

“Line” Technology

FRIED loudspeakers are designed for the purposes of the mature music lover, who wishes to have in his home the closest recreation of the grandeur of the concert hall, who wishes to hear the celli of the world renowned Philadelphia Orchestra, the percussion of the Cleveland Orchestra, the brass of the Chicago, the voluptuous strings of the Vienna Philharmonic, or the popular equivalents of these, in music ranging from rock to jazz. The fundamental differences between Fried loudspeaker designs and all others are differences based on history and need: the history of evolutionary product development over the course of five decades, and the need for accurate reproduction of the aforementioned musical signatures.

The designs and the purposes of most loudspeakers are innocent of correspondence with the need. It is as if the designers really didn't know or care, or thought the public didn't care about the accurate reproduction of the live musical experience.

All Fried-designed loudspeakers, from the IMF line of the late sixties to today's very advanced examples have employed either transmission lines, “line tunnels”, or “distributed loading” systems.

Let us describe first the benefits of transmission line loading, the optimum method of enclosing mid and bass drive systems. In the three-way loudspeakers, the midrange, in addition to the woofer, is always enclosed in a transmission line, because the beneficial effects of *line* technology, as opposed to the conventional *box* techniques of most other loudspeakers, are even more clearly revealed in the midrange of music, where the ear is especially critical and sensitive to *box* effects.

1) The theory of the transmission line is simply expressed: as an enclosure system that absorbs the rear wave progressively down a

long passage, so that a wave leaving the rear of the driver will never again come back to it or to the sidewalls, thus ridding the sounds in the midrange and upper bass of the *time smear* and *boxy* effects of unwanted reflections.

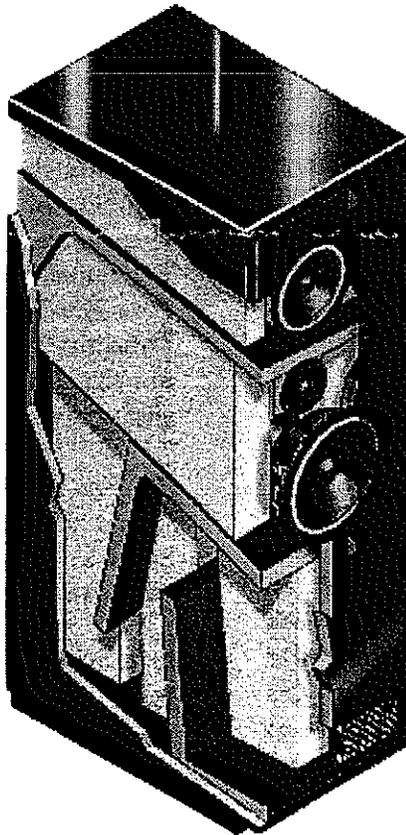


Figure 1: Studio V Cross-Sectional View

The listening effect, as noted by critical listeners for the last thirty years, is a clarity and freshness and rightness of timbre which are unobtainable by *box* systems, or for that matter, from dipole and bipole systems (with their uncontrolled rearward radiations).

2) A rightness of response from midbass down to the deepest bass frequencies. This is a product of the “resistive” nature of lines in these frequency bands; as contrasted to the “reactive” (resonant) nature of all other loading systems; so that

the amplifier can transfer power cleanly. In addition to which, lines give an additive to the piston, making it enormous in acoustic terms, thus able to reproduce cleanly in frequency response and in time the bass and mid-bass information.

3) Lines propagate as a "plane source", i.e., directly forward and to the listener; whereas "box" speakers propagate as a "spherical source", i.e., in every direction; and of course dipoles and bipoles propagate in wanted (i.e., toward the listener) as well as unwanted directions (toward walls and floors). Because of this dispersion pattern, as well as the "resistive" nature of line propagation, room involvement, a subject on which the author has written extensively, is much less of a problem. There is no need for special rooms, for special room treatments, for "digital equalization" --- because the line systems of propagation are inherently and acoustically correct -- for listening in rooms!

Indeed, the superiority of lines for highest quality propagation is one of the most accepted tenets of the art! --- "the LF transmission line's superiority over anything short of a huge horn is one of the few things practically all high-enders agree about." (J. G. Holt, *The Stereophile*, May 1993, p. 103).

