Product Review

Marchand PM48 Computer Amp

Reviewed by Charles Hansen and Duncan and Nancy MacArthur

PHOTO 1: PM48 card.

Marchand Electronics, Inc., PO Box 473, Webster, NY 14580, (585) 872-0980, FAX (585) 872-1960, www.marchandelec.com. Price: $100. Warranty: 2 years.

The Marchand PM48 is a 12W per channel stereo amplifier card for a personal computer. The card fits into—but does not make any connections to—a standard PCI expansion slot connector. Power is obtained from one of the unused power-supply disk drive connectors, where the 12V DC yellow and black wires are used to power the amplifier card.

INSIDE THE AMPLIFIER

Photo 1 shows the Marchand PM48 amplifier card, and *Photo 2* shows how the connections are made to the PC and to the external audio source and speakers. Audio signals are connected to the PM48 through a 3.5mm stereo phone jack. Two pairs of plastic speaker binding posts on ¾″ centers allow you to connect 4Ω or 8Ω speakers with standard banana plugs. The review amplifier came with a 1m shielded interconnect with 3.5mm stereo phone plugs.

TOPOLOGY

A schematic was not furnished with the unit. The PM48 is based on the Philips TDA8566Q stereo bridge-tied-load (BTL) car radio power amplifier IC with differential inputs. Of course, with the three-conductor 3.5mm stereo jack connection, there is no way to implement fully differential inputs. The two negative differential inputs at the amplifier chip are connected in common through isolation caps and returned to the jack ground sleeve via a resistor.

Just a few discrete parts make up the remainder of the card. The power amp IC is mounted to a 4″ × 3⅛″ × 1⁄16″ black painted aluminum plate that serves as a heatsink. The plate and the IC are mounted on the PC card. The audio path uses metal film resistors, and what appear to be polypropylene coupling caps. The card uses a mute delay turn-on circuit to avoid speaker pops during power-up. The IC itself has thermal, short-circuit, and reverse polarity protection.

PHOTO 2: PM48 connections.

Inside the PM48, the computer +12V DC input is filtered by a total of 660µF. The TDA8566Q has a rather low supply voltage ripple rejection (SVRR) of 50dB[1], as compared with a power-supply rejection ratio (PSRR) of 120dB[2] for a dual supply power amp IC such as the LM3875. It will be interesting to see how much computer power-supply noise gets through to the speakers (see sidebar, "ATX Computer Supply Noise and Voltage Regulation").

MEASUREMENTS

Making measurements on the PM48 presented a number of challenges. The BTL output stage does not have a common connection to ground, so I needed to work out a ground isolation scheme that allowed me to measure the audio output without shorting one of the speaker connections to ground. Along with that was the concomitant requirement not to introduce excessive hum or noise.

My distortion test set has an input ground lift switch, and I ended up using my laptop for the computer-based ADC-216 DSO because the desktop computer I usually use eventually makes its way to power line ground. My IMD test signal generator has a floating output, but its metering circuit is ground-referenced. In order to monitor results with my analog scope, I made a "phantom" ground for the scope probe with two series resistors across the +12V DC supply.

Making measurement connections

in the confined space inside my PC was also out of the question. For this reason, I used a separate ATX computer switching power supply with the following ratings:

+5V DC at 22A
+12V DC at 8A
-12V DC at 0.5A
-5V DC at 0.5A
+3.3V DC at 14A
+5V SB (standby voltage) at 0.8A

The ATX motherboard connector wants to "see" a motherboard before the power supply will start. This requires jumping the green ATX connector wire to the adjacent black wire (thanks to computer guru Bill Schatzow for solving that little problem).

Before any audio testing, I made some noise and regulation measurements on the supply (see sidebar). I loaded the +5V DC (the red and black wires in the hard drive power plug) to 3A to simulate a modest PC motherboard load without drive activity. This probably represents an ideal case for the audio board. Inside the PC, the PM48 will be subject to much high-frequency EMI and the constantly varying +12V DC supply voltage as the computer performs its various tasks.

