AUDIO BASICS

A IRREGULAR NEWSLETTER OF AUDIO INFORMATION

NOVEMBER, 1997

Welcome back to *Audio Basics*.

It's been a while since we last said hello, and we have a lot to tell you about.

This issue I'd like to introduce a new *Audio Basics* feature written by the founder of **biró** technology, Mithat Konar. In this and upcoming installments, Mithat will be discussing many of the issues connected with loudspeaker design. You can get a sneak peak at some of what's to come by visiting the **biró** website at http://www.winternet.com/~biro/. For now, the **birólogue** column starts on page two.

The $ensible Sound has recently published a number of reviews and other tidbits you'll want to know about. Both the Fet Valve preamp and the Fet Valve power amp got a very favorable run-down in the Sept/Oct 97 issue. The reviewer liked the preamp so much that it now serves as his new reference—replacing older AVA equipment! In the power amp review the author states, " I have never heard better sound in my system than with the Fet Valve preamp/power amp combination." Not surprisingly, both pieces appear on their $ensible Choices list. Also appearing on their preamp list (Sept/Oct 97) is the Ωmega III EC—which netted a "$enible Standard" rating as well, and our Ωmega III TOPP-DAC made it to their list of recommended DACs (Nov/Dec 97).

The long-awaited and very favorable review of the **biró** L/2 finally appeared in the Sept/Oct 97 issue. Previously, both the L/2 and its bigger brother, the L/1, got top honors in **T$S**'s list of recommended loudspeakers (?/? 97). This review complements that of the L/1—from the ?/? issue—and further validates what we've been saying for some time now: **biró** loudspeakers represent unprecedented performance and value. Check out our website (http://www.avahifi.com) for copies of reviews as well as catalog contents, up-to-date used equipment listings, some *AB* strides, and more.

We recently completed a cost analysis of our entire product line and discovered that on some products we've actually been losing as much as $10 per unit! Various imcremental increases in the cost of materials and other overhead have finally caught up with us. What this means is that effective immediately, we have a new price list with somewhat higher prices.

The good news is that *Audio Basics* readers can purchase new AVA equipment at the old prices until 12/31/97. And there's more good news. As a holiday season incentive, **biró** technology is having a factory-authorized sale—with 15% off the normal retail prices on orders placed before 12/31/97. Sale price on the L/1 is $1270/pr. and the L/2 is on sale at $845/pr.

Published by Frank Van Alstine of Audio by Van Alstine, Inc., 2202 River Hills Drive, Burnsville, Minnesota 55337 USA. Telephone 612 890-3517, e-mail info@avahifi.com, http://www.avahifi.com. Subscription price is FREE plus $10.00 per year for foreign air mail. Annual back issue sets available from 1982 to 1994 at $15.00 per year.

© Copyright, Audio by Van Alstine, Inc., 1997. All rights reserved. No part of AUDIO BASICS may be reprinted or reproduced in any manner without the permission of the publisher.

b i r ó l o g u e

biró technology
p.o. box 582
circle pines, mn 55014 usa

tel.: 612.786.6643
e-mail: biro@winternet.com
www: http://winternet.com/~biro/

One of the aims of **biró** technology is, quite simply, to make the whole of the audio world a better place. In our opinion, a major obstacle keeping audio from moving forward and better assuming its proper role in the universe—as a servant to truer and deeper musical experiences—is the fact that it is treated by a preponderance of the industry as essentially a marketing-oriented activity rather than as an engineering or music-oriented one. What this means is that the less you, the audio consumer, know about how things really work, the easier it will be for the marketing people to go to work on you and make you buy (literally) what they want you to. The flip-side of this is that the more you know, the more easily you'll be able to spot the exaggeration, hyperbole, or outright lies in a marketing effort, and the better decisions you'll be able to make. Ultimately, this means that the deserving products and companies will get rewarded, and the ones who survive by exploiting your ignorance, neuroses, and/or insecurities feel the pressure to get real.