For those who will not accept mediocre reproduction of music, the modern transmission line loudspeakers of the author's design are recommended.

Line Tunnel Designs:

For those who cannot afford to invest in transmission line loudspeakers, but still have the intelligence to appreciate their virtues, all is not lost; for the "line tunnel" approach offers the next best technology for reproducing music. The principle and operation of the "line tunnel" has been described elsewhere. For now, its virtues parallel those of the transmission line, to wit:

1) The "line" makes the enclosure primarily resistive; so that the air pressures within do

not rise as do those in "reactive" systems. The "bellows" effect of sealed or reflex systems does not occur, and the reproduction has a purity and clarity, in both amplitude and time, that is akin to that of transmission line systems.

2) In the bass end of the spectrum, there is

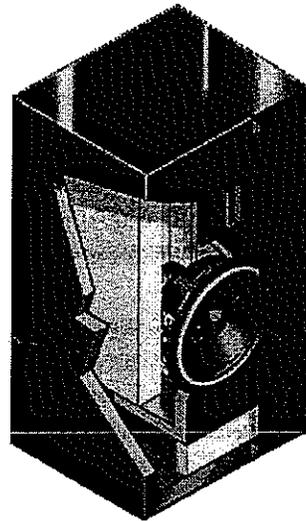


Figure 2: Line Tunnel Cross-Sectional View

not the enormous "acoustic gain" of the transmission line; however, there is a doubling of the piston (driver) size, leading to an increased clarity and band pass. The line tunnel does make the system "aperiodic" ("resistive"), as opposed to the "resonant" ("reactive", "periodic") of other enclosures; so that the reproduction approaches the purity of the classic transmission line.

3) The "line" makes the dispersion pattern "plane source", and also resistive; so that a speaker with a line tunnel is less room sensitive -- i.e., designed to work in rooms.

It is hoped that this brief discussion of the basic differences between Fried "line" loudspeakers and all others will aid the music lover in making the correct choices in a sometimes confusing marketplace.

-- Irving M. Fried

Sound Fundamentals

WHAT'S NEW

Fried Generation95

Fried is happy to introduce soon a new line of loudspeakers with many exciting features. The new products will look better, sound better and generate a new level of interest in our products.

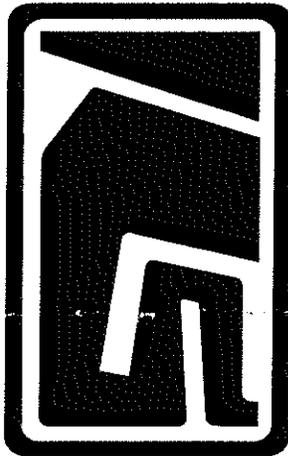
As always, our founder and chief designer, Irving M. "Bud" Fried is never content to let the state of the art remain stagnant. New drivers coupled with the *m.a.r.s.*TM technology has reinforced Bud's commitment to series network crossovers. Combining these advances with higher quality cabinetry, improved binding posts and other aesthetic improvements results in loudspeakers that really stand out among the crowd.

Specifically, most of the new models feature real wood veneers with radiussed sides. The floor-standing models come with better spikes, and all of the models have all-metal binding posts.

The new Baby Beta is our first shielded speaker. This small two-way can be used in a variety of ways in home theater systems: as a center channel, as front speakers or as side or rear speakers. Of course they can also be used in audio-only applications or combined with our other models.

The satisfied dealers and end-users of the new Studio V are telling us that it outperforms systems that sell for many times its price. One dealer has stated that in all of his years in the industry this is one of two or three "jaw-dropping" products that he has come across. He has sold several to customers who came in the store only interested in new amplifiers.

The bottom line is that Fried is committed to improving its products and service to its customers, and we are excited about the future!



Sound Fundamentals is
the occasionally
published newsletter of
**FRIED Products
Corporation.**



THE ADVENTURES OF DETECTIVE SHERLOCK OHMS

The Case of the Missing Double Bass

It was a Saturday evening shortly after Ohms and I had returned from quite a harrowing adventure on the Continent. We had just thwarted the evil Professor Blanderdiel's latest plot to corrupt the accurate reproduction of music.

The venerable detective was in his study playing his violin, and the sweet but somewhat sad melody drifted into the sitting room where I was reading a review in the *Times* of the latest performance of Vivaldi's *Concerto Grosso*.

