points are higher than 10Hz, even allowing for the actual 81k input pot resistance and capacitor tolerances.

Figure 9 shows the K12M's output spectrum reproducing a combined 19kHz + 20kHz intermodulation distortion (IMD) signal at 12Vpp (about 2.2W) into 8Ω. The nonlinear tube transfer characteristics produce a wide range of intermodulation products. The 1kHz IMD product is a high 1.25%, with the 18kHz product about the same level.

REFERENCES

1. "Guitar Direct Box," Hansen, C., *Performer's Audio*, pp. 18-21, 44-45, 3/97.

The 12Vpp output test level for a multi-tone intermodulation signal (MIM, Fig. 10) of 9kHz + 10.05kHz + 20kHz produced a 1kHz response product of 0.89%. I also plotted the 1kHz product of this MIM signal versus output power in Fig. 2. This gives a better

indication of the K12M's nonlinear response, since it is a closer approximation to music than a sine wave.

I applied square waves to the input of the K12M at three frequencies. The 2.5Vpp square wave at 40Hz into 8Ω showed signifi-

TABLE 1
MEASURED PERFORMANCE

PARAMETER	MANUFACTURER'S RATING	MEASURED RESULTS
Input impedance	100kΩ	81k left, 88k right
Output impedance	8Ω	6.6Ω at 1kHz; 5.5Ω at 20Hz, 20kHz
Power output, maximum	8W per channel	8W 1kHz 4Ω (28% THD)
Minimum input for full output	0.4V	0.427V RMS, 1kHz 8Ω 0.504V RMS, 1kHz 4Ω
Frequency response	20Hz-20kHz	14Hz-58kHz ±3dB 8Ω
Total harmonic distortion	<1% at 1W	1.3% 1W 1kHz 8Ω
IMD—CCIF (19 + 20kHz)	N/S	0.90% CCIF 6Vpp 8Ω
MIM (9 + 10.05 + 20kHz)		0.57% MIM 6Vpp 8Ω
Signal to noise ratio	N/S	-66dB
Noise	N/S	0.6mV maximum
Gain	N/S	21dB 4Ω, 25dB 8Ω

TABLE 2
CROSSTALK

FREQUENCY	CROSSTALK R-L	CROSSTALK L-R
100Hz	-60dB	-64dB
1kHz	-56dB	-51dB
10kHz	-44dB	-33dB
20kHz	-43dB	-27dB

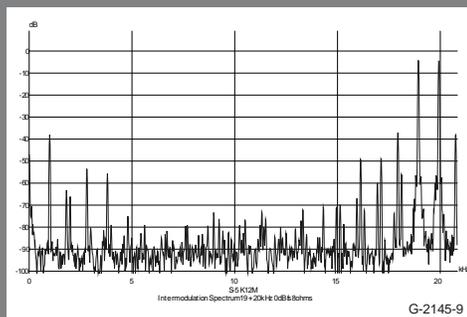


FIGURE 9: Spectrum of 19kHz + 20kHz intermodulation signal.

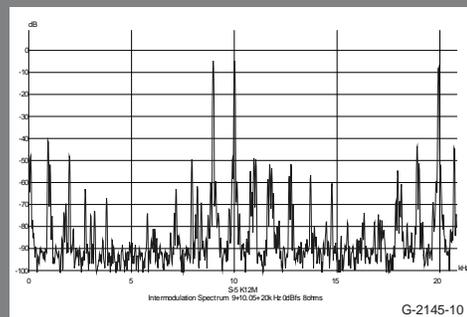


FIGURE 10: Spectrum of 9kHz + 10.05kHz + 20kHz intermodulation signal.

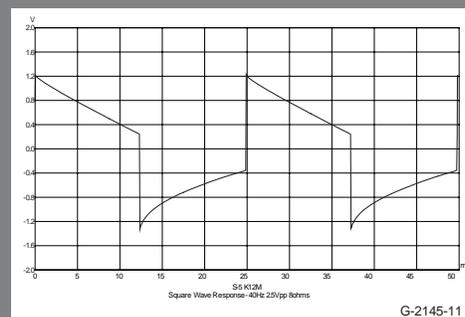


FIGURE 11: Square wave response, 40Hz 2.5Vpp 8Ω.