It was with this in mind that I decided to write a series of articles covering some of the often-asked questions regarding loudspeakers. From the outset I must apologize for being unable to break things down into bite-sized factoids that you can easily tuck away in your brain. The truth is, loudspeaker drivers and systems are deceptively complicated things. And while I have tried to simplify things as much as possible, our primary concern has been to not give so little information as to create a bigger problem than the one I am trying to solve. Especially true in audio, a little knowledge can be a dangerous thing.

And so, we begin our series with...

Q. What is the best material for loudspeaker cones?

A. As anyone shopping for speakers is undoubtedly aware, loudspeaker cones are made from a variety of materials, each one being claimed to have some property or another that makes it better than all the rest. Unfortunately, in spite of what the ad copy writers would like you to believe, there is no single "best" cone material for loudspeaker applications. Different cone materials have different mechanical and acoustical properties that result in various performance trade-offs, making them better or worse suited for various situations. However, almost always the choice of material involves some kind of compromise.

The basic material parameters that affect the acoustic performance of a cone material are its density, stiffness, and internal lossiness (i.e., the internal damping). Very loosely speaking, the stiffer and lighter a cone material is, the wider the bandwidth of the cone will be. The more lossy it is, the smoother the response. Unfortunately, the above parameters are typically interactive, and it is very difficult to optimize all three parameters simultaneously. To find out why, we need to understand a little better what happens in a speaker cone when it is making music.

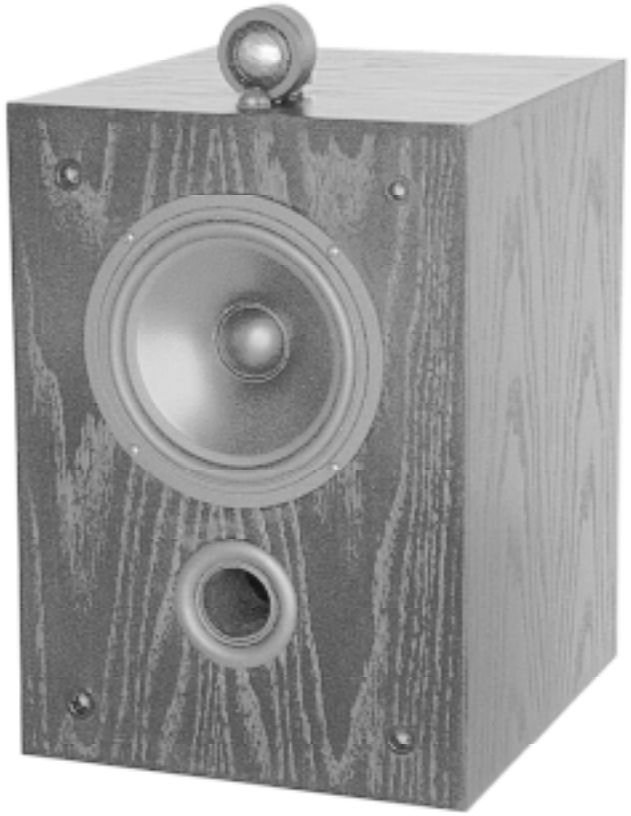
At low and very low frequencies, a loudspeaker cone moves essentially as a homogeneous unit, and there is only one cone parameter that has significant impact on the performance of the driver: the total cone mass (which is itself a function of the cone material's density and the total amount of material used).[1] All other parameters being equal, the greater the cone mass,

the lower the frequency of the fundamental resonance of the driver, the less damped the resonance, and the less sensitive the driver will be. However, other driver component parameters—such as the suspension compliance and lossiness—also affect the resonance, damping, and sensitivity of the driver. All these variables must be considered when performing a design analysis to get you to the desired result. Fortunately, the mathematics describing the low-frequency behavior of loudspeakers is not terribly complicated, and so the modeling of loudspeaker drivers at low frequencies is a fairly straightforward task.