The tranquil scene was interrupted by Mrs. Fletcher-Munson's entrance. She said that a gentleman wished to see the great Mr. Ohms.

"Did he say what it concerns, Mrs. Fletcher-Munson?" asked Ohms, as he walked into the room.

"No, sir, but here is his card."

She handed the master of the house a calling card on a small silver tray.

"Send him up immediately, Mrs. Fletcher-Munson," said Ohms, examining the card. "We are about to have a most interesting caller," he said as he turned to me. "He is a heavy gentleman, very well dressed, and well educated. He has a slight German accent and enjoys chamber music, but he has a strange tale of woe. Something very important is missing from his life."

As he finished speaking, he handed me the card.

"But, Ohms, how could you possibly know so much about him based upon one brief glance at his card?"

"All will become clear momentarily. All will become clear."

There was a knock on the door.

"Come in," said Ohms.

In walked a portly gentleman wearing lederhosen.

"Baron von Zobbel, willkommen," said Ohms as he clicked his heels and bowed sharply at the waist. "This is my associate Dr. Wattsson. I hope that we may be of some assistance."

"Danke, Herr Ohms, unt I hope you can help me. Zwei days ago I attend ze performance uf Vivaldi's *Concerto Grosso*. Ja? Unt ven I return to mine haus unt listen to ze same music un mine stereo, I hear no double bass. Ist kaput! Ja!? I immediately rush oot to ze audio store unt buy very expensive cables, a new amp unt pre-amp, unt even new crossovers for mine "infinite baffle" loudschpeakers! But zis has changed noting! Vhat can I do! Can you help me!"

"You need not look any further for your missing double bass, Baron von Zobbel," said Ohms, confidently. "We can help you."

"But how, Ohms?" I asked. "It seems quite an enigma to me."

"It is fundamental, my dear Wattsson. Hand the Baron the latest literature from Fried Products."

"Now, why don't we all retire to the sitting room and discuss your next step, sir."

I followed amazed, as I usually am, by my friend's talents.

YOU'RE NEVER BEHIND THE TIMES WITH FRIED SPEAKERS

m.a.r.s.™ UPGRADE INFORMATION

As it has in the past, FRIED PRODUCTS continues to offer speaker upgrades and retrofit kits.

Try as designers might, they have been unable to alter or amend the fundamental laws of acoustics or the way in which humans perceive sound. What they have been able to do is experiment with various materials and the application of those materials within the framework of those laws and along the avenues of perception.

By far the most dynamic (pun intended) area of loudspeaker technology is driver design and cone material. As most loyal FRIED followers know, we are continually searching for drivers that when used in transmission line and *line tunnel* enclosures will recreate as accurately as possible the source material. In this day and age with technology advancing along a geometric curve, speaker systems are almost obsolete as soon as they are in homes.

At FRIED we have always made the effort to help our customers maintain the balance between obsolescence and progress. In continuing to offer upgrade kits for most of our models, we have enabled countless music lovers to enjoy the results of many new developments in technology without having to rob a Brink's car every time a better cone material is discovered.

We currently have a number of *m.a.r.s.*™ upgrade kits available for recent G, C, D, O, Studio IV and Studio V models. The new drivers can also be used in a non-*m.a.r.s.*™ configurations, if desired. Please give us a call for more information on a particular upgrade.



Bud's Corner

It was just a year and a half ago that we sprung upon the loudspeaker industry the *m.a.r.s.*™ principle, namely, a rational method of widening and improving the stereo field from a single pair of loudspeakers, simulating more closely the sound field one experiences at a live concert of a great orchestra in a great hall -- and rendering forever "obsolescent" the narrow field, "semi-stereo" of conventional two loudspeaker setups.

Indeed, from several sources come statements that "two channel stereo" is defunct! However, there is still a "head in the sand" attitude in most of an industry that has always claimed to thrive on continuous improvement and refinement, toward the goal of the "you are there" performance! This is not true at FRIED. During the last year and a half, the beginning of a complete redesign of FRIED range has been in process; employing radical new cone and driver technologies, and refinement of the series crossover network approach, that which has been part of the FRIED ethos for over a decade -- because it leads to better integration, greater dynamics on program, and a general improvement in the concept of a linear loudspeaker (i.e. A loudspeaker that is accurate in frequency, in time, in dynamic amplitude, and in image propagation. One that creates the sensation that you are listening to a complex musical event, rather than to a special tweeter, or midrange, or subwoofer.)

