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June 2009
US \$7.00/Canada \$10.00

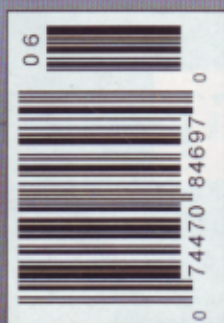
HEADPHONE AMP UPGRADE

How to Achieve
A Better Preamp

Uncovering a
Class D Amp Secret

Designing a
Studio-Quality Mike

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Building a **BETTER**
Single-Ended Transformer

The Pragmatic Class D Amplifier

With the "best-kept secret" in audiodom, you can construct your own Class D amp.

Class D amplifiers are gaining in popularity these days. Hypex and Tripath offer great products for DIY enthusiasts. Class D has some advantages over class A, AB, B, or tubes—one of which is its high efficiency. At normal output power there is no need for heatsinks, simply because heat dissipation is almost nonexistent. At higher output only a rather small heatsink is required. Another advantage is the amp's physical size and weight.

One of the very early class D designs was the Sinclair X-10 amplifier, which was sold in the early 60s as both a kit and as a complete product. This power amplifier yielded 10W of output power but, in reality, produced only a couple of watts. Those who successfully built the kit reported that the amplifier radiated like a radio transmitter.

In the 80s I repaired high-end audio for a specialized audio shop. Many rare amps passed through my hands, including the heavily-built Sony TA-N88 audio power amplifier. This model was one of the first commercial amplifiers to use class D pulse width modulation (PWM) technology, along with the use of a switching power supply.

At that time I did not really pay attention to this. My interests in class D started in 2000 after reading an article on Tripath's class D technology. I even ordered some modules. However, for some reason, I never got around to using them in a project. Last year I listened to Tripath and Hypex UcD based class D amps and built a class D

amplifier using B&O's ICEPower technology based on the 200ASC board as used by Cary Audio and Jeff Rowland.

Searching eBay is often part of my daily routine, and one day I came across a tiny amplifier that was completely unknown to me. Even the company's name *Pragmatic* didn't ring a bell, but it piqued my interest nonetheless. The ad listed the following features: class D, low distortion of typical 0.01% to 0.05%, no ripple in the passband, and audiophile sound.

Searching for "pragmatic amplifier" in the Google search engine, I was disappointed by the number of related hits. Either this amp was a forgotten treasure or just not a good item, but I decided to take a risk anyway. I purchased three of the ten pairs of amplifiers the eBay auction offered. The final price was \$115 US—a good deal—and I later regretted that I did not buy all ten pairs.

THE PRAGMATIC CLASS D MODULE

The modules (**Photo 1**), measuring only $8.7 \times 5.1 \times 2.0$ cm (L \times W \times H), use

SMD components throughout. Because the modules use an EMI/RFI PCB enclosure, you cannot determine component locations or any device numbers. So the amplifier technique and circuit design remain a mystery.

Pragmatic Communications Systems has been selling these class D products since 1996. Prasanna Shah, who designed this class D module, says the following: "One reason for our anonymity is that we have not been able to spend money on magazine advertisements. We have invested money in technology and performance rather than advertisements. We have sold our amplifiers to lovers of high fidelity all around the globe (Sweden, Norway, Denmark, Switzerland, UK, Germany, the Netherlands, Belgium, Italy, France, Hong Kong, Singapore, Australia, USA), and most of the sales have been word-of-mouth referrals."

Shah continues: "The Pragmatic amplifiers have been tested against very expensive Mark Levinson amplifiers at Madrigal Audio Labs' listening station. . . at listening sound levels they could not tell the difference between the

Pragmatic amplifier and Mark Levinson amplifiers, except that the Mark Levinson amplifiers were an order of magnitude more expensive, weighed more than 100 times more, and dissipated tremendous amount of heat energy into the room."