I operated the PM48 amplifier at 2W into 8Ω for one hour. The aluminum heatsink (sitting flat on the test bench without benefit of the computer cooling fan) was quite hot to the touch. The amplifier dissipates a minimum of 1.8W at idle, and up to 18W at two-thirds power into 4Ω. You must exercise care in selecting the motherboard slot into which you install the PM48, since surrounding boards could be subject to the high temperature at the heatsink, or block its cooling air flow.

The initial 0.27% THD reading remained the same throughout this run-in period. The distortion was essentially the same for each channel, so I present the bottom output channel here.

TABLE 1
CROSSTALK

FREQUENCY	R TO L	L TO R
100Hz	–52dB	–53dB
1kHz	–52dB	–52dB
10kHz	–51dB	–50dB
20kHz	–48dB	–49dB

By Duncan and Nancy MacArthur

Computer amplifiers such as the Marchand PM48 are aimed at two separate but overlapping markets. The first consists of listeners desiring better or louder sound effects for computer games: we'll call this group Type 1. The second consists of people using their computers for listening to music: we'll call them Type 2. The latter category includes those who like to listen to background music while working on the computer (Type 2a) as well as those who intend to use their computer as a dedicated audio reproduction system (Type 2b).

Given the wide variety of expectations, any single product is unlikely to meet every user's requirements. Most computer systems place little emphasis on sound. Often any additional amplifier and speakers will sound much better than those supplied with the computer. For a user ranging from Type 1 to Type 2a, any separate amplifier, including the Marchand, will provide a more satisfying output than the very inexpensive amplifier already wired into his or her computer.

But the audio quality required for Type 2b use is another matter. When an amplifier is part of a dedicated audio reproduction system, it must be compared with other audio reproduction equipment as well as with live music. Depending on its intended use, a computer amplifier should be judged by two or more completely different standards.

REVIEWING THIS AMPLIFIER

In addition to the multiple-possible-uses issue, computer amplifiers such as the Marchand don't fit easily into traditional audio systems. The amplifier input is through a ⅛″ stereo phone jack, which fits in well with the most common computer output but does not allow use of known RCA cables for evaluation.

Similarly, the outputs of the Marchand are on ¾″ spaced five-way binding posts recessed into the back of the computer. Large speaker cables will not fit into this recess. Bare wires or banana plugs will work.

In fairness, both these connector issues cause problems for Type 2b users (and comparative reviewers) rather than for computer users, who appear to be the Marchand's intended market. For a typical computer user, the ⅛″ phone plug and bare wire speaker connection may be more of a blessing than a concern.

INTRINSIC ISSUES

In general, a very quiet computer is a very noisy audio system. The standards of comparison for each use are wildly different. A computer commonly is used in an office environment where you'd expect a moderate amount of fan noise.

An audio system, on the other hand, usually is located in a quiet living or family room; furthermore, audiophiles often regard even a tiny amount of fan noise with extreme suspicion. Replacing computer fan(s) with quieter versions is certainly possible, but to our ears, unmodified general-purpose computers generate an unacceptable amount of noise for a dedicated audio system. This complaint is not specific to the Marchand, which has no fan, but is a general comment about computer-based audio.

Computers generate abundant RF noise, even outside the shielded case. The Marchand, on the other hand, is located inside the case where the RF environment is much worse. Obviously, any amplifier built into the computer will be in the same high-RF environment, but many audio component designers spend time and money to ensure low levels of RF within their designs. As we see it, while the Marchand is a viable alternative for Type 1 (computer) purposes, its design includes compromises that may be less than optimal for Type 2 (audio) purposes.

Another area of compromise involves the DC power supply. The same switching power supply that supplies the disk drives powers the Marchand amplifier. This power supply was never designed for audio use. In contrast, many amplifier designs place at least as much emphasis on the power-supply design as on the amplifying elements themselves.

A computer accesses its disk drives constantly. With the Marchand this disk access, as well as other computer housekeeping functions, was quite audible. These sounds constantly reminded us that we were listening to a computer "add-on"; their presence distracted us from listening to the music itself. Not only is the power supply not part of the amplifier, but also it's entirely dependent on the host computer. (For this review we used an AOpen computer.)

