By Satoru Kobayashi

Back

IC Preamp with Electronic Level and Selector

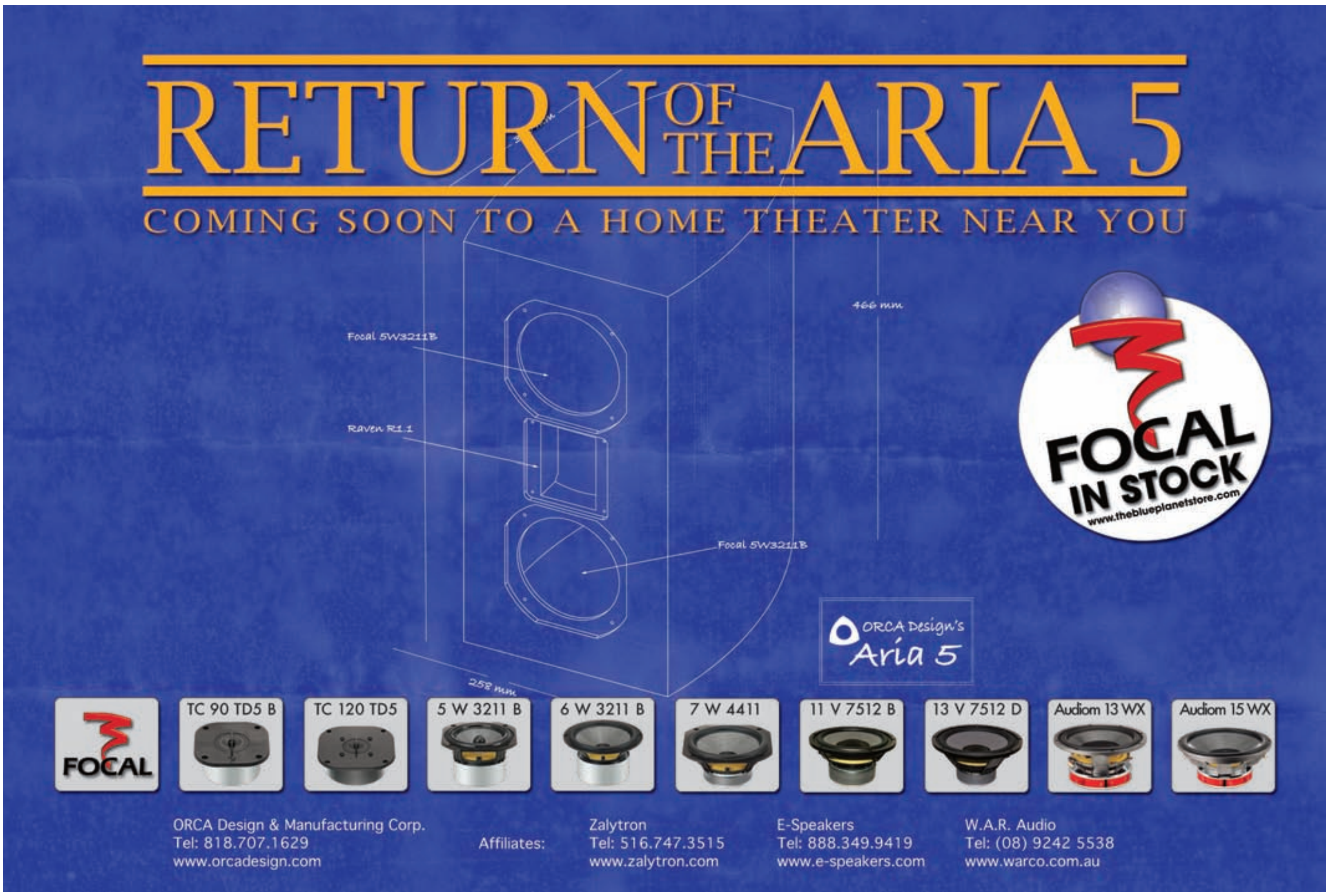
This Japanese preamp design features electronic analog switching. . . plus an MC step-up transformer.

It has been several years since I designed a simplified preamplifier using the DACT CT-100 and CT101 amplifier unit. I still would love to use DACT components such as a rotary switch and/or a volume to achieve a professional feel and smoothness when turning the knob. But the design I present here uses state-of-the-art semiconductor devices such as an electronic volume, electronic selector and so on, resulting in excellent presentation and an isolation characteristic as well as S/N ratio.

The sound is really pure and natural and brings a presence and dynamism. The amp is encapsulated into a compact chassis, including a RIAA equalizer and a couple of MC step-up transformers. The footprint of this unit equals that of a PC Notebook.

DESIGN CRITERIA

1. Use an electronic volume. Although Burr-Brown's PGA2310 is well known, I chose a Wolfson electronics (UK-based) device, WM8816, in conjunction with the Tachyonix (Japan-based) 8-bit microcontroller chip (8616S06M) exclusively designed for WM8816.
2. Use an electronic selector, called an analog switch, available from sev-



eral IC manufacturers.

3. Make the chassis as compact as possible. Actually, this project is an upgrade of my project using DACT-made modules. I renovated the internal circuit, using my own circuit, with a RIAA equalizer.
4. Use the Van der Veen MC step-up transformer. Because the transformer is tiny (about the size of a couple of sugar cubes) it exhibits excellent performance.
5. Use DACT-made attenuator and a rotary switch, which provide a nice feeling when turning the knob.

BASIC CIRCUIT DIAGRAM

The amp (**Fig. 1**) consists of three major blocks: RIAA equalizing amp, an electronic switch and electronic volume with a buffer amp, and a switching power supply with a ripple filter.

Because I had fallen in love with Van der Veen's toroidal transformers, I had been greatly anticipating his newly designed MC step-up transformer (MC-10, *please note this is not a toroidal!*) whose

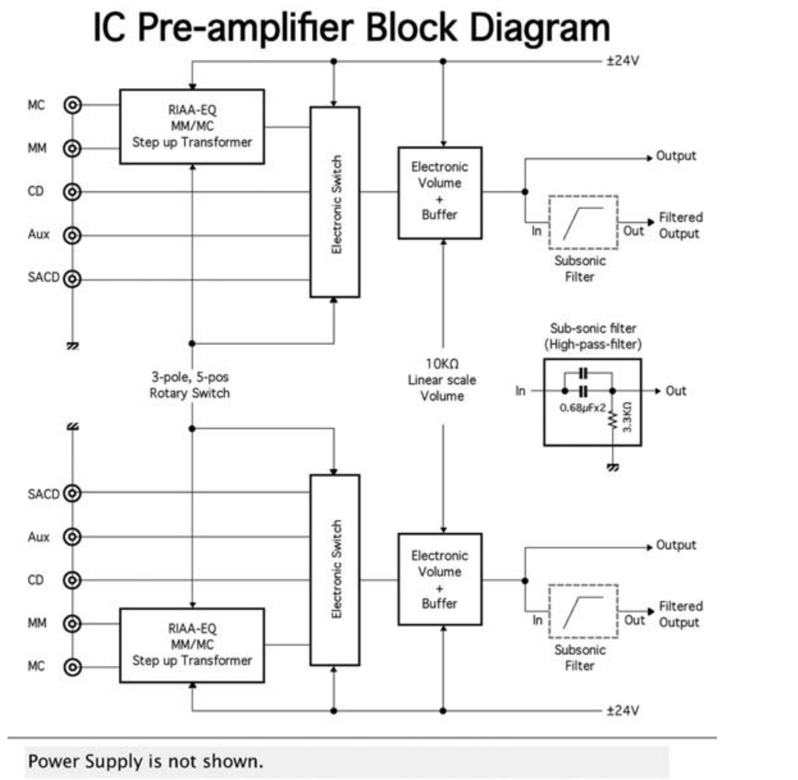


FIGURE 1: Circuit block diagram (power supply not shown).