THE PRACTICAL REALIZATION

These tiny amps are very easy to use. Each amp comes as a complete working module, so

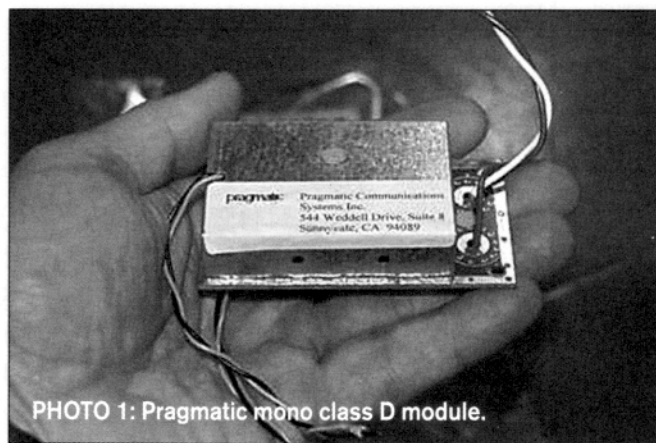


PHOTO 1: Pragmatic mono class D module.

there is no need for component soldering or stuffing a circuit board using SMD devices and no need for adjustments.

Each amp comes with three pairs of wires: power supply (red and black), line input (orange and black), and a speaker pair (positive output marked on PCB). All you need is to connect the 12V DC PSU (at least 5A per channel) and a fine line input signal (plus, of course, speakers) to have a full power amp.

I first set up a laboratory power supply and two Pragmatic modules, with no enclosure—just some wires laying around on the floor. All worked without hum or hiss.

I built three amplifiers. Amp One (Photos 2-4) uses an ABS enclosure and a Dell SX280 miniPC 12V DC switching power supply, both of which I bought for not too much at a radio flea market. The standby function of the PSU is used for switching on and

off, with the speakers not suffering from any dangerous pops or clicks. I built this amp for a total cost of less than 70 euros (about \$65 US).

Because the first amplifier performed so well, I built another, better-looking, amp. Amp Two (Photos 5-7) uses a switching power supply by XP Power (Farnell 1337158), which was a leftover from a former project. A PSU by Mean Well, such as the SP-150-12 or SP-100-12, would be a better choice, pricewise, but the XP PSU fits the used enclosure perfectly, and the specs are great.

Amp Two uses a Sansui VU meter, which I also bought at a radio flea market. The VU meters use a dedicated DIY circuit board by JLM Audio Australia, and these are directly mounted on the VU meters. This circuitry is powered by the 12V DC from the switching power supply. The 12V scale lighting uses a flexible white LED strip.

Because I still had one amplifier pair left, I built a third amplifier (Photos 8-10). This amp uses a conventional power supply with a toroidal mains transformer and a voltage regulator; I used one single 120VA transformer and a LM338 voltage regulator for each channel. The LM338 comes in TO-3 housing and is good for 5A.

I also purchased all parts for this amp at a radio flea market. The LM338 goes for 1.50 euros and the 120VA mains transformer for 20 euros. I bought the ABS enclosure for just 15 euros.

Use of a switching power supply is interesting, not only because of its price and compact size, but also because this kind of power supply works on a similar principle as that of a class D (or pulse width modulation) ampli-



PHOTO 2: Prototype Amp One.

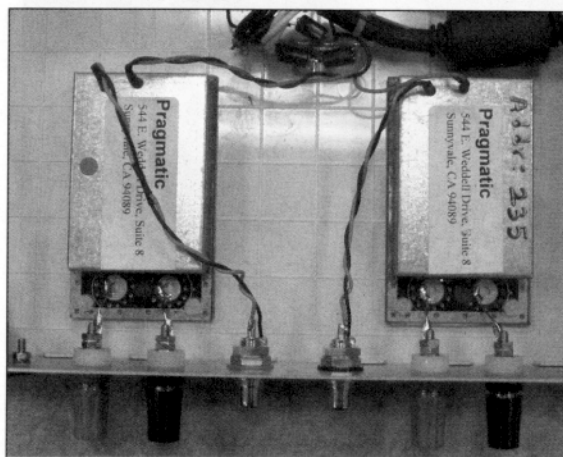


PHOTO 3: Overview inside Amp One.