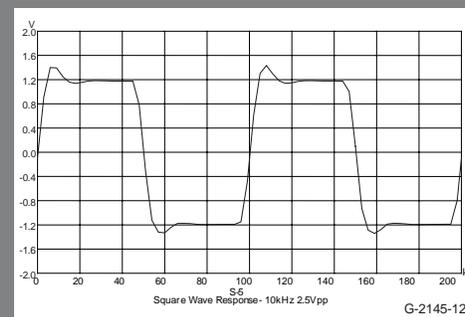


FIGURE 12: Square wave response, 10kHz 2.5Vpp 8Ω.

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typically owned by beginning listeners.

The comparison between the AMP-1 and the K-12M was much closer. The AMP-1 had a deeper and stronger bass response and an overall good sound, but when compared with the K-12M it sounded slightly harsh, unnatural, and "hi-fi." Although the AMP-1 was significantly more expensive, we both preferred the natural sound of the K-12M.

We auditioned the K-12M using a number of tracks from the *Hi-Fi News and Record Review Disk III* (track 2: Parry's "Jerusalem"; track 4: Vivaldi's trumpet concerto; tracks 5 and 6: excerpts from Prokofiev's "Peter and the Wolf"; track 7: Purcell's "Welcome, Welcome Glorious Morn"; track 10: a Corkhill percussion piece; and track 14: Rio Napo RSS demo). We also listened to a wide variety of other CDs, including a recent live album by BROTHER (*This Way Up*, Rhubarb Records RR07CD). See sidebar.

The K-12M produced an enjoyable sound with music ranging from Jethro Tull (*A Little Light Music*, Chrysalis, F2-21954) to Mozart (*Horn Concertos*, Den-

nis Brain, EMI CDH 7 61013 2). It was at its best reproducing instruments such as the horns and oboes in "Peter and the Wolf" and the trumpets in the Vivaldi trumpet concerto.

The high-frequency response of the winds in "Peter and the Wolf" was clean, sweet, and reasonably detailed, but the high frequencies of cymbals and miscellaneous noises on the "Rio Napo DSS Demonstration" were slightly recessed and lacking in sparkle. When we played the Purcell at reasonable volumes, the K-12M's sound was uncongested and very musical; however, this quality suffered as we increased the volume.

As you might expect, the K-12M amplifier lacked the extreme clarity and detail produced by some much more expensive amplifiers. Microdynamic contrasts were excellent; the Corkhill percussion pieces were crisp, and the individual drumbeats in the RSS demonstration were well defined, fast, and solid. Rhythmic recordings, including several songs from the BROTHER CD, generated an appropriate feeling of aliveness. This dynamic quality was lost at higher volumes.

At higher volumes some glare also became apparent

on midrange instruments such as horns. The Vivaldi trumpet concerto made us cringe at high volume, although it sounded fine at our normal listening levels.

The K-12M was capable of reproducing a reasonable amount of ambience information. On the recording of "Jerusalem" the space around and above the choir was clearly audible. The K-12M produced a wide soundstage extending beyond the speakers on the "RSS Demonstration"; however, the instruments were not precisely placed within that soundstage but were slightly smeared. The drum kit on the BROTHER recording was appropriately centered, located above and to the rear of the other instruments.

FINAL THOUGHTS

NM: Tube amplifiers often receive good reviews for sound but poor reviews for measurements. For me a component's sound—particularly its sound when played with our system—takes precedence.

The K-12M's sound coupled with its modest price tag blew me away. I've heard amplifiers I liked better with our system but none for under \$800. If you'd told me before I heard the K-12M that a \$140 amplifier could sound this good, I wouldn't have believed you.

That being said, I have a few reservations. Don't buy this amplifier if you have inefficient speakers, if you must have deep bass, or if you're unwilling to build a box for it. The melted tube sockets (and to a lesser extent the easily-damaged volume control) still worry me. S-5 tells us they will try to replace the tube sockets. If they haven't done so before you buy this amplifier, consider either postponing the purchase or replacing the sockets yourself.

DM: The K-12M has many of the sonic characteristics attributed to classic tube designs. It possesses a wonderful midrange, a clean but slightly rolled off high end, and a somewhat muddy bass response. Although I have not compared the K-12M directly to any of the classic designs, to my ears its deficiencies are less pronounced than those of many earlier amplifiers. Its combination of midrange and high frequency response is ideally suited to taming the sound of an inexpensive CD player.