HUMAN INTERFACE

As mentioned previously, the input connector is quite standard for computer use. A ⅛″ phone to ⅛″ phone patch cord (supplied by Marchand) makes connection to the computer's audio output easy. But, as noted later, although zip cord is widely available, perhaps it isn't the best choice for speaker wire for the Marchand.

Although the Marchand doesn't make any electrical connection to the PCI bus in the host computer (power is supplied through the existing internal disk power cable), the amplifier is intended to be plugged into a bus socket, which provides additional support required by the amplifier and especially by the large heatsink (a flat metal plate). Mounting the Marchand in a non-powered position is possible but requires additional support of the amplifier board. In either case, we recommend removing the amplifier prior to shipping the host computer.

SOUND JUDGMENTS

As with previous listening critiques, we auditioned the Marchand using 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), as well as a wide variety of other music. The PM48's sound was warm and slightly rounded-off. These characteristics were particularly noticeable in the Prokofiev and Corkhill pieces. Its imaging was blurred, and the images tended to "pull" towards the speaker positions on the Prokofiev and RSS tracks. On the Parry and Vivaldi pieces, the PM48 provided little ambience information. Overall, the sound was pleasant but not engaging.

Using 12 GA zip cord for speaker connection exacerbated all these characteristics. With zip cord cables the bass became excessive and the sound warmer and blurrier. We recommend pairing the Marchand with a more detailed (but still inexpensive) cable such as the DH-Labs T-14. We performed these listening tests and the following comparisons with T-14 cable.

We did all our listening using the CD drive of the AOpen computer. The quality of the host computer drive is another variable to consider when evaluating a computer-based amplifier. Since we weren't familiar with the sound of this drive, we compared the performance of the PM48 to several other amplifiers using identical speakers (Genesis 400) and cabling (the supplied patch cord and T-14 speaker cables).

Because we didn't have access to a comparable internally mounted amplifier board, we compared the PM48 with a variety of amplifiers, including a boom box, an Audiosource AMP-1, and (briefly) the Manley Stingray. The Marchand surpassed the boom box's amplifier in every category. Even with its supposedly lower output power, the Marchand was cleaner and more dynamic. It possessed a more extended frequency response.

The AMP-1, on the other hand, bested the Marchand in all categories and provided a more pleasant listening experience. To be fair, the AMP-1 when new cost more than the PM48. We chose the AMP-1 for comparison as being representative of spare amplifiers that you might already own. *(Spousal note: Most audio hobbyists keep an extra amplifier—or two or three or four—stashed away in the garage. Not that I'm bitter, mind you.—NM).* To nobody's surprise, the relatively expensive Manley Stingray sounded better than the AMP-1 and much better than the PM48.

FINAL THOUGHTS

NM: Should you buy the Marchand PM48? Let's ask a second question: What are your circumstances and listening habits? If your computer desk is short on space or you're interested in improving the sound of your computer games, the PM48 will sound better than the cheap output circuit already built into your computer. If you plan to listen seriously to music and you have extra space on your computer desk, you might prefer to experiment with an external amplifier.

DM: If you're looking for the ability to drive speakers directly and reproduce sound effects realistically and are unwilling to add an external amplifier to an already crowded computer table, then the Marchand PM48 is a straightforward answer worth considering. But if having an extra amplifier box is not a concern, an external amplifier—either a used one from the garage or a new one such as the S-5—is probably a better bet.

This would be the left channel using the top-left definition of phone jack polarity. There is no noise at all during start-up or shutdown, and the amplifier brings itself to life after a short time delay.

Then, with your ear to the speaker, you hear a hashy white noise. The output noise (input shorted) measured a high 68mV RMS, with +20mV DC offset. The signal-to-noise (S/N) ratio was 33dB referenced to 1W, 8Ω, 80kHz BW. With A-weighting the S/N ratio increased to 94dB.