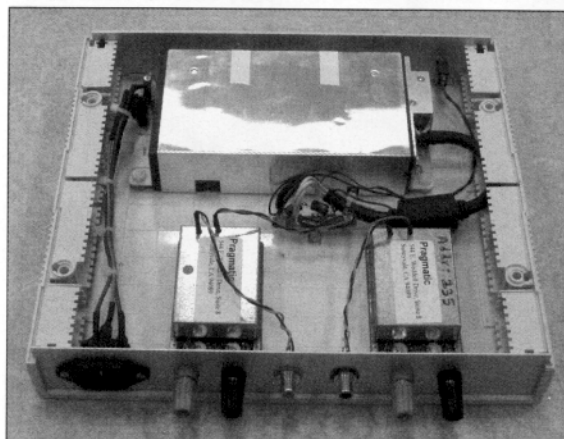


PHOTO 4: Amp One.

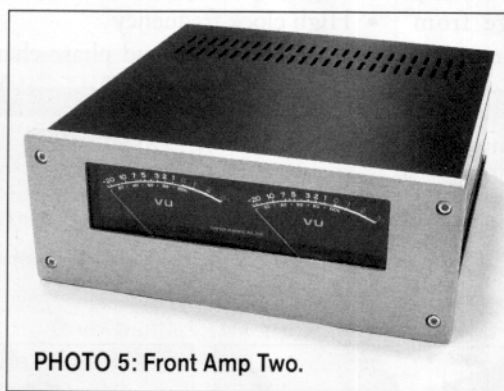


PHOTO 5: Front Amp Two.

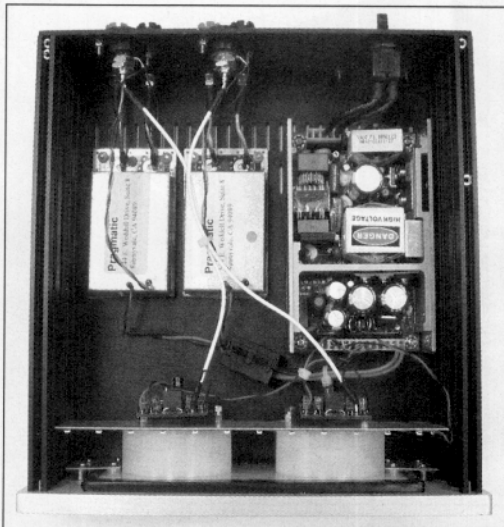


PHOTO 6: Amp Two overview.

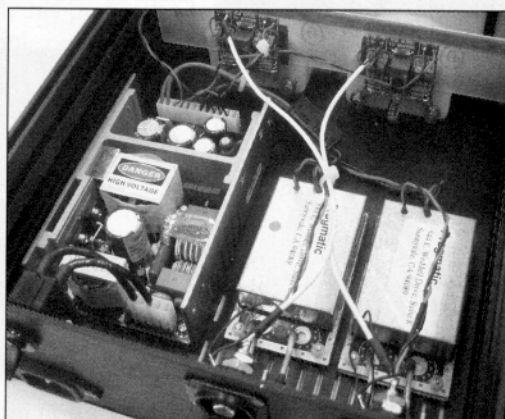


PHOTO 7: Amp Two inside overview.

fier except that the reference voltage of a PWM amplifier is the varying audio signal instead of a fixed voltage as in a switching power supply.

TECHNICAL ASPECTS

Its monoblock design provides extremely clean state-of-the-art power. The SIWA-248 unit accepts any volume-controlled line level input and uses a 12V-15V DC power supply. It has continuous power of 24W and a peak power of 60W. Advanced protection circuitry guards against system damage from overload, overheating, or short circuits.