At higher frequencies (where the wavelength of the sound wave becomes comparable to the radius of the cone) the cone ceases to move as a homogeneous unit, and our low frequency model breaks down. At these frequencies, you'd do best to think of the sound wave as starting at the base of the cone (at the voice-coil former/cone joint) and propagating outward towards the edge of the cone. When the wave hits the edge of the cone, it is reflected back toward the base of the cone (towards the voice-coil former). When the wave hits the voice-coil former, it is again reflected back towards the edge of the cone, and the whole process starts again. This process is similar to sound waves traveling in a room, hitting a wall, reflecting back, etc. In both situations, significant standing waves result, and these standing waves can produce really, really huge peaks and dips in the response of a driver unless steps are taken to counteract it. (For example, the first standing wave resonance for a good 6-1/2" driver typically falls in the upper midrange, well within the range where it would be contributing significantly to the output of a two-way system.)

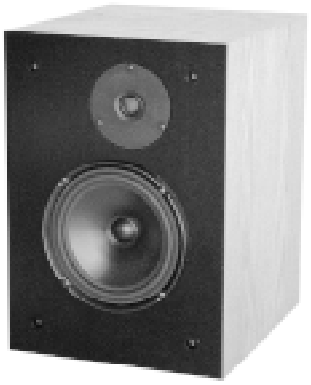
Fortunately, most cone materials have a degree of lossiness in them—meaning that they are imperfect sound conductors. A portion of the wave energy travelling through the material is converted to heat, and the wave is gradually attenuated as it travels down the cone. Such lossiness reduces the intensity of the standing waves by reducing the intensity of the reflected wave energy, thereby smoothing the response of the driver. Different cone materials vary greatly in the amount of internal damping they have, ranging from almost none (metal) to a lot (some plastic materials).

Another means of controlling the intensity of standing waves in a cone is the cone surround. Typically, a speaker cone is supported around its edge by some kind of material—usually a rubber-like elastomer or foam, but sometimes cloth or even accordioned paper. One function of this surround is to allow the cone to move back and forth with relative ease at low frequencies while providing an air-tight seal. At higher frequencies, it can be used to absorb some of the cone's standing wave energy. As the wave travelling out



[1]Having said that, I would be amiss if I did not mention that there might be additional mechanical properties which influence the low frequency behavior of cones in subtle, difficult to measure ways. Unfortunately, opinions vary widely on this subject, and there is very little research backing up any claims one way or the other. Stay tuned for more on this.

from the base of the cone hits the surround/cone interface, a portion of the wave energy is actually transmitted into the surround material, with the remaining energy immediately reflecting back into the cone. Depending on how lossy the surround material is, the portion of the wave energy transmitted into the surround may be converted into heat (effectively damping resonances), or it may be bounced around inside the surround and then back into the cone (creating a more complicated series of resonances). Synthetic rubber-like surround materials are typically formulated to have very high internal losses, although there are a few that are surprisingly low. Foam surrounds are typically less lossy than "rubber" ones, although I'm betting that someone, somewhere makes a foam that is very lossy. In either case, the amount of loss in a surround (or a cone for that matter) may or may not be constant with frequency.



The correct amount of damping in the cone and surround depends on the demands of the situation. Generally speaking, you want enough loss in the combined cone/surround system to produce a smooth and well-controlled high frequency response, unless all the standing wave resonances occur well outside the bandwidth under which the driver will be used.[2]