The PM48 amplifier does not invert polarity. Input impedance measured 22k5. The gain at 2.83V RMS output into both 4Ω and 8Ω loads was about 23dB. The output impedance at 1kHz was 0.25Ω, decreasing slightly to 0.19Ω at 20kHz. While the power amp IC is rated for 2Ω loads, I limited my testing to 4Ω and 8Ω.

The frequency response (*Fig. 1*) was within ±1dB from 20Hz to 85kHz, at an output of 2.83V RMS into 8Ω. I normalized the response graph at 0dB for 1kHz into 8Ω. There was a slight +0.5dB peak at 39kHz.

When I connected a load of 8Ω paralleled with a 2μF cap, the PM48 appeared to operate without any fuss, but the internal protection disabled the output after about 30 seconds. In order to reset the amplifier, I needed to remove the capacitive load, remove the input signal, and cycle the +12V power.

The IHF load, which simulates a loudspeaker impedance peak at 50Hz, produced a 0.3dB higher response at this frequency than the 8Ω resistive load alone. The PM48 amplifier will be fairly insensitive to variations in speaker impedance with frequency. Crosstalk performance was limited by the 45dB channel separation limit of the TDA8566Q and wasn't helped by the close coupling of the two audio channels within the 3.5mm interconnect (*Table 1*).

THD+N versus frequency is shown in *Fig. 2* for the loads indicated at the right side of the graph. During distor-

TABLE 2

MEASURED PERFORMANCE

PARAMETER	MANUFACTURER'S RATING	MEASURED RESULTS
Frequency response	20Hz–20kHz ±1dB PBW	20Hz–85kHz ±1dB
Gain	24dB	23.1dB 8Ω
Input sensitivity, full output	0.45V RMS typical	0.5V RMS
Total harmonic distortion	0.1%, 1W, 1kHz	0.26%, 1W, 1kHz
Power output (RMS)	12W per channel 4Ω	11.76W 4Ω
IMD-CCIF (19 + 20kHz)	N/S	0.25% CCIF
MIM (9 + 10.05 + 20kHz)		0.09% MIM
Signal to noise ratio	Better than 100dB	94dB "A"-wtg (see text)
Noise	N/S	68mV RMS
Input impedance	10kΩ	22k5
Output load capability	2Ω min (4Ω or 8Ω typical)	
Power requirements	+12V DC	0.155A min to 3.62A max
Output impedance	N/S	0.25Ω 1kHz 0.19Ω 20kHz

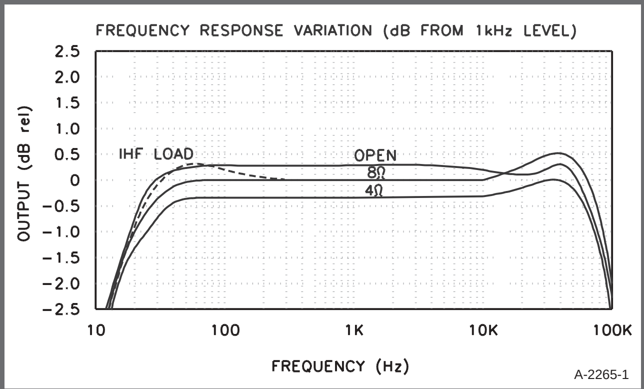

FIGURE 1: Frequency response.

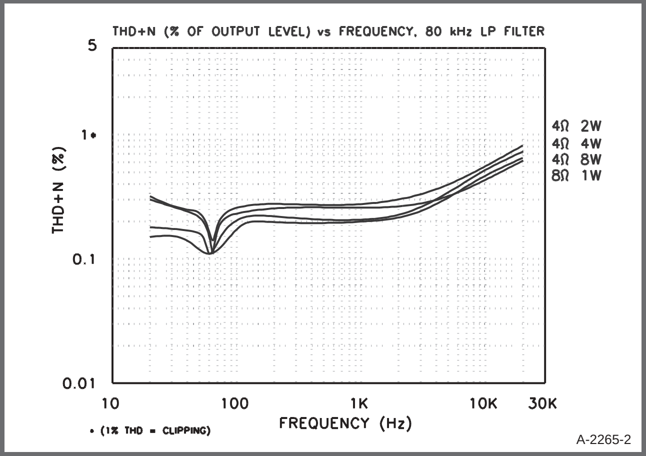

FIGURE 2: THD+N versus frequency.