COMPANY SPECS

Power: 12-15V DC
Continuous power: 24W per channel
Peak Power: 60W
Signal-to-noise ratio: >100dB
Dynamic range: >100dB
Frequency response: 20Hz to 20kHz

Applications: Features and Benefits

- Compact monoblock amplifier
- Residential or commercial audio amplification compact design
- High efficiency
- High clock frequency
- Very linear gain and phase character-

istics

- Flat frequency response from 10Hz to 50kHz
- No ripple in the passband
- Very high signal-to-noise ratio
- Very high dynamic range
- 24W (peak 60W)
- Only 12V DC power required
- Module works with 4 and 8Ω loudspeakers
- Very low and uniform distortion on all frequencies and very high signal-to-noise ratio and dynamic range.

SOUND IMPRESSIONS

To evaluate the sound performance, I used a large Tannoy D700 and a small-size Dynaudio. The Dynaudio is based on a T330D Esotar tweeter and 17WXL04 low mid unit, both by Dynaudio. At first you notice the ease with which music is reproduced. Sound

TABLE 1

How to connect the Pragmatic module

power supply	+12V DC = red.....	ground = black
line input	signal in = orange.....	ground = black
speakers.....	- output not marked on PCB.....	+ output is marked on PCB

Please note: the amplifier circuitry is designed in such a way that you can *not* connect the negative loudspeaker output to ground.

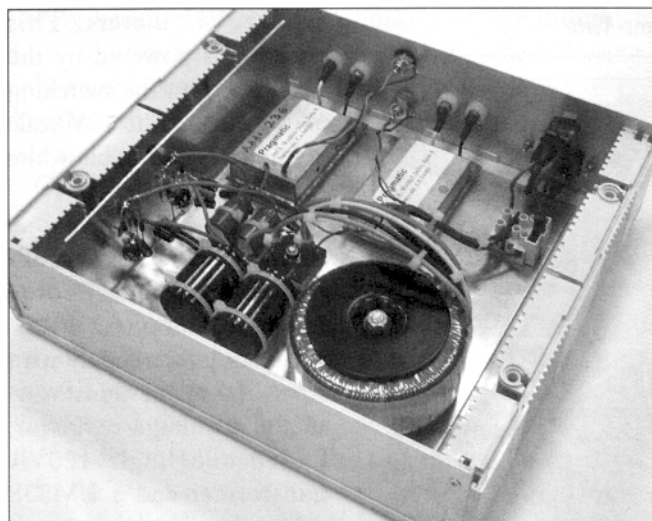


PHOTO 8: Front Amp Three.

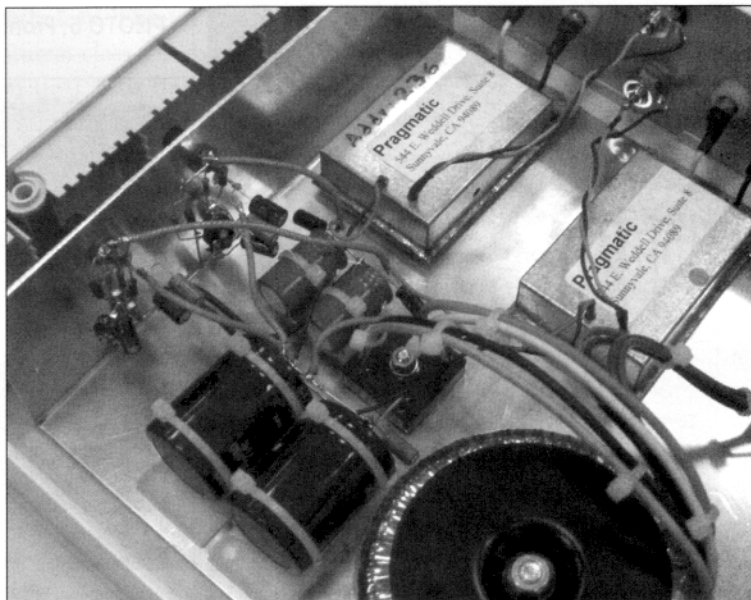


PHOTO 10: Amp Three inside.