The last several months have convinced me more than ever that what I have been pursuing, the concept of a linear transducer, fits in with all the requirements for reproduction in space, which is what the late great Raymond Cooke termed "the next necessary frontier to cross."

So, the redoubtable Valhalla System and the Studio V have been put into the field where they have been greeted with virtual awe by those who

are familiar with live performance. The prototypes of the A/6 and Beta VI have been designed and are about to go into production.

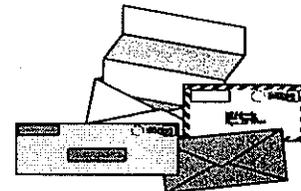
As for the R/6, successor to the R/5, we have decided to "go all the way" by using the same drive system and the same revolutionary crossover as the Studio V. The less expensive model will lack only the finite resolution of the advanced bass transmission line loading of the Studio V. Naturally, the R/6 will not "sound like a box". Nor does the Beta VI, the A/6 or any other FRIED speaker, current or contemplated.

What more? Well, plans are afoot to revive my other revered label, IMF. It is thought that speakers beyond the pale, not yet fully realized anywhere, may bear this once highly regarded trademark, used when I was designing loudspeakers in England for the world.

Irving M. Fried



If you have any questions or comments about *SOUND FUNDAMENTALS*, or anything else, please contact us at the address, phone numbers, or FAX given below.



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STUDIO V *m.a.r.s.*™ - Information Sheet

The Studio V is a three way, floor standing loudspeaker. Compact in size when compared to the great FRIED transmission line transducers of the past, it contains two transmission lines: one for the midrange and one for the bass. The Studio V is a wide band speaker with very low compression effects. It is highly linear, with great timbral and dynamic accuracy. Like all properly designed transmission lines, it delivers the sound of the performance in the recording space. With the implementation of the *m.a.r.s.*™ Technology, this sense of ambience and location is truly amazing. The Studio V is a sophisticated concept, from a company which has been developing reference loudspeakers for twenty years.

The MCF drivers: The 8" woofer and 6 ½" mid-range are dual voice coil, vented pole piece drivers. In addition, these drivers incorporate a unique Multi-Composite Fiber (MCF) cone in which are combined the beneficial properties of kevlar, wool and paper. Optimally damped with a specially developed coating material, these features combine to provide smoother, more dynamic mid and lowband reproduction. The treble unit is a ¾", ferrofluid filled, double chamber dome with outstanding dispersion and ruler-flat response. All the drivers are engineered with linear magnet systems for improved dynamic range -- thus avoiding the compression effects of lesser drivers.

The series crossover network: The series networks developed for the larger FRIED loudspeakers are adapted to the Studio V. Properly designed series networks are superior to parallel networks in maintaining closer control over the drivers at all program levels. They are phase coherent, with "quasi second order" attenuation rates. The inflection points are 200 Hz and 2.7 kHz. All drivers are in the same absolute polarity, maintaining the maximum in homogeneity and timbral accuracy.

The dual transmission line enclosure: The midrange backs into a heavily damped, tapered chamber, which is open to the rear of the speaker. Below that is the dome. Below the dome is the woofer which is enclosed in a tapered and contoured line that is folded three times and terminates at the bottom front of the enclosure. The front edges of the enclosure are radiussed to minimize diffraction re-radiation effects. The cabinet is furniture grade, handmade by a master cabinetmaker.

Why transmission lines? Because they are acoustically superior to other enclosure types! As J. Gordon Holt, founder of *Stereophile*, has stated, "the [low frequency] transmission line's superiority over anything short of a huge horn is one of the few things practically all high-enders agree about." Conventional loudspeakers place the midrange in a box that inevitably produces rear wave reflections back at the driver and through the enclosure walls. The Studio V, however, is designed so that the rear energy leaves the driver *permanently* -- never to be reflected back! In essence, all possibility of *time smear* from reflections is removed. Similarly, in the bass range, uncontrolled reflections back at the cone are eliminated. At the very lowest frequencies the mass of air in the line combines with the mass

of the driver diaphragm to create an enormous equivalent acoustic air mass. This acts as a large piston, which reproduces the lowest frequencies effortlessly.