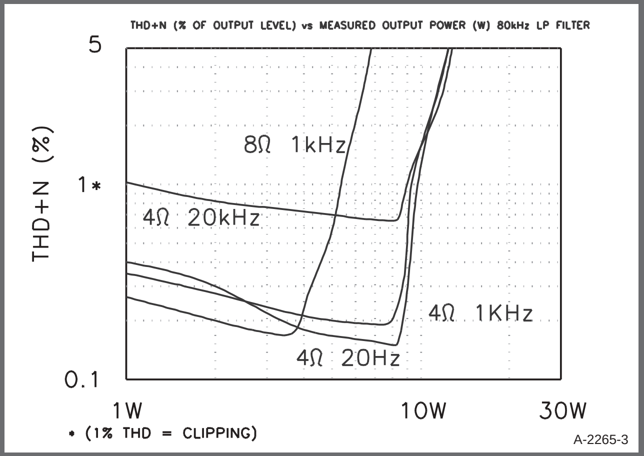

FIGURE 3: THD+N versus output power.

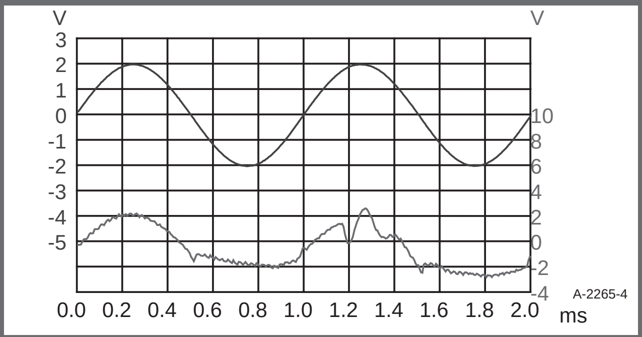

FIGURE 4: Residual distortion.

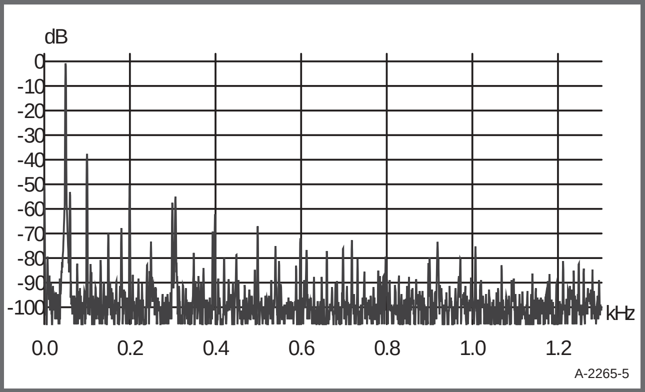

FIGURE 5: Spectrum of 50Hz sine wave.

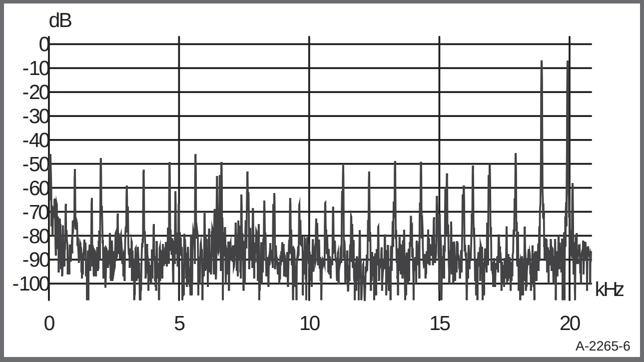

FIGURE 6: Spectrum of 19kHz + 20kHz intermodulation signal.