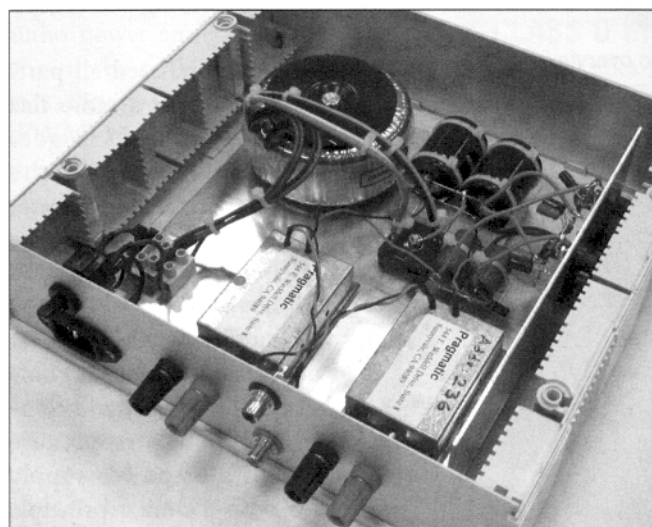


PHOTO 9: Amp Three overview.

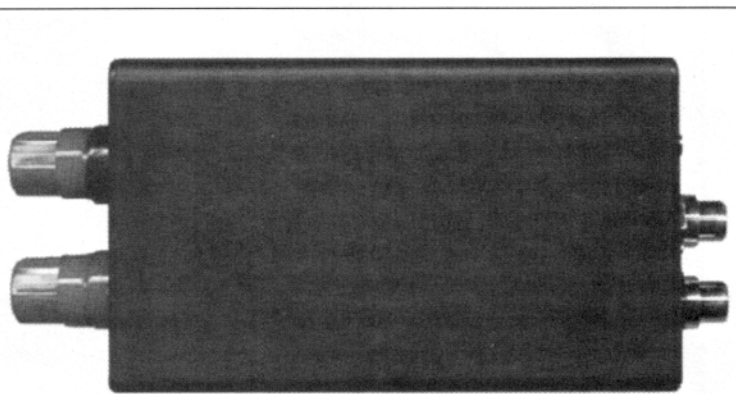


PHOTO 11: The Pragmatic SAA-224 stereo standalone amplifier.

is very clean, dynamic, and precise with a beautiful soundstage. The Dynaudio's 4Ω load and 84dB sensitivity are no problem for these low power modules; however, the Tannoy's 94dB sensitivity allows *headbanging* levels.

Big Band sound, such as in Gerald Wilson's *In My Time* CD, drives both speakers to a very high level. Music is reproduced with great authority and ease, rhythm and pace are excellent, and it is also free of any distortion artifacts. Also, at low and moderate levels all music can be felt and heard; its dynamic behavior is excellent.

Chet Baker's *Great Last Concert* (Enja) sounds impressive, with very good tonal balance and great atmosphere/ambience. Piano solos such as classical pianist Arcadi Volodos' *Live in Carnegie Hall* (Sony) are wonderfully reproduced; the Rachmaninoff pieces are extraordinary and captured by this amp in the best way. Audience, the bench, recording/hall noises/ambience—this amp offers high-resolution sound with impact and drive.

Another great piano solo recording is Marc-André Hamelin's Nikolai Medtner four-CD box (Hyperion). This wonderful recording by Tony Faulkner is *real*, and, with these Pragmatic amplifiers, the Dynaudios fade away. The low and high units melt together as the left and right speaker and results in a three-dimensional sound.