The usable bandwidth of a cone is determined largely by the frequency of the first standing wave, and the faster the wave travels through the cone material, the higher in frequency this will occur. The primary mechanical properties which determine the rate of sound propagation through the material are its stiffness, density, and thickness: stiff, light, thick cones producing faster rates of sound propagation than limp, dense, thin ones. Unfortunately, the general tendency is that the lighter and stiffer a material is (yielding wider bandwidths) the less internal loss it has—meaning that the less damped the standing waves and rougher the frequency response will be. In addition, the more dissimilar the cone material is from the surround, a stiff metal cone with a loose and lossy elastomer surround, for example, the less wave energy will be transmitted into the surround, and the less effective it can be at damping the standing waves. These characteristics make it very difficult to get wide bandwidth and smooth response simultaneously from a cone. To further complicate matters is the very annoying phenomenon that the lossier a surround material is, the less linear it tends to become at high excursions—as it might experience when the driver is reproducing large low-frequency signals. So if on top of a wide, smooth bandwidth you also want good low frequency performance, you are stuck with a very complicated juggling act where no one can be completely happy, but with luck nobody will be overly let down.

While the above is certainly not an exhaustive description of every aspect of loudspeaker cone behavior, it does hit on some of the major ones. Indeed, one could write several books on the subject. (And I wish someone would!)

Unfortunately, our space here is limited, and so I must bring to an end the first part of this series. Next time I'll begin to discuss specific cone materials and their general characteristics. In the meantime, if you have any comments or questions, please feel free to write, call, or send me e-mail at `biro@winternet.com`. Or, if you like, visit our web site at `http://www.winternet.com/~biro` for more answers to your questions.

©1997 Mithat Konar/
biró technology

[2]Another option is to use active or passive equalization to compensate for the resonances. This turns out to be a pretty bad idea since the actual frequencies of the resonances move around a little depending on manufacturing variances and ambient conditions. A compensation circuit that works for one driver on one day may or may not work on a different driver or on a different day.

Audio by Van Alstine, Inc. Price List September 15, 1997

AVA PREAMPLIFIERS (factory wired and kits)

Ωmega III RB Solid State Preamp (wired)	399.00
Ωmega III RB Solid State Preamp (kit)	299.00
Ωmega III SL Solid State Preamp (wired)	449.00
Ωmega III SL Solid State Preamp (kit)	349.00
Ωmega III EC Solid State Preamp (wired)	649.00
Phono, Inverter, Tape Buffer options (each, wired)	90.00
Phono, Inverter, Tape Buffer options (each, kit)	60.00
Ωmega III SF RIAA Phono Preamp (wired)	369.00
Ωmega III SF RIAA Phono Preamp (kit)	299.00
Ωmega III SF Phase Inverter Bridge (wired)	369.00
Ωmega III SF Phase Inverter Bridge (kit)	299.00
Ωmega III SF Buffered Line Driver (wired)	369.00
Ωmega III SF Buffered Line Driver (kit)	299.00
Super Pas 3i SL Tube Preamp (wired)	669.00
Super Pas 3i SL Tube Preamp (kit)	529.00
Super Pas 4i SL Buffered Tube Preamp (wired)	709.00
Super Pas 4i SL Buffered Tube Preamp (kit)	569.00
Super Pas 3i RB Tube Preamp (wired)	549.00
Super Pas 3i RB Tube Preamp (kit)	439.00
Super Pas 4i RB Buffered Tube Preamp (wired)	569.00
Super Pas 4i RB Buffered Tube Preamp (kit)	459.00
Super Pas 3i SF Tube Phono Preamp (wired)	449.00
Super Pas 3i SF Tube Phono Preamp (kit)	379.00
Super Pas 4i SF Buffered Phono Preamp (wired)	479.00
Super Pas 4i SF Buffered Phono Preamp (kit)	399.00
Fet Valve RB Hybrid Tube Preamp (wired)	789.00
Fet Valve SL Hybrid Tube Preamp (wired)	899.00
Fet Valve EC Hybrid Tube Preamp (wired)	1099.00
RIAA Phono or Hybrid Bridge options (either)	180.00
Buffered Tape Output option (wired)	90.00
Fet Valve SF Hybrid Phase Inverter Bridge (wired)	649.00
(If purchased with an AVA amp or preamp)	549.00
Fet Valve SF Hybrid RIAA Phono Preamp (wired)	649.00
add for 240V wiring (any new AVA preamp)	25.00
Kit Constructions Plans Only (specify)	20.00