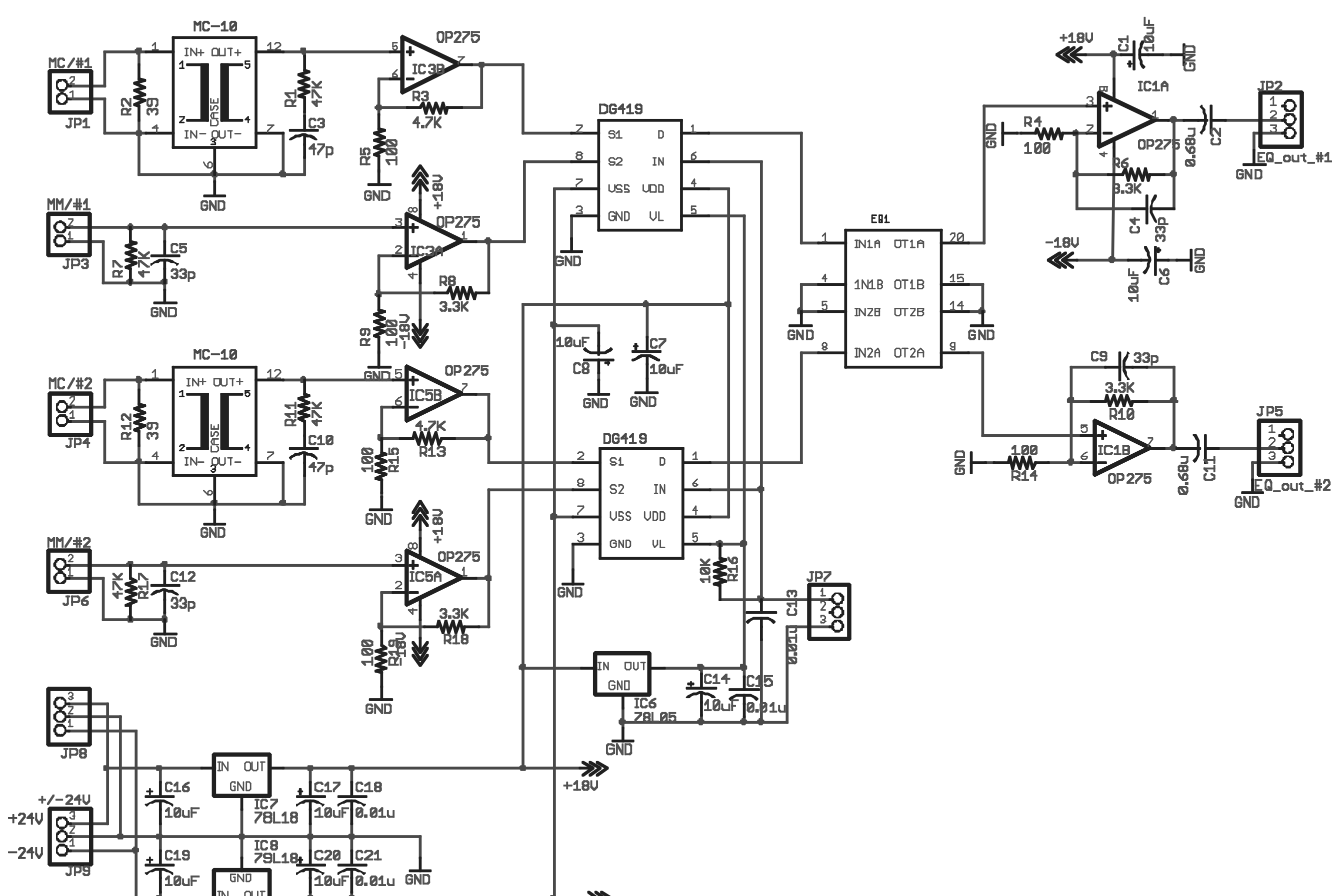


FIGURE 2: RIAA equalizer.

tiny, compact shape fit into a printed circuit board. Visit his website at www.mennovanderveen.nl/.

I also chose a CR-filter type equalizer rather than a NFB type equalizer. The key component is an IC chip, such as OP275 by Analog Devices, featuring an ultra-low-distortion characteristic. It might not need to use a NFB, lowering distortion as little as possible.

I calculated the CR filter components based on the traditional formula, prioritizing a capacitance value rather than a resistor value to minimize the deviation between the original RIAA curve and its actual value.

The circuit consists of a preamp and a post-amp by OP275. The former amplifies either MC or MM cartridge signal with 34X gain, the latter amplifies further with 48X gain, equalizing the CR-filter with a 20dB loss (1/10X), inserted between a couple of amplifiers.

The equalizing RIAA amp provides an electronic switch, an analog SPDT type that lets you choose either an MC or MM signal after pre-amplifying its signal with a 34X gain. The overall gain of RIAA equalizing buffer for MM and MC will be 116X(≈41dB, =34x1/10x34) and 1958X(≈66dB, =12x48x1/10x34).

Other signals such as CD, SACD, and so on will go to an electronic switch directly with a buffer amp and an electronic volume, providing approximately 2X gain.

After the selected signal the amp will finally go to a low-cut filter, with a 40Hz cutoff frequency, preventing a howling when you listen to a LP record with a LP player, working as a subsonic filter.

The final block, a ±24V DC power supply, drives these functional blocks securely, in conjunction with a ripple filter, which reserves a time-constant for a soft start.

RIAA EQUALIZER

Figures 2 and **2a** show the RIAA equalizer circuit and its RIAA CR-filter circuit. I mounted the RIAA filter over a small chunk of PCB so that I could easily fine-tune and replace components on the PCB, using a PCB pin and connector.

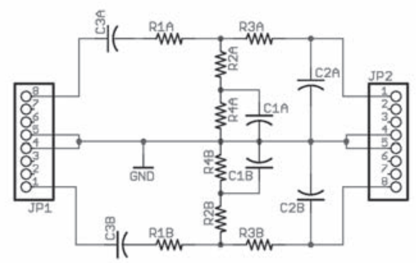


FIGURE 2a: Equalizer filter.

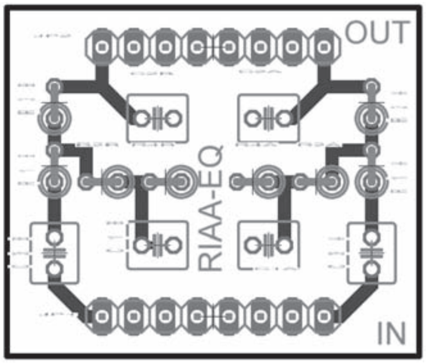


FIGURE 2b: Equalizer filter board.

Fig. 2b shows the completed etched PCB. I originally used a universal PCB for the experiment (**Photo 1**), but switched to the etched PCB.

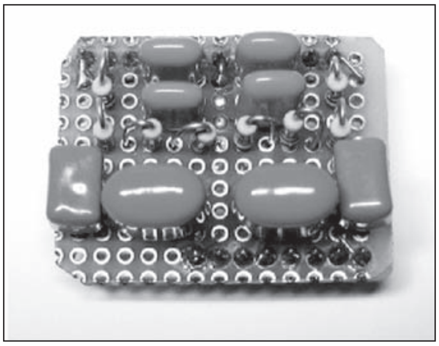


PHOTO 1: Experimental board using a universal PCB.

ELECTRONIC SWITCH

Instead of a conventional mechanical switch, I have recently found an electronic switch that could improve cross-talk characteristics (**Figs. 3** and **3a**). Accuphase (Japan-based) produces excellent products, featuring nice isolation using a compact mechanical relay of either NEC or Takamizawa, for example. Those components need a lot of space and an extra electronic control circuit to choose a signal that I want. However, an electronic analog is made of an IC chip contained in a standard 300mil-wide DIP or a smaller IC package such as SOIC and so on, featuring a better isolation and a higher S/N ratio than a conventional switch. So it did not take long for me to decide to implement such a device into this new preamp.