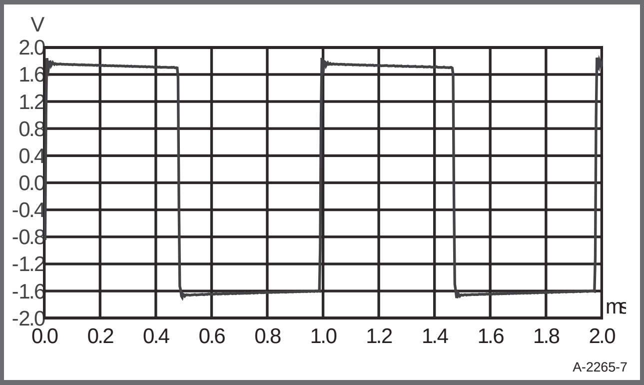

FIGURE 7: 1kHz square-wave response.

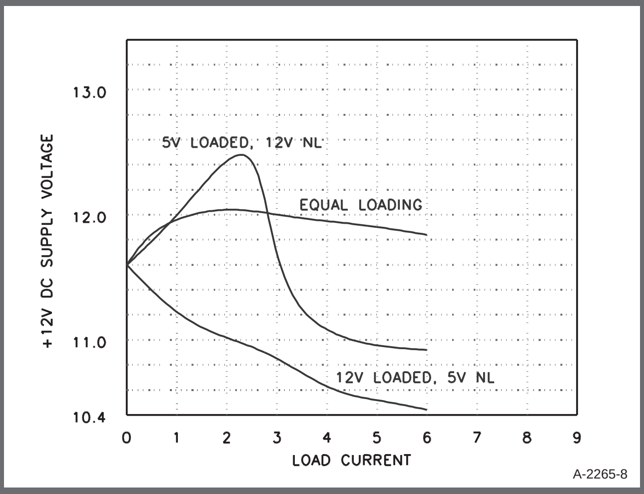

FIGURE 8: ATX power-supply variations.

tion testing, I engaged the test set 80kHz low-pass filter to limit the out-of-band noise. You can see where the distortion test set notch filter has removed some power line hum at 60Hz. Without this hum component, the THD+N would have been lower overall.

Figure 3 shows THD+N versus output power for various loads and frequencies. The PM48 does not exhibit brick-wall clipping, and the sagging +12V DC rail voltage limited its maximum output power. I saw 11.76W driving both channels, and 11.84W with one channel driven, into 4Ω. Assuming its rated power is specified at 1% THD, it fell just short of its 12W per channel 4Ω rating by 0.09dB.

The distortion residual waveform for 1W into 8Ω at 1kHz is shown in *Fig. 4*. 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. This distortion residual signal shows a fairly high second harmonic due to what appears to be non-symmetry of the BTL

ATX COMPUTER SUPPLY NOISE AND VOLTAGE REGULATION

Most computers use efficient switching power supplies, so audio quality is not one of their design criteria. The ATX-compatible (Rev 2.03) supply I used operates at a switching frequency of about 78kHz. The PM48 taps into the +12V DC supply. This is also used for the hard disk, floppy and CD drives, and the processor cooling fans. At its maximum audio output the PM48 adds about 3.6A to the total 12V DC load.

The +5V DC and +3.3V DC outputs are the critical supply voltages, since the logic has a supply tolerance of only 5% (±0.25V DC on the 5V DC). These two supplies usually have overvoltage protection monitoring. The +12V DC output may or may not be specified for 5% regulation, while the other lower current supplies can vary as much as 10%. *Figure 8* shows the variation in the +12V output for various loading conditions I applied to the two outputs at the hard drive plug. Overall, I found the +12V DC rail varied from +10.4 to +12.5 over the limited 0–6A loading I applied to the two sources, while the +5V rail remained within the ±0.25V logic limit.

The power-supply outputs also carry a fair amount of 78kHz switching supply noise, and may have up to 1% ripple. *Figure 9* shows the output noise from the PM48 with its inputs shorted. The noise is predominantly made up of the 78kHz switching frequency slightly modulated by 60Hz.

This shows one of the problems with using a computer switching supply for audio equipment. The PSRR for op amps and power amplifier ICs is at its maximum at low frequencies and decreases at 20dB per decade of frequency below the PSRR breakpoint. (This is also true of the common-mode rejection ratio, CMRR.)