For the critical listener, the clarity and naturalness of reproduction is a revelation. The bass is crisp, clear and weighty -- without the smudge and smear of conventional resonant propagators. Moreover, these virtues do not depend on critical room positioning or extensive room treatments. By its very nature, the transmission line in the Studio V projects a *plane source* toward the listener (unlike conventional enclosures which furnish a *spherical source*). The *plane source* intermingles less with the room environment. Since the bass system is inherently non-resonant, the response rolls off smoothly. *Room gain* flattens the bass, so that in most rooms the response is effectively flat to below 20 Hz. Additionally, the midrange and treble drivers are fitted in mirror imaged pairs, for inward dispersion. This separates further the first arrivals from the late arrivals and aids in eliminating room effects upon the musical reproduction. Expert listeners have always commented on the FRIED studio enclosures, stating that the performers seem to appear in the room. This illusion must be heard to be believed!

***m.a.r.s.*[™] Technology:**

The Studio V includes the acclaimed *mcshane ambience recovery system, m.a.r.s.*[™]. This well-received method of creating a complete stereo image and expanding the sound stage helps the Studio V in the creation of the most realistic playback possible. Unlike earlier attempts at image expansion and ambience creation, *m.a.r.s.*[™] is not an active or additive manipulation of the source material. In a *m.a.r.s.*[™] system a differential signal is passively filtered and then sent to the opposite speaker, using information available in the source material to recover a sense of the place in which it was recorded. Since the ambient information is sent to dedicated voice coils on the midrange and bass drivers in the opposite speaker instead of separate drivers, the image in a *m.a.r.s.*[™] system is less sensitive to the listener's position.

For more information on the *m.a.r.s.*[™] technology please read the sheets entitled, *m.a.r.s.*[™] vs. *Semi-stereo* and *Further Thoughts on the m.a.r.s.*[™] *Revolution* available from FRIED.

User Specifications

Studio V Loudspeaker

- *Dimensions:* 39" H x 12" W x 18" D
- *Shipping Weight:* 90 lbs.
- *Crossover Points:* 200 Hz, 2.7 kHz
- *Finish:* Dark Cherry Veneer - standard
other veneers - optional
- *Drivers:* 8" vented pole piece MCF,
6 ½" vented pole piece MCF, ¾" double chamber dome
- *Sensitivity:* 90 db.
- *Impedance:* 8 ohms
- *Frequency Range:* ± 2 db., 26 Hz - 22 kHz
- *Recommended Amplifier Power:* 25 - 200 watts per channel
- *Input Facilities:* 5-way gold-plated binding posts
- *Warranty:* Five years, limited

- *Retail Price per Pair:* \$3595.00



M.A.R.S. VS SEMI-STEREO

Among the few who truly understand loudspeaker design, it is a well known fact that loudspeaker technology has not advanced significantly since the introduction of the IMF Super Monitor back in 1968. For years loudspeaker manufacturers have struggled to find new and innovative solutions to the same old problem -- recreating the sound of an entire orchestra from a two point system. Changes have been made to every conceivable aspect of the so-called "state of the art" loudspeaker. Manufacturers have played with different enclosures, modes of transducing, crossover networks, drivers, cone materials, wiring material, and on and on. Yet, no manufacturer of any speaker system has invented a working solution to the inescapable problem innate in all humans, a narrow head. Because of our narrow cranial arch, we are unable to perceive a true stereo image below 800 Hz.

It is important to remember that stereo is an illusion, an attempt to duplicate the reality of a live performance. Thus, at a live performance, the concept of "proper imaging below 800 Hz" is irrelevant. However, when listening to recordings in the home, the above concern is quite relevant. Until now loudspeakers have been unable to properly separate the left channel information from the right channel information as it arrives at the listener's ears. Thus left and right signals in the frequencies below 800 Hz (most energy from music is found between 100 and 500 Hz) arrive at our ears intertwined and muddled. The result is, in reality, semi-stereo. You have been subjected to listening to semi-stereo, a combination of mono and stereo signals! Loudspeaker manufacturers have not progressed toward the desired goal of realistic sound reproduction much beyond where they were nearly thirty years ago! Happily, this is about to change.