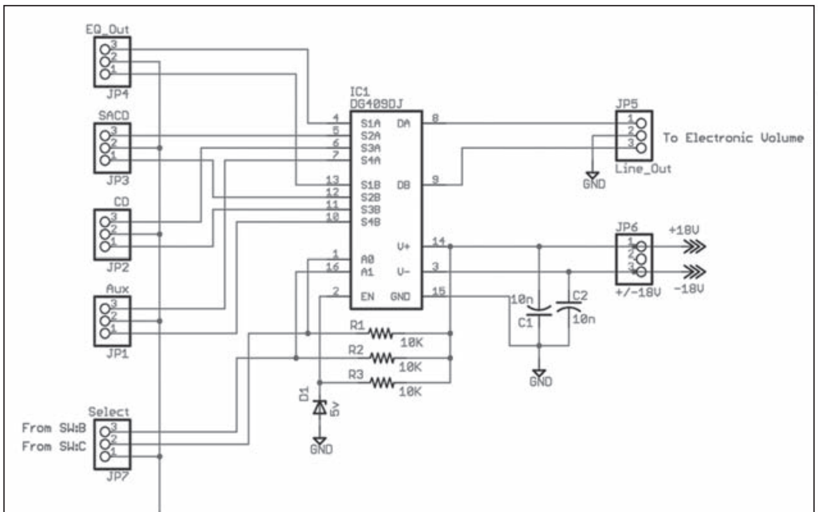


FIGURE 3: Electronic switch.

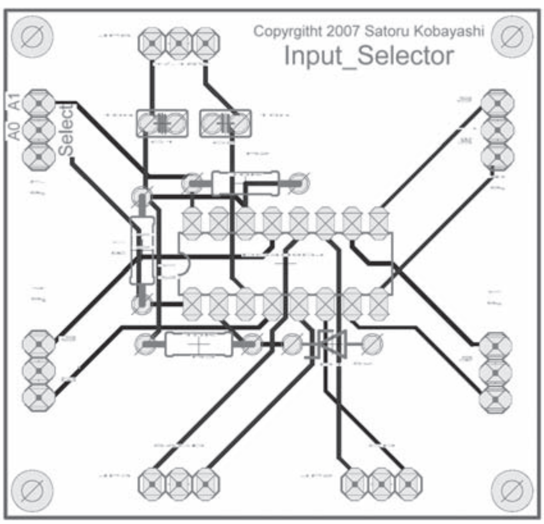


FIGURE 3a: Electronic switch PCB.

I first chose a SPDT switch selecting either an MC signal or MM signal after preamplified via a step-up transformer in case of the MC signal. I chose DG419 by Maxim in the US, whose compatible chips are available from several IC vendors such as TI, Vishay, Analog Devices, and so on.

Next I chose a dual 4-input, 1-output analog multiplexer, selecting one of four inputs (equalized LP signal, CD, SACD, or Aux signal) electronically. Through actual listening tests, I chose the Maxim DG409, which is compatible with the MAX4509, MAX309, MAX339, and so on.

Both electronic switches need a digital logic signal, a 0 or 1—i.e., below 0.8V or higher than 2.4V DC—to activate the switch or a multiplexer. So a conventional mechanical rotary switch works to apply such a logical input signal to these electronic switches. The 1 (high level) comes with a 10kΩ pullup resistor to a 5V power supply, and the 0 (low level) occurs by grounding a terminal. **Figure 3a** shows the PCB.

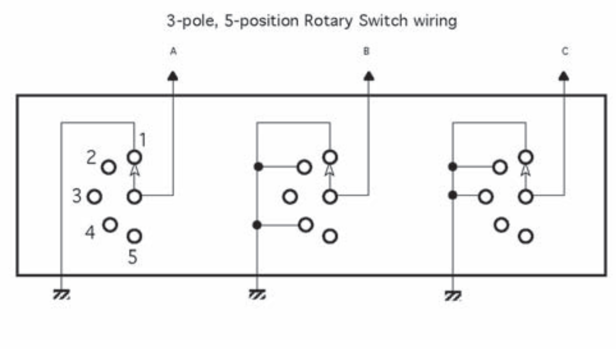
MECHANICAL SWITCH

DACT CT-3 features a 4-pole, 5-position switch that produces a smooth feeling when you turn the knob, so I love this component as well. Out of the 4 poles, 3 poles need to generate a logical signal to those switches. The first one generates either a "0" or "1" logic level. The second and third poles generate a binary logic code such as "00," "01," "10," or "11" with a combination of wiring shown in the **Fig. 4** diagram.

ELECTRONIC VOLUME

I learned that Marantz Japan introduced the high-end preamp SC-7S1 and SC-7S2, using Wolfson's electronic volume for the first time. This prompted me to use this device for my design because of its low-noise performance, high S/N ratio, and high crosstalk characteristic (**Photo 2**).

Fortunately, I found a dealership (www.tachyonix.co.jp/) locally in Japan to purchase this device with a customized microcontroller chip. I placed the order to get those, to taste a flavor of this device. The key component, WM8816 (www.wolfson.co.uk/), is available, and you can program its controller chip very easily using Microchip's 8-bit PIC technology



Switch Pos.	Input Source
1	MC
2	MM
3	SACD
4	CD
5	Aux

FIGURE 4: Mechanical switch.

MUNDORF®
High End Components Made In Germany Since 1985

MCap® RXF (Radial Xtra Flat) Capacitor
Featuring the ultimate winding geometry (edgewise) for
• extremely short, low-loss signal transmission,
• extremely reduced residual-resistance (ESR),
• remarkable low residual-inductivity (ESL).
Polypropylene capacitor-foil, alu metallized.
Grouted winding against microphonic effects.
Massive connection endplates.

• MCap® Supreme - unique induction-free winding technology for the utmost audiophile music performance!

• MSolder Silver/Gold - ensures the excellent sonic properties of all concerned components in your application – including, of course, the involved Mundorf parts.

• TubeCap® - high voltage MKP - compact as an electrolytic capacitor, as fast and voltage proof as a film capacitor. Due to its considerable low ESR and lower residual inductivity the TubeCap® contributes to great fidelity. Advanced no drying out and selfhealing properties!

• MLytic® HV - These electrolytic capacitors have been developed especially for the requirements of tube amplifiers. In addition to the utilisation in new developments, they are also outstandingly suitable for repairs and tuning of existing amplifiers.

See more audio innovations on
www.mundorf.com
and subscribe for our newsletter
info@mundorf.com
OEM and dealer inquiries invited

Recommended US Dealer
MADISOUND SPEAKER COMPONENTS
www.madisound.com
Exclusive Canadian Distributor
AUDIYO INC.
www.audiyo.com
Exclusive Australian Distributor
SOUNDLABS GROUP PTY LTD
www.soundlabsgroup.com.au