There is no PSRR curve on the TDA8566Q data sheet, but the data for the better-performing LM38752 shows the +PSRR to be 107dB out to 250Hz, decreasing to 71dB at 78kHz. The −PSRR curve doesn't do as well, with 100dB out to 50Hz and only 40dB at 78kHz. The TDA8566Q has only one supply voltage ripple rejection (SVRR) point specified—at 50dB. I think it's safe to assume this is the low-frequency limit.

Using the same 20dB per decade curve approximation, the TDA8566Q may very well have 0dB SVRR at 78kHz. Thus the quality and type of power-supply filter and bypass capacitors becomes much more critical with switching power supplies used for audio. The ATX supply has one 1000µF filter cap at each of the three high-current outputs (+3.3V,

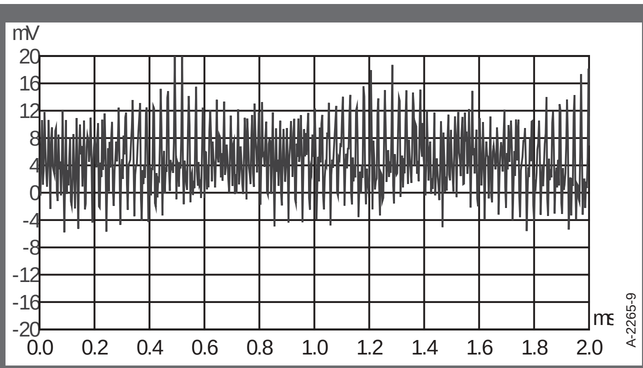

FIGURE 9: Output noise, input shorted.

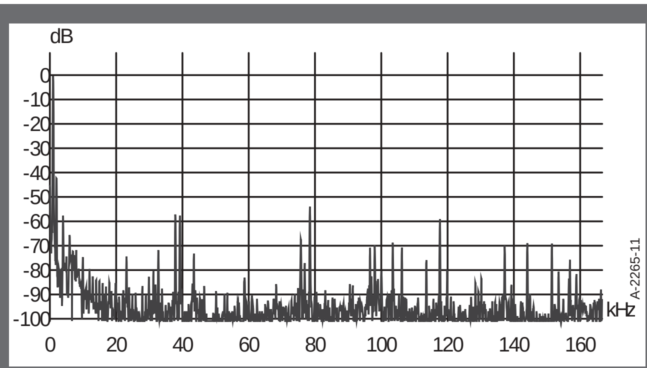

FIGURE 11: Spectrum with ATX switching power supply.

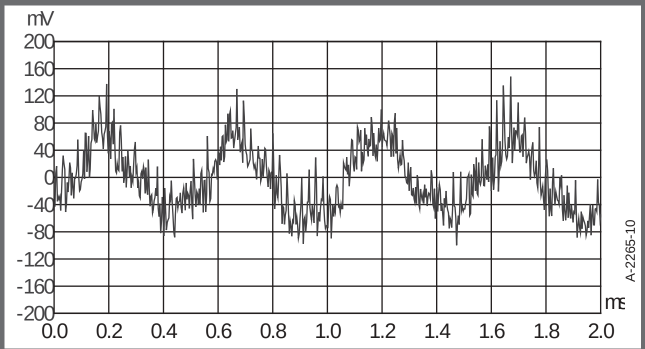

FIGURE 10: ATX 12V power-supply ripple.

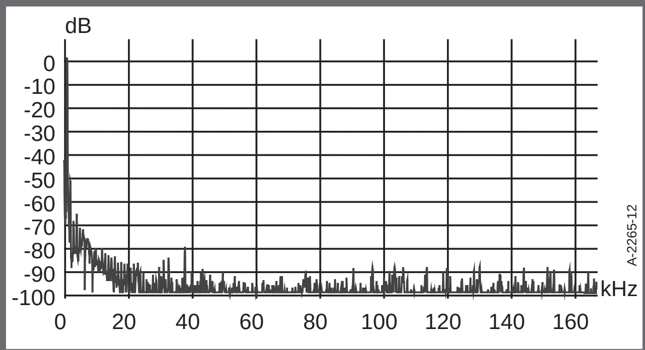

FIGURE 12: Spectrum with regulated linear supply.

output stage, overlaid with switching supply noise. THD+N at this test point is 0.26%.