The music of Russian composer Nikolai Medtner results in a wonderful journey. Natalie Cole's voice on *Take a Look* is full-bodied with lots of air around it; the differences in recording of the different tracks can easily be detected. Fusion jazz such as Lee Ritenour's *Wes Bound* (GRP) will make you smile. Such big sound from such a tiny amplifier. Also noticeable is that the higher frequencies don't show any rolloff. The Keith Jarrett Trio *Live at the Blue Note* six-CD set is a real treasure; I guess these Pragmatic modules already knew this.

Yes, I am aware that I am overly enthusiastic. These modules are really fun and capable of reproducing music in all its pros and cons.

EPILOGUE

These interesting Pragmatic modules are very quiet, even in my simple test

setup. Musicality is enormous; they can rock and shake. Intimacy, imaging, soundstaging, and high resolution are its strong points. I guess these modules are probably the best-kept secret in audiophile circles. And remember: this class D design dates from 1996, which is remarkable because class D back then was not in the picture nor as developed as today.

Just before publishing deadline, I found out that the Pragmatic Company never sold these modules separately, so

the modules I bought on eBay were likely taken from a Pragmatic SIWA in-wall configuration. However, the Pragmatic Company sells modules as standard products. Check out their website for the standalone amplifiers such as the mono MBA-124 and the stereo SAA-224 amplifier (**Photo 11**), as well as in-wall configurations such as the SIWA-224; the first two are beautifully made standalone units with external power supplies. A 12-channel version is also available. **aX**

ABOUT THE DESIGNER

Prasanna Shah is the Chief Pragmatist and Thinker at Pragmatic Communications Systems, Inc. He earned his M.S. degree in Electrical Engineering from Stanford University and B.S. degree in Electrical Engineering from Santa Clara University, Santa Clara, Calif. He is a member of Tau Beta Pi and Eta Kappa Nu Electrical Engineering Honor Societies. He has almost three decades of experience working on semiconductors for analog and digital audio, video, cellular telephones, wireless communications, fiber optic communications, data communications, data acquisition, and industrial controls in the Silicon Valley. He holds one patent on power line communications, several patents on audio, video, and wireless multimedia systems, and many more patents pending in the area of industrial automation, health care patient interaction, and power generation/energy storage technologies. An avid audiophile and music lover, in his free time he likes to apply his pragmatic thinking to solve complex problems.

ABOUT THE COMPANY

Pragmatic Communications Systems, Inc. (www.wireless-experts.com and www.pragmatic1.com) is a Silicon Valley company established in 1994 to design, develop, and produce a variety of innovative products for wireless audio, video, and data communications. The majority of the company's products until 1997 were primarily designed for industrial and commer-

cial applications. The success of these products has led to a strong and dynamic technology base, which has been applied to a new generation of products such as CATS™ and others such as the DMS™, TrueMusic™ wireless hi-fi system and TrueView™ wireless video system. The company's philosophy is to use its technologies to solve problems that have gone unresolved for decades.

Further products include high-performance, low-profile line-array speakers, high-efficiency audio amplifiers (monoblock, stereo, multi-channel, in-wall), high-performance TV/CATV/FM tuners, category 5 (CAT5) audio/video transmission and cross-point matrix switchers, hard disk music servers, ambient audio levelling systems, microphones, and IR detectors.

PADS™—Multi-room audio distribution system on a single category 5 wire.

DMS™—Multi-source, multi-zone distributed music system on a single category 5 wire.

DAVES™ 4.43—Distributed Audio Video Entertainment System.

CATS™—Multi-source, multi-zone DVD quality audio/video signal distribution and IR control on a single category 5 wire.

CATS™ HD—High definition audio/video on category 5 wire.

The Class D tiny power amplifiers are part of the so-called Hide-Away™ Series (SIWA).

All are trademarks of the Pragmatic Company. ■