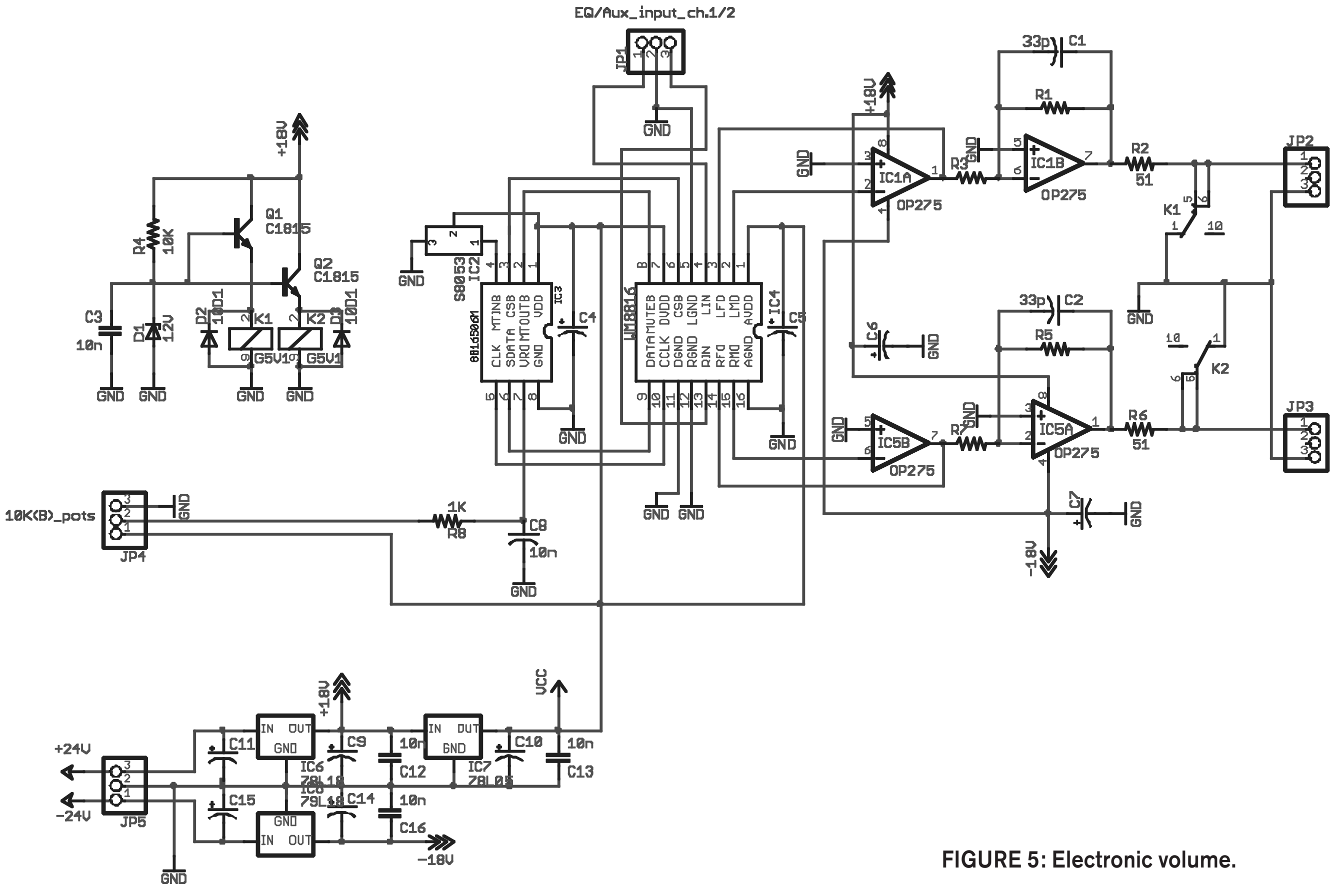


FIGURE 5: Electronic volume.

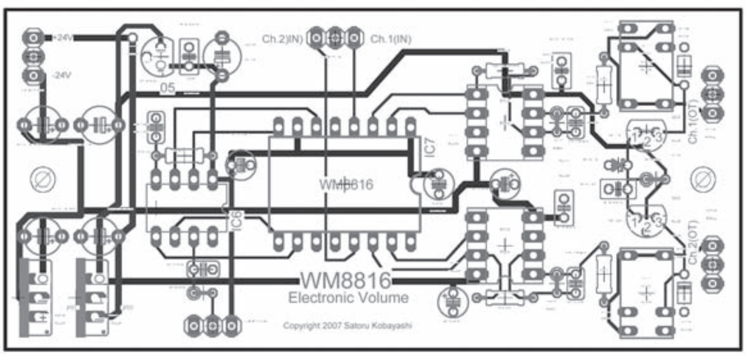


FIGURE 5a: Electronic Volume PCB.

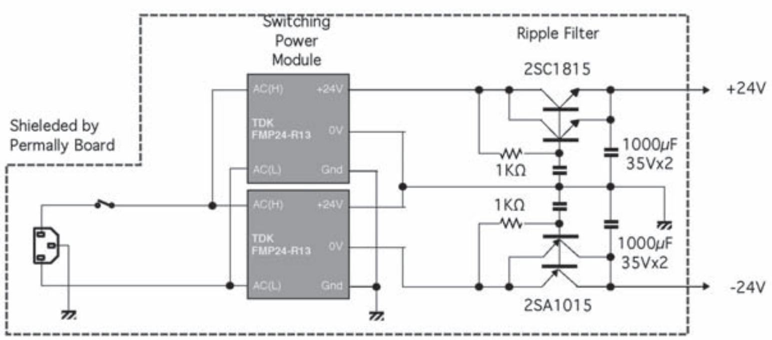


FIGURE 6: Power supply with a ripple filter.

(www.microchip.com/).

Prior to assembling the preamp, I performed an initial evaluation, using a standalone electronic volume, and putting the chip and the control chip as well as op amps onto a small universal PCB, enclosed in a neat case (**Figs. 5 and 5a**). The result from the listening test showed excellent presentation. This prompted me to upgrade my IC preamp instantly.

The buffer amplifier stage is also built in. Because the Wolfson WM8816 chip needs an extra inverting buffer by an op amp, generating the inverted output against the input signal, I included another inverting amplifier cascaded after the inverting amplifier.

SUBSONIC FILTER

When listening to LP records with a RIAA equalizer, I needed to implement a subsonic CR passive filter to avoid howling at the low tone below 40Hz at the final stage of this electronic volume. I placed the subsonic filter circuit just next to the non-filtered output jacks, mounting the filter onto a small chunk of universal PCB.

POWER SUPPLY

The original design used a ±24V switching power supply by TDK, but this time I added a ripple filter after the switching power supply in order to produce a slow-starting feature of the power supply with an approximate 0.6 second time delay. I built in a couple of permalloy boards to enhance a magnetic shield between the power supply section and the amp section and to improve S/N ratio (**Fig. 6**).

On the other hand, some audiophiles may wonder how switching power supply degrades the sound quality when such a power supply, installed inside the chassis, uses a 100kHz through 300kHz switching device over a PCB. I propose an alternative component using a PCB mount toroidal power transformer with a linear regulator chip of 78XX and 79XX series three terminal regulators (**Figs. 7** and **7a**).

PARTS SELECTION

Japanese dishes, according to traditionalists, need a good chef, well-chosen raw materials such as fish, meat, vegetables, gradients and so on, and cooking must be as simple as possible. With this philosophy of simplicity in mind, I carefully chose the components to fit perfectly into this amplifier.

• MC10 designed by Van der Veen

The small size of the MC-10 (**Photo 3**) allowed me to integrate it into the chassis. This will fit in my Denon DL-103R cartridge.

• Stainless-Steel Case

The 320 × 200 × 55mm case (**Photo 4**) is shell-structured with the top cover and

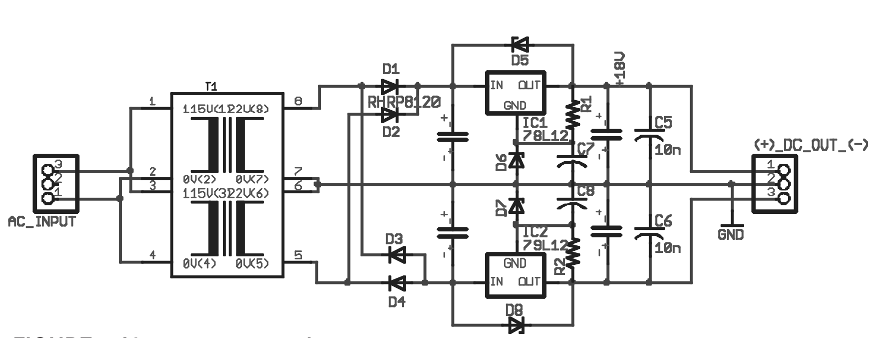


FIGURE 7: Linear power supply.