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TEST FOR TRANSIENTS, BASS, IMAGING, AND "SLAM"

BROTHER is a rock band with roots in Australia; they add bagpipes and didgeridoo to the usual mix of guitars, vocals, and drums. Their live album, *This Way Up* (Rhubarb Records RR07CD), contains two tracks that test a music system's ability to reproduce bass transients realistically. BROTHER's recordings probably aren't available at your local CD store, but you can order them online at <http://brothermusic.com/>. (If you're wondering what a didgeridoo is, this page has some good pictures.)

On a good system the drums on track 1, "Thetimeisnow," sounds as close to "live" as I've heard from a CD. The bass drum, although not especially deep, is fast, rhythmic, and insistent. If you are at all given to tapping your toes or stamping your feet in time with music, this track should get you going.

The drum sound on track 5, "The Unknown (Granny MacLeod & Rory MacLeod)," is deeper and less defined than on "Thetimeisnow" but just as insistent. This tune is another "foot-stomper"—with good woofers you should be able to feel each drumbeat. The didgeridoo sounds as unique as it looks, and on this track it should be appropriately "twangy" with a deep bass fundamental. If it sounds like any normal instrument, the midrange resolution of your system and/or room needs work.

Both tracks have a very strong bagpipe lead. The bagpipe isn't a kind instrument to digital recording techniques. If you've turned these pieces up loudly enough to feel the drum and the bagpipe doesn't drive you out of the room, you've solved your digital sound problem.

On a good system the drum kit on both tracks is clearly located between the speakers (fairly easy), behind the speakers (harder), and significantly above the speakers (harder still). The drummer on this live album probably was sitting on a platform behind the other musicians. This spatial information is present on the CD and can be retrieved by a good reproduction system.—N + DM

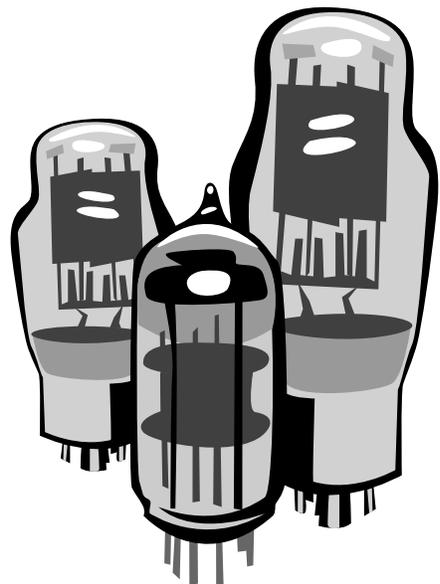
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cant tilt, as you can see in Fig. 11. This is indicative of the fairly high 14Hz -3dB point in this design.

The 10kHz square wave showed one half-cycle of peaking at the leading edge (Fig. 12). This peak was also present in the 1kHz square wave response (not shown). The leading edge of the 10kHz square wave showed a full cycle of ringing when I connected 2 μ F in parallel with the 8 Ω load. However, there was no evidence of additional high-frequency peaking or instability, nor did I measure any in the frequency response test (Fig. 1).

After the measurements, I installed the K12M in my system for some brief listening. Then I had the idea to connect the left channel to my

guitar amplifier speaker via my guitar direct box¹. With its distortion performance, I found it to be a terrific little practice amplifier. The bass was reasonably full, and the high end had "bite" but without any treble harshness. The treble responded nicely to string dynamics, with easily controllable overload distortion at high volumes. Maybe the best enclosure for this little tube amp would be two reasonably efficient 8" musical instrument drivers in a cabinet.

Manufacturer's response:

In keeping low cost and ease of construction as primary goals, the design was optimized for practical use with emphasis on the musical listening experience. NM's comment "The S-5's sound coupled with its modest price tag blew me away" attests to the design success.

We also comment that the tube sockets used have been completely satisfactory in the field with over 100 amplifiers in use by customers. We still plan to change to ceramic sockets,

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Along with the classic sonic signature, the K-12M integrated amplifier has managed to retain a price reminiscent of yesteryear. If its tube sockets were replaced, I would unhesitatingly recommend the inclusion of the K-12M in a starter system, assuming you've considered the three guidelines mentioned in the introduction. If you're even slightly competent with a soldering iron, I recommend buying the K-12M as a kit, not because the price is lower but because fitting an enclosure and replacing the sockets will be easier. Also, the volume control probably won't break if it's shipped as part of a kit. ❖

but this necessitates changes in the circuit board, which requires considerable lead time.

We also point out that the need for output power has been generally over-emphasized. Practical listening levels are of the order of 1W per channel. ❖

*Larry Stafford
S-5 Electronics*

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