The spectrum of a 50Hz sine wave at 1W into 8Ω is shown in *Fig. 5*, from zero to 1.3kHz. The THD+N here measures 0.21%. The second, third, fourth, and fifth harmonics measure –39dB, –75dB, –61dB, and –91dB, respectively. Power line artifacts are also present at 60Hz (–54dB) and 180Hz (–68dB). You see the effect of notching out the 60Hz component in *Fig. 2*. Repeating the test with a 1kHz sine wave produced a similar distribution of harmonics.

Figure 6 shows the amplifier output spectrum reproducing a combined 19kHz + 20kHz CCIF intermodulation distortion (IMD) signal at 10V p-p into 8Ω. The 1kHz IMD product is a high –52dB (0.25%). Note the even higher amounts of IMD present at approximate multiples of 1kHz throughout the spectrum.

Repeating the test with a multi-tone IMD signal (9kHz + 10.05kHz + 20kHz, not shown) resulted in a 1kHz product of 0.09%, with the same relative distribution of 1kHz multiples. This test gives a better indication of the PM48's nonlinear response, since it is a closer approximation to music than a sine wave.

The 3.5V p-p square wave into 8Ω at 40Hz (not shown) showed reasonable LF tilt. The leading edge of the 1kHz square wave had just a bit of HF ringing (*Fig. 7*). The 10kHz square wave (also not shown) showed approximately four cycles of the same ringing. This appears to be related to the slight frequency peak at 39kHz. *Table 2* shows my measured performance as compared with the manufacturer's specifications. ❖

+5V, and +12V). The PM48 adds its three 220µF aluminum caps to the +12V input, with one 220nF film bypass cap.

At no load the 78kHz power-supply ripple measured 30mV p-p on the +12V DC output (0.25%, or –52dB). With my 3A preload on the +5V DC supply and an output of 2W into 8Ω at 1kHz, it increased to 200mV p-p (*Fig. 10*). The noise is modulated at twice the 1kHz output frequency as it changes the current demand on the +12V supply at a rate of 2kHz.

I expanded the scale of my spectrum analyzer to 166kHz to show the full effect of the power-supply noise. *Figure 11* shows the output of the PM48 at 1W into 8Ω at 1kHz with the ATX switching power supply. This spectrum of power-supply noise helps explain the big difference between the broadband and A-weighted S/N ratios.

Figure 12 shows the same test condition using a well-filtered 14.4V DC regulated linear supply I use for car audio testing. The THD+N at 1W into 8Ω at 1kHz has dropped to 0.21% from 0.26%. This is not as dramatic a reduction as the comparison between *Figs. 11* and *12* would lead you to expect. The reason is that the band-limiting 80kHz LP filter in the distortion test set has removed most of the HF power-supply hash from the audio output.

However, given the mediocre intermodulation performance (*Fig. 6*), you can assume the 78kHz ripple may interact with audio signals and cause non-harmonic in-band artifacts to appear. Unfortunately, a slight peak in the amplifier frequency response occurs at half the 78kHz power-supply switching frequency, so some of the intermodulation products may be due to an excitation of this response peak. This is only speculation on my part, but note the peak at 38kHz in *Fig. 12*.

The performance of the TDA8566Q is fairly typical of car audio amplifier ICs, and, while not up to high-end standards, it is better than many of the AC-adapter powered computer speaker amplifiers that come standard with most personal computers. The high noise environment in a PC is a real challenge for critical audio applications. Keep that in mind when selecting a sound card to archive your LPs to digital, since the A-D conversion will take place inside your PC, most likely using the ATX supply as a power source.

REFERENCES

1. Philips TDA8566Q Data Sheet, 21 Feb. 2001.
2. National Semiconductor LM3875 Data Sheet, June 1993.