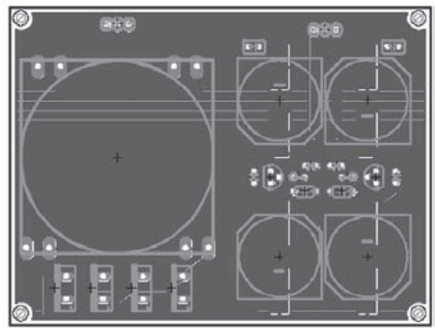
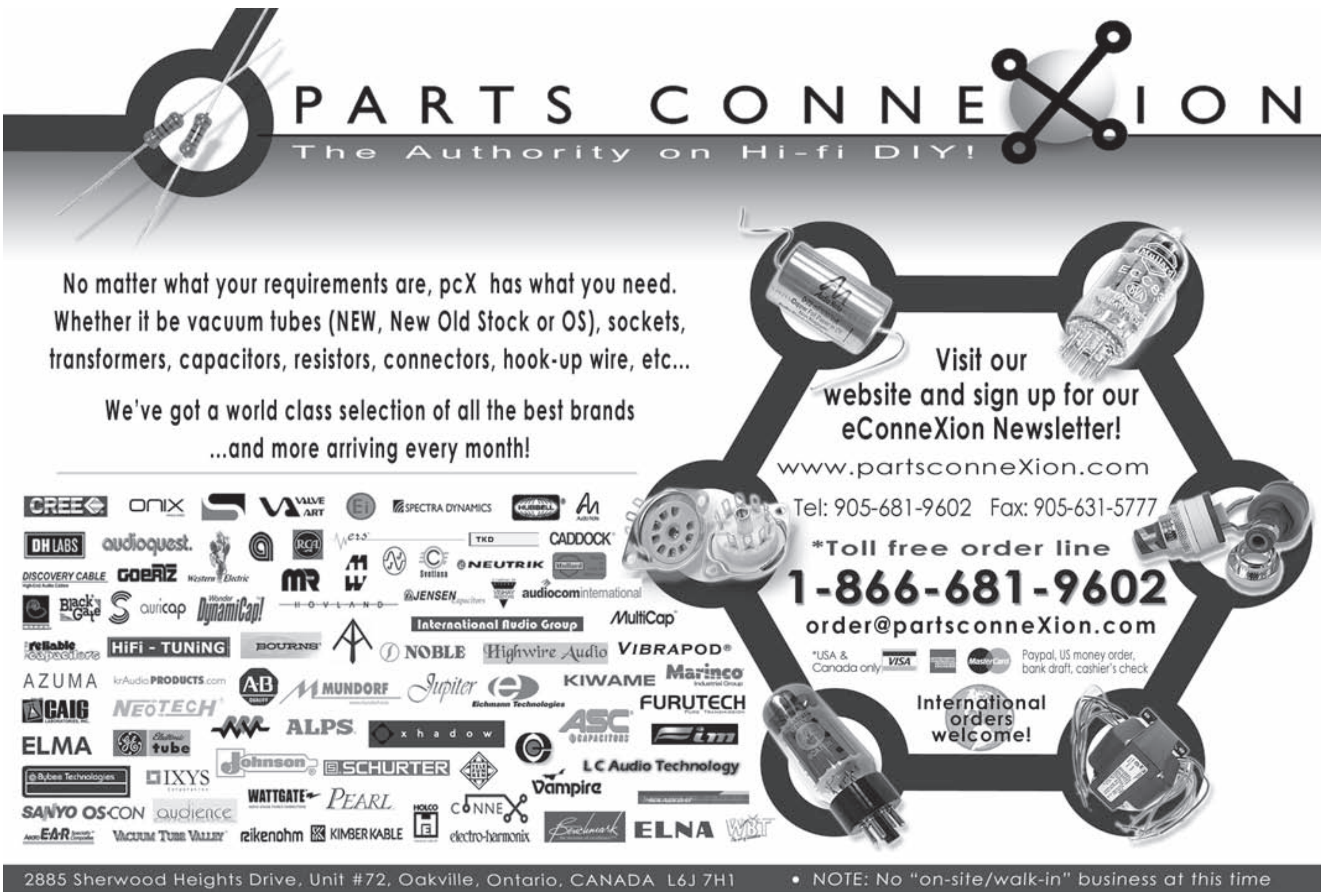


FIGURE 7a: Linear power supply PCB.



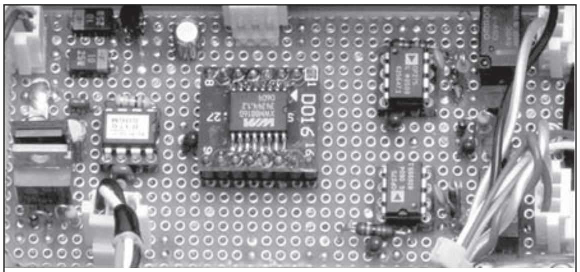


PHOTO 2: Switch components on PCB.

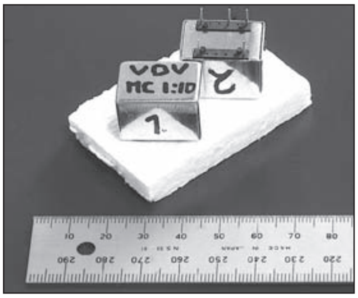


PHOTO 3: MC10 transformers.

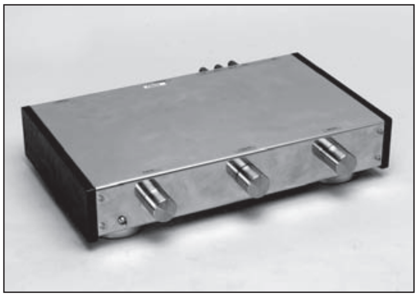


PHOTO 4: Stainless–steel case.

the internal case using a 1.5mm-thick stainless-steel plate. The major reason to use a top cover is to hide screws to fix the parts over the inner case. The top cover gives the amp a professional look and matches with stainless steel knobs by DACT on the front panel. The drawback is the added weight, which is over 2kg—heavier than a typical notebook PC.

The side walls are made of teak wood panels, 200W × 58H × 9mm thick. I polished the side panels with #400 through #600 sandpaper, drilled the inner sides, used three screws to attach onto the metal case, and polished again with walnut oil. As a result, the surface of the wood appeared smooth and professional-looking.

• Linear Scale CT-2 DACT Mono Volume

The Tachyonix control chip (8816S06M), which sends a program value of attenuation to WM8816 chip, needs a linear scale 10kΩ volume, instead of a log-scale volume, which has been used for the conventional analog audio equipment. Now I needed to modify the DACT-made CT-2 mono volume for this application. The DACT CT-2 volume uses chip resistors soldered over the PCB, where the chip resistors are placed peripherally to form a compact shape and its log scale curve. The value of those chip resistors is carefully calculated and selected to provide an accurate log scale curve.

But a linear scale volume for a digital volume chip does not need one at all. I pulled all chip resistors out of the PCB and put the new chip resistors of 470Ω evenly to make the attenuation curve a linear scale. Once modified, the new volume works with the control chip to generate a linear scale voltage to apply the control chip that converts an analog value to a digital code for WM8816 (**Photo 5**).

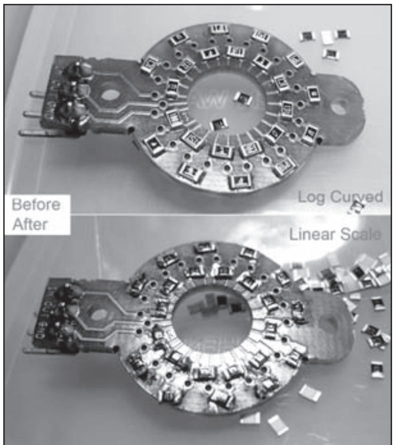


PHOTO 5: Linear scale CT-2 DACT mono volume.

ASSEMBLY

Because this project is an upgrade of the previous one, there was a restriction in terms of assembly board size. I used a universal PCB that provides 100mil spacing through holes, allowing me to assemble components easily. The PCBs are 1) RIAA equalizing amplifier, 2) electronic volume with a buffer amplifier, 3) subsonic filter, 4) electronic switch, and 5) a ripple filter board, installed separately in the case. I implemented a bunch of PCB connectors so assembly and disassembly for the adjustment would be simple and easy.

After a while, I had a chance to try PCB CAD software, called EAGLE. So a few universal PCBs were updated with this software, to get a professional-made PCB.

HOOKUP AND SIGNAL WIRES

Hookup wire was made by Sumitomo Electronic and featured a high melting point at 105° C. I also used Neglex brand signal wire by Mogami-wire in Japan (www.mogami-wire.co.jp/e/index.html) to link between the input and output terminals over the PCB and the terminals placed on the rear panel.

ADJUSTMENT

While no adjustment is required, you should at least have a tester at hand to check wiring errors prior to power-up. Once you have found no errors, then disconnect the internal DC power connectors and pull all IC devices out of the amp modules. Then turn the AC power on.

Check the power module output pin level, which should be +24V or so. And check the voltage of all Vcc pins of the IC devices, such as ±18V or 5V, respectively.

After this, turn off the power and plug the connector cable back in, put all IC devices into the socket, and turn the power on again for standby.

CHARACTERISTICS

Electronic Volume Stage

• Input Versus Output Characteristics

The electronic volume stage mounting Wolfson WM8816 chip and a couple of OP275 op amps showed a perfect linear curve; maximum output level showed approximately 12V RMS under ±18V regulated power supply (**Fig. 8**).