AVA POWER AMPLIFIERS (factory wired)

Δelta 200 Amplifier	599.00
Δelta 260 Amplifier	749.00
Ωmega III 200 Amplifier	799.00
Ωmega III 260 Amplifier	999.00
Ωmega III 260hc Amplifier	1099.00
Ωmega III 440 Amplifier	1299.00
Ωmega III 440hc Amplifier	1399.00
Fet Valve 350hc Hybrid Tube Amplifier	1499.00
Fet Valve 550hc Hybrid Tube Amplifier	1799.00
add for 240V wiring (any new AVA amplifier)	50.00

AVA TOPP-DAC D-TO-A CONVERTER

Ωmega III Solid State TOPP-DAC	599.00
Fet Valve Hybrid Vacuum Tube TOPP-DAC	949.00
biró t2c Optical-to-Coax Converter	99.00

AVA PHONO CARTRIDGE

Longhorn Grado Phono Cartridge	99.00

GRADO HEADPHONES

Grado SR-225 state of the art Headphones	169.00

BIRO LOUDSPEAKERS

biró L/1 high performance loudspeakers (pair)	1495.00
biró L/2 high performance loudspeakers (pair)	995.00

REPLACEMENT VACUUM TUBES

Set of 4 select high gain 12AX7A tubes	40.00
Set of 2 select high gain 12AX7A tubes	25.00
Set of 2 select high gain 12AT7A tubes (350hc, 550hc)	25.00
12X4 Rectifier Tube for Dyna Pas	10.00
Set of 2 select 6GH8A tube for Super 70i	20.00
Set of 4 select 6CA7 tubes for Super 70i	80.00

AVA PREAMP CIRCUITS FOR YOUR DYNA CHASSIS

Ωmega III Pat-5	Rebuild Kit 279.00	Factory Rebuild	399.00
Ωmega II Pat-4	Rebuild Kit 239.00	Factory Rebuild	359.00

Super Pas Three Rebuild Kit (tubes extra)	279.00
Super Pas Three Factory Rebuild (with tubes & jacks)	499.00
line and phono buffers factory installed	199.00
line buffers only factory installed	125.00
Rebuild Plans Only (specify kit)	20.00
Rebuild Plans and Bare PC Cards Only (specify kit)	79.00

Dyna Preamp Rebuild Options

Gold Plated Jack Set	Kit Price 60.00	Factory Installed	99.00

Fiberglass Selector Switch Kit for Super Pas Three	50.00
Fiberglass Selector Switch Factory Installed	75.00

AVA AMPS FOR YOUR DYNA/HAFLER CHASSIS

Dyna St-70 Vacuum Tube Amplifier Chassis

Super 70i Rebuild Kit (includes 6GH8A tubes)	199.00
Super 70i Factory Rebuild (with tubes and jacks)	399.00
AVA Input - Output Jack Set kit for St-70	49.00
Super 70i Rebuild Plans and Bare PC Card Only	50.00

Dyna St-120 & St-80 Chassis

Δelta 120 Circuits or Δelta 80 Circuits	399.00
Ωmega III 170 Circuits (with new toroid transformer)	599.00

Dyna St-150 Chassis

Δelta 150 Circuits	499.00
Ωmega III 240 Circuits	649.00

Dyna St-400, St-410, & St-416 Chassis

Δelta 400 Circuits	599.00
Ωmega III 400 Circuits	899.00

Hafler DH-200, DH-220, & XL-280 Chassis

Δelta 250 Circuits	499.00
Ωmega III 250 Circuits	749.00

Hafler DH-500 & XL-600 Chassis

Δelta 500/600 Circuits	699.00
Ωmega III 500/600 Circuits	999.00

Check with us for special system prices when you order at least two pieces of electronics and loudspeakers at the same time.

All prices & specifications are subject to change without notice.

Add 6.5% sales tax for orders to be delivered in Minnesota.