• Distortion

Distortion characteristics showed an extremely low value below 0.01%, even with 0.002% distortion of signal source, due to Analog Devices' OP275 chip (**Fig. 9**).

• Frequency Response and Crosstalk

Due to Wolfson's chip, the crosstalk showed an extremely low level below -100dB under EIAJ standard measurement conditions, bringing the silence in the listening room even at the maximum volume position of the preamp (**Figs. 10**

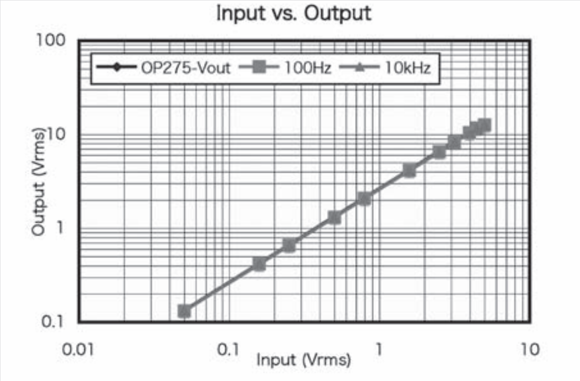


FIGURE 8: Input vs. output.

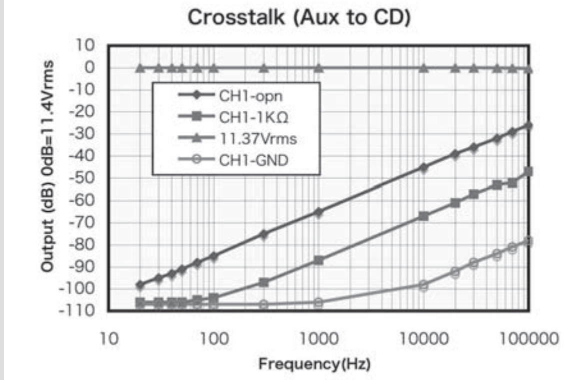


FIGURE 10: Frequency response & crosstalk (AUX->CD).

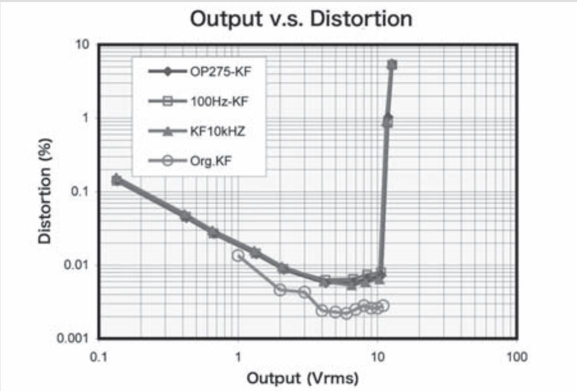


FIGURE 9: Output vs. distortion.

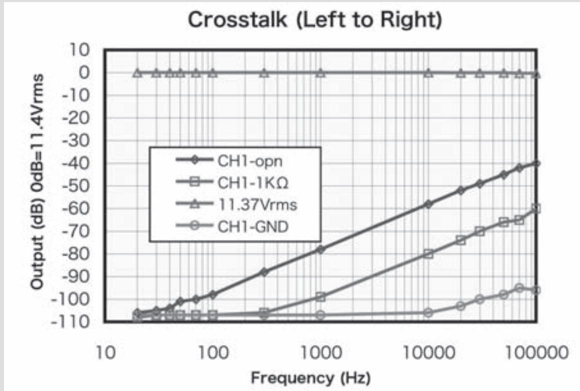
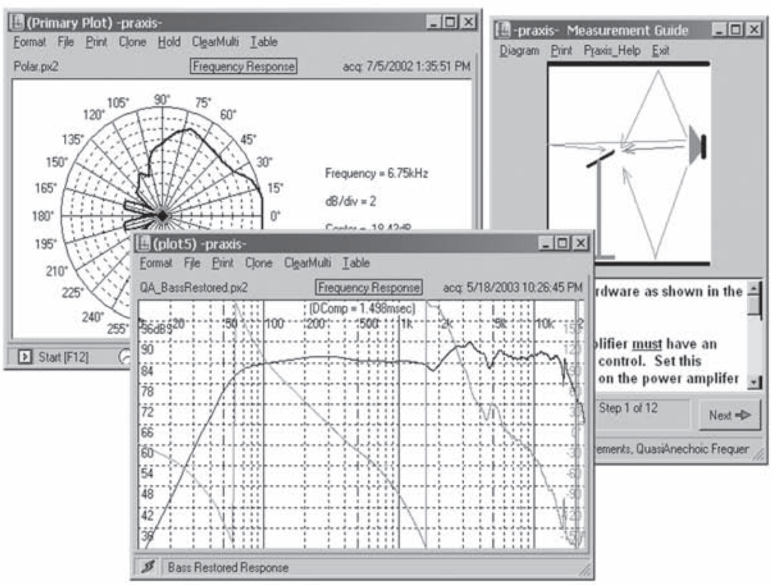


FIGURE 10a: Frequency response & crosstalk (Ch1->Ch2).

PRAXIS audio measurement system

- Provides full-featured customizable measurement including loudspeakers, room acoustics, noise surveys, transducers, electronics, vibration testing, PA alignment, and quality control.
- Flexible, portable system advances with the latest 24bit/192kHz soundcard converter technology.
- Latest version always available online.
- Informative website includes technical articles and downloadable demos.
- Friendly small company. No endless voicemail!



www.libinst.com
Liberty Instruments, Inc., P.O. Box 1454, West Chester, OH 45071 USA
Phone/Fax 513 755 0252, carolst@one.net

and **10a**).

•Subsonic Filter
At either MC or MM position when enjoying LP music, you might need a subsonic filter to avoid a howling caused by unwanted vibration via the room acoustic. Such a 40Hz low cut filter might work effectively, consisting of a basic passive CR filter (**Fig. 11**).

•Electronic Volume Attenuation Curve
The Tachyonix control chip works fine with the WM8816 chip, showing the linear stepped attenuation in log scale with an approximate 2.5dB per step. At the minimum position of the volume, the attenuation reaches to below -100dB, bringing the silence at the speaker system (**Fig. 12**).

Equalizer Amplifier Stage
• Input Versus Output Characteristics
With the RIAA equalizer and CR filter, the input versus output characteristics at 100Hz, 1kHz, and 10kHz showed a very clean linear curve in the range from the minimum value of the measurement system to the maximum output voltage at over 10V RMS (**Fig. 13**).

• Distortion
The minimum value shown is below 0.01%, which might be comparable to the manufacturer's preamp. At 100Hz, because of a hum, somehow the distortion value showed worse than at 1kHz and 10kHz (**Fig. 14**).

• RIAA Curve Deviation
In the range between 20Hz and 21kHz, I measured the RIAA equalizer devia-

Parts List

RIAA Equalizer Amplifier	
Components	Model, specification, manufacturer
MC step-up transformer	MC-10, Van der Veen (2)
op amplifier	OP275, Analog Devices (3)
Analog switch	DG419DJ, Maxim (2)
IC pin header	2-pin, 3-pin Nihon Attyaku Tanshi (8)
IC socket	8-pin (5)
resistor	39Ω ¼W (2)
resistor	100Ω ¼W (6)
resistor	3.3kΩ ¼W (4)
resistor	4.7kΩ ¼W (2)
resistor	10kΩ ¼W
resistor	47kΩ ¼W (4)
capacitor	33pF ceramic (4)
capacitor	47pF ceramic (2)
capacitor	0.68μF film 5% (2)
capacitor	0.01μF film (4)
capacitor	10μF 25V tantalum (9)
linear regulator	7818 or 78L18
linear regulator	7918 or 79L18
capacitor	1000μF 35V electrolytic (4)
Universal PCB	P-00185, Akizuki Denshi
PCB	custom made (OLIMEX)
RIAA Equalizer filter	
R1	33kΩ 1/6W~¼W (2)
R2	3.3kΩ 1/6W~¼W (2)
R3	130Ω 1/6W~¼W (2)
R4	100kΩ 1/6W~¼W (2)
C1	0.1μF film 5% (2)
C2	0.015μF × 2, film 5% (4)
C3	1.5μF film 5% (2)
IC pin header	8-pin Nihon Attyaku Tanshi (2)
Universal PCB	P-00186 Akizuki Denshi
Subsonic filter	
resistor	3.3kΩ ¼W (2)
capacitor	0.68μF (4)
IC pin header	3-pin Nihon Attyaku Tanshi (2)
Universal PCB	P-00184 Akizuki Denshi
Input selector	
Analog switch	DG409DJ, Maxim
IC socket	16-pin
IC pin header	3-pin Nihon Attyaku Tanshi (7)
resistor	10kΩ ¼W (3)
capacitor	0.01μF film (2)
Universal PCB	P-00186 Akizuki Denshi
Zener Diode	5V 500mW, Hitachi
Electronic Volume	
Electronic Volume	WM8816S, Wolfson
controller	8816S06M, Tachyonix

Parts List cont.

op amplifier	OP275, Analog Devices (2)
Voltage decector	S-8053ALR Seiki Denshi
transistor	2SC1815 Toshiba (2)
relay	G5V-1, 12V OMRON (2)
resistor	51Ω ¼W (2)
resistor	1kΩ ¼W
resistor	2.47kΩ ¼W Dale (2)
resistor	4.75kΩ ¼W Dale (2)
resistor	10kΩ ¼W
capacitor	33pF ceramic (2)
capacitor	0.01μF (5)
capacitor	10μF 35V electrolytic (9)
IC pin header	3-pin Nihon Attyaku Tanshi (5)
zener diode	12V 500mW, Hitachi
Silicon diode	10D1 (2)
IC pin socket	8-pin (3)
IC in-line pin	8-pin (2)
switching power supply	
switching regulator	FMP24-R13, TDK (2)
transistor	2SC1815 Toshiba (2)
transistor	2SA1015, Toshiba (2)
resistor	1kΩ ¼W (2)
capacitor	1000μF 35V electrolytic (4)
Linear power supply	
toroidal transformer	70015k, AMVECO International
diode	RHRP8120, Fairchild (4)
linear regulator	7812
linear regulator	7912
zener diode	6.2VV 500mW, Hitachi (2)
capacitor	1000μF, 50V (4)
capacitor	0.1μF 50V (2)
resistor	10kΩ ¼W (2)
IC pin header	3-pin Nihon Attyaku Tanshi (2)
Universal PCB	P-00184 Akizuki Denshi
Case and Peripherals	
Stainless-steel case	custom designed 320 × 200 × 55mm
permalloy board	Ohtama Denki (2)
rotary switch	CT-3, DACT
volume	CT-1-10kΩ, DACT, modified to linear scale
sidewall board	Teak wood, 200 × 55 × 9mm (2)
metal feet	50mm, 20mm height IAG made (4)
stainless-steel knob	25mm, DACT (3)
power switch	ARN01, 25A 125V AC, OTAX
extension rod	6mm, aluminum (2)
extension	6mm, no brand (2)
RCA jack	white, red (14)
ground pin	gold plated
IEC inlet	25V, fuse built-in
AC outlet	250V, 10A

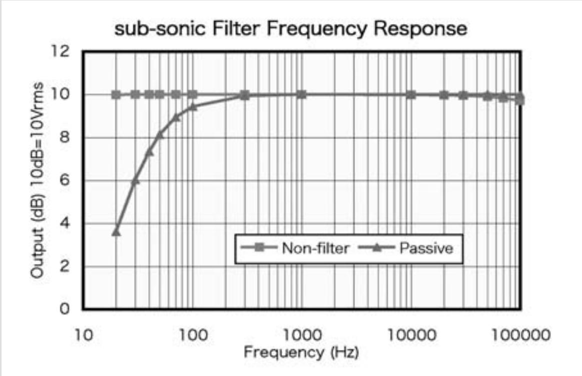


FIGURE 11: Subsonic filter frequency response.

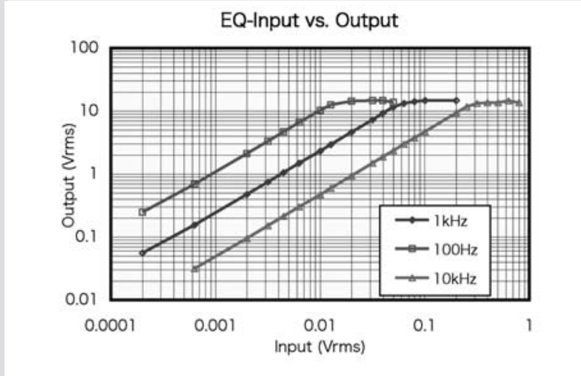


FIGURE 13: RIAA equalizer input vs. output.

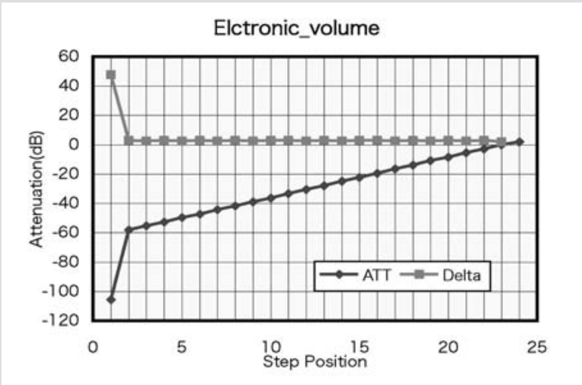


FIGURE 12: Electronic volume attenuation curve.

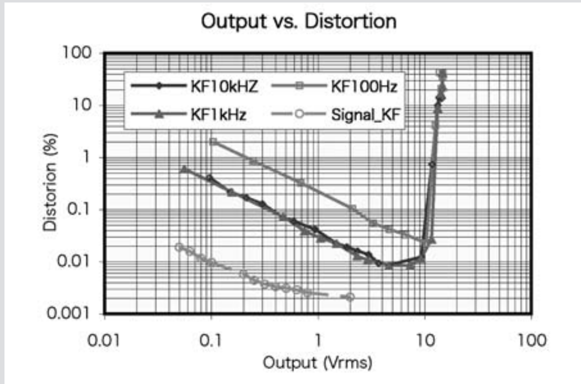


FIGURE 14: RIAA equalizer output vs. distortion.