All prices are plus shipping. Check shipping rate chart on page 35.

Audio by Van Alstine, Inc. • 2202 River Hills Drive • Burnsville, MN 55337 • 612-890-3517

Component Factory Retrofit and Upgrade Prices September 15, 1997

Chassis	From	TO	Price	Notes
Preamplifiers				
AVA EC, SL, RB	Fet Valve Line Preamp	Add Phono or Inverter	300.00	either but not both
AVA EC, SL	Fet Valve Preamp	Add Tape Buffers	150.00	
AVA EC, SL, RB	Ωmega III	Add Phono, Inverter, or Buffers	150.00	each
AVA SL	Super Pas 4 (kit or wired)	Super Pas 4i	100.00	major low cost upgrade
AVA SL	Super Pas 3 or 3i	Super Pas 4i	200.00	
AVA SL	Ωmega II	Ωmega III	250.00	+ $90 per extra (phono, inverter, buffer)
Dyna PAT-4	Any AVA Circuits	Ωmega III	300.00	tone controls $75 extra if now disconnected
Dyna PAT-5	Any AVA Circuits	Ωmega III	300.00	tone controls $75 extra if now disconnected
Dyna PAT-5	Any AVA Circuits	add AVA gold jack set	99.00	
Dyna PAT-5	Any AVA Circuits	add fiberglass switch	100.00	
Dyna PAS-3	Super Pas Three	add Ωmega II buffers	199.00	phono and line buffers
Dyna PAS-3	Super Pas Three	add Ωmega II buffers	125.00	line buffers only
Dyna PAS-3	Super Pas Three	add fiberglass switch	100.00	
Dyna PAS-3	Super Pas Three	add AVA gold jack set	99.00	
Power Amplifiers				
AVA Chassis (any)	Ωmega or Ωmega II	Ωmega III	400.00	
AVA Chassis (any)	Δelta	Ωmega III	500.00	
AVA Chassis (any)	Fet Valve 300hc	Fet Valve 350hc	500.00	
AVA Chassis (any)	Fet Valve 300hc	Fet Valve 550hc	700.00	
AVA Chassis (any)	Fet Valve 500hc	Fet Valve 550hc	500.00	
Dyna ST-120	Ωmega or Ωmega II	Ωmega III 170	400.00	
Dyna ST-120	Mos-Fet or Δelta	Ωmega III 170	550.00	includes new toroid power transformer
Dyna ST-150	Ωmega or Ωmega II	Ωmega III 240	400.00	120 watts per channel!
Dyna ST-150	Mos-Fet or Δelta	Ωmega III 240	500.00	
Dyna ST-150	Fet Valve 200 or 300	Fet Valve 350hc	1000.00	includes new AVA chassis w/12 outputs
Dyna ST-410	Fet Valve 300i	Fet Valve 350hc	1000.00	includes new AVA chassis w/12 outputs
Dyna ST-410	Fet Valve 500	Fet Valve 550hc	1200.00	includes new AVA chassis w/12 outputs
Dyna ST-400, 416, 410	Ωmega or Ωmega II	Ωmega III 400	400.00	
Dyna ST-400, 416, 410	Mos-Fet or Δelta	Ωmega III 400	600.00	
Hafler (any chassis)	Ωmega or Ωmega II	Ωmega III	500.00	300v/μS slew rate!
Hafler (any chassis)	Mos-Fet or Δelta	Ωmega III	600.00	

Notes:

All prices are plus return shipping cost. Refer to shipping price chart for shipping prices.
Call us at 612-890-3517 to confirm the status and cost and packing instructions to upgrade your equipment before shipping to us.
Our prices assume you are sending an AVA wired and working unit not subsequently modified by others.
If you do not see your old AVA equipment on this list, call us to find out if there is an upgrade available for it.
Upgrade prices assume no complications. If your unit needs additional work to complete the conversion the price may be higher.
All upgrades include a new limited 3 year parts and labor warranty on all AVA installed circuits.