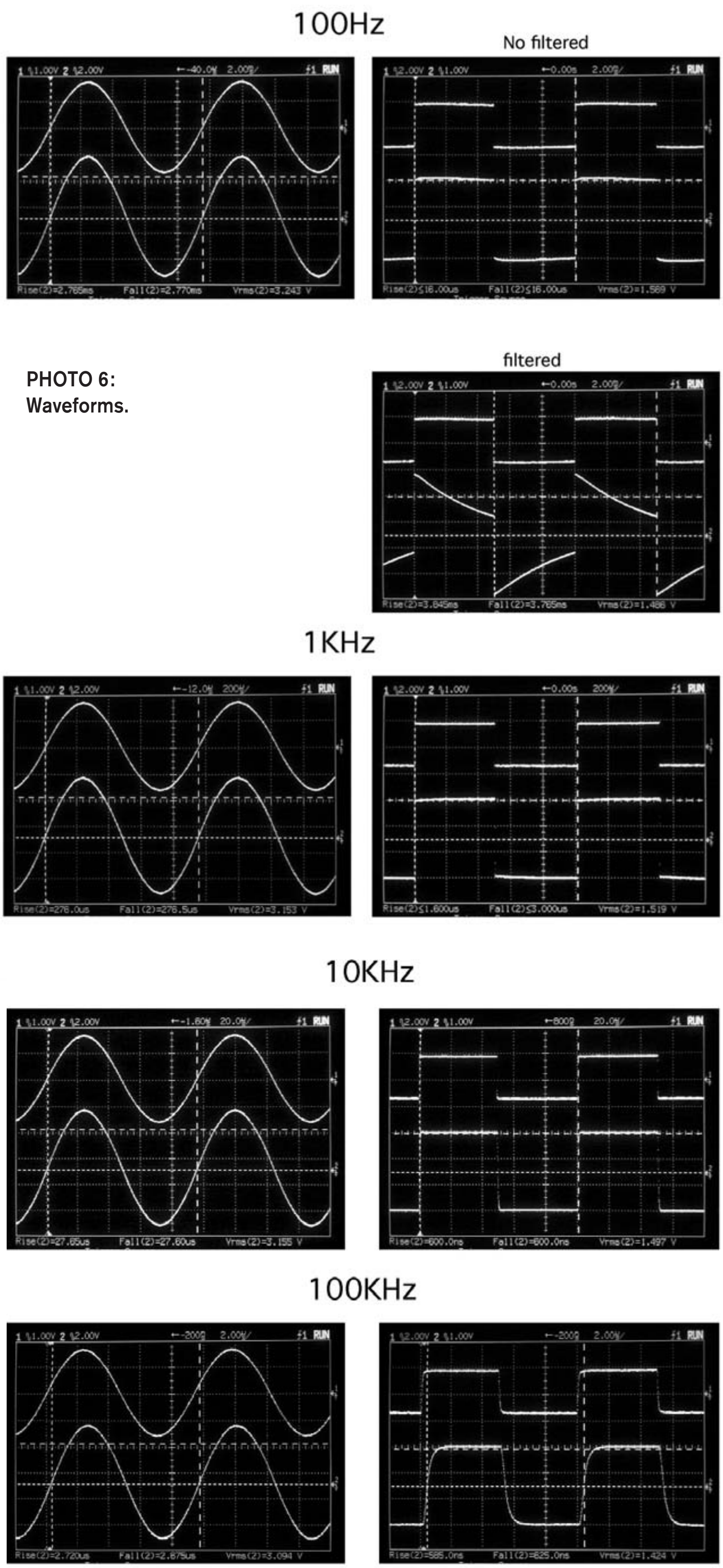


PHOTO 6: Waveforms.

tion by calculating the balance between the measured value and the theoretical value and plotted the values onto **Fig. 15**. The deviation calculated is extremely small below 0.1dB in the entire frequency range of RIAA equalizer (**Fig. 15**).

• Waveforms

Waveforms (**Photo 6**) at 100Hz, 1kHz, and 10kHz sine and square wave show a typical clean shape due to the lowest distortion environment. I observed neither visible distortion nor phase errors.

• Residual Noise Voltage

The measured residual output voltage level was extremely low as though it were a measurement instrument. Due to such an extreme low level of residual noise level, my B&W 802 speaker system does not generate any hum—even in CD mode at the front edge of speaker cone with the maximum volume level of both power amplifier (Luxman M-7f) and this preamp. The only sound I could hear was a noise surrounding me coming from outside my house, which is typical Japanese style.

Even in the MM input mode, the speaker produces just a clean noise other than a hum (100Hz or so). During this listening session, I could detect only the silence.

In the MC position, some improvement is needed, because of the magnetic shield structure; it produced some S/N ratio degradation, which corresponds to 10dB or so. The measured noise level was approximately 3× worse than at MM input. However, at the regular listening volume position on my system, which is about the mid-position of the volume (corresponding to 12 o'clock position), the noise was negligibly small (**Table 1**).

LISTENING IMPRESSIONS

What was most noticeable when listening to this amp was the perfect silence even at maximum volume before starting the CD or LP players. Furthermore, no crosstalk was observed at all.

RIAA EQUALIZER

This seemed very natural to me. I have tested several LPs, classical music, jazz, R&B, Japanese POPs, Japanese Enka,

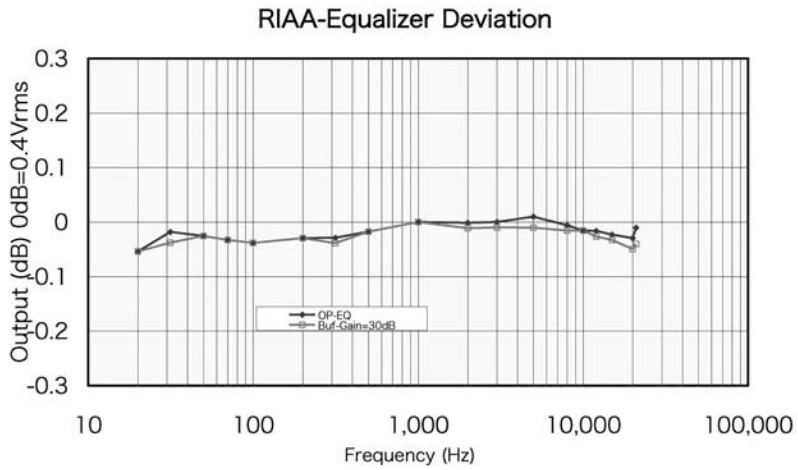


FIGURE 15: RIAA equalizer deviation.

TABLE 1

A-weighed filter	AWT-30	Nihon-Audio		
Right Channel				
Residual Noise	vol. min.	vol. mid.	vol.max.	Ω
Grounded	25	33	136	µV
A Filtered	5	7	19	µV
1kΩ-Grounded	42	43	135	µV
A Filtered	5	6	19	µV
Residual Noise	vol. min.	vol. mid.	vol.max.	Ω
MM-Grounded	43	55	400	µV
A Filtered	5	8	100	µV
MM-1kΩ-Grounded	44	55	410	µV
A Filtered	5	8	108	µV
MC Grounded	43	85	2050	µV
A Filtered	6	16	320	µV
MC-1kΩ-Grounded	43	77	1750	µV
A Filtered	5	11	285	µV

and so on. The sound of those was really natural and exhibited no stress and strong enhancement at all. As compared to a few CDs, which are identical to LP records, both showed the same presence as well.

CD PRESENTATION

It surprised me that Wolfson's electronic volume chip produced an excellent presentation of CD music. I found this electronic volume chip with an external op amp produced a new era of the sound as compared to the valve line amp. Also, I could customize the sound by altering the external op amp with other favorites, such as the OPA627.

Listening Test with the Valve Line Amp

I recently had a chance to test this with the valve line amplifier using a 12AX7 valve with 18dB NFB between its plate and a grid terminal. This valve was sorted out of over 20 tubes designed and built by a friend of mine.

The result was no significant sound difference; it was difficult to describe the difference. Somehow, because he loves the valve amplifier, he believed the sound of my amplifier gave a sort of solidness as compared to his 12AX7 line amp. *aX*

Measurement Equipment
1) Audio Analyzer HP-8903B
2) Audio Generator Kenwood AG-204D
3) Audio Generator HP-3311
4) Attenuator HP-3467A
5) Digital Multimeter Fluke 177
6) Oscilloscope HP-54600B

CONTRIBUTORS

Edward T. Dell, Jr., ("Music Inside the Brain," p. 6) is owner and publisher of Audio Amateur, Inc., publishers of *audioXpress, Voice Coil,* and *Multi Media Manufacturer* magazines.

Satoru Kobayashi ("IC Preamp with Electronic Level and Selector," p. 8), from Tokyo, Japan, has been interested in audio and ham radio since he was in his teens. After majoring in EE in Tokyo, he joined the semiconductor industry, designing DRAM chips for a living, although he now works in the technical and marketing area of semiconductor packaging industry. He periodically writes on the subject of audio for a few different magazines.

Paul J. Stamler ("Adaptable Power for Tube Amps," p. 20) is a recording engineer/producer, musician, and technical writer; he also hosts a radio program, "No Time to Tarry Here," featuring traditional folk music and related stuff. He has delighted in 78s since he was a boy, when they were still being made.

Jack Walton ("High End 120W MOSFET IC Driven Amp," p. 30) is an investment consultant and entrepreneur in Short Hills, NJ. His educational background is in chemistry, physics, and finance. He has had a lifelong interest in electronics, ham radio, photography, and the arts.

Matthias Brennwald ("MATAA: A Free Computer-Based Audio Analysis System," p. 36) lives in Switzerland.

David J. Weinberg (Review, HIFICRITIC, p. 48) is an engineering consultant and technical journalist on audio, video, and film technology. He provides audio and home theater engineering consultation and professional on-location digital audio recording services to companies, radio stations, and individuals. He brings to his work an MSEE, a First Class Radiotelephone license, and over 40 years of continued study and active involvement in the audio, video, and computer industries. He is Vice Chairman of the Audio Engineering Society's DC section, a manager in the Society of Motion Picture and Television Engineers' DC section, and membership officer of the Boston Audio Society (www.BostonAudioSociety.org).