It is true that our industry's more talented designers have solved many problems of accuracy, phase, and timbre to some degree. However, no one has been able to successfully translate the *feeling* of a live performance, the illusion one has of being immersed in the music of a live performance. This sensation is known to audiophiles as *ambience*. Audiophiles speak longingly of the *ambience* (or *sound*) of such revered halls as Sanders Theatre, the Meyerson Symphony Center and of course the Academy of Music. Until now, this was something they could only experience *in vitae*, never in their home -- no matter how expensive their stereo system was. This is why these terribly frustrated audiophiles will soon be thanking Chuck McShane, Irving "Bud" Fried and God (not necessarily in that order).

The new McShane Ambience Recovery System, the brainchild of veteran speaker designer Chuck McShane, is plainly the most significant step forward in the art of high quality sound reproduction in over two decades. Granted, attempts at ambience recovery have been made by other manufacturers in the past, only to result in failure. Perhaps the most valid attempt was made by David Hafler in the mid sixties with his Dynaquad System. M.A.R.S., however, is quite different -- IT WORKS! The new technology involves dual voice coil drivers and an interconnect between the two speakers feeding L - R, R - L information back and forth. The result is a dramatically improved illusion of the

locality and presence of a live performance. M.A.R.S. is superior to all previous attempts for the following reasons;

1. M.A.R.S. does not require you to put your head in a vice. It is not limited to a single, tiny listening position as was the case with certain other attempts. The illusion can be heard from any point in a room. Moreover, unlike the semi-stereo transducers of today, music is not localized to the speakers. Thus a soloist performing at center stage *remains* at center stage as the listener moves about the room! In other words, if you position yourself in front of your conventional left speaker the soloist moves with you. However if you move in front of the left M.A.R.S. speaker, the soloist remains at center stage, to your right! The illusion is uncanny and must be heard to be truly appreciated.

2. M.A.R.S. does not add false effects to the music. The illusion created is completely natural. There is no strange directionality (such as hearing a trumpet behind you) or disproportion.

3. All musical instruments, including the singing voice, have a much more natural timbre. The sterility of semi-stereo is gone! Timbral accuracy is optimized to such a degree that the stereo image literally *engulfs* the listener. M.A.R.S. gives music an incredibly round, rich, warm sound that until now could only be experienced in the concert hall.

Simply put, M.A.R.S. and FRIED have finally brought Sanders Theatre to the living room -- any living room!

So, you may say, what about surround sound? Surround sound is a wonderfully entertaining technology geared for home theater. It is definitely a thrill to hear the blast of a shotgun from behind you. However, more often than not, we tend to face the stage during a musical performance. Typically, one of the few times you hear a violin or guitar behind you is when you're slouched in your chair at a restaurant praying the guy won't be by your table next. Surround sound is for movies, not music.

Gimmick. That's what your thinking if you have any sort of seasoning as a home audio consumer. Gimmicks are temporarily intriguing and marketable, but hardly worth getting excited over. Experienced audiophiles can spot a gimmick from a mile away. Certainly one would expect this to be true of senior editor Peter Mitchell of *Stereophile* Magazine. Yet, he too is convinced of the significance of Mr. McShane's invention (see the May '94 edition of *Stereophile*). Moreover, Irving Fried has been fighting gimmicks in this industry for the past four decades. It is safe to say that he is one of the most qualified men in the world at identifying and discarding any new gimmick that comes along. However, Mr. Fried's conviction of the veracity and genius of this new technology has prompted him to take steps toward implementing M.A.R.S. into his *entire* line of loudspeakers. In fact, M.A.R.S. has already been fitted to the new generation of FRIED's Reference Series loudspeakers.

M.A.R.S. is no gimmick. It's a milestone, and it's here to stay. You have the opportunity to become a part of the new era in music reproduction. See your nearest FRIED dealer for details or call FRIED direct at (800) 255-1014.



FURTHER THOUGHTS ON THE MEANING OF THE *m.a.r.s.*TM REVOLUTION

I offer a few more thoughts on what the development of the *m.a.r.s.*TM technology has brought to the science and art of music reproduction.

The evolution of more perfect drivers: The obvious test of a driver, and its resultant loudspeaker system, is its ability to play back the singing voice in opera -- the Wagnerian soprano. For reasons which are known to everyone cognizant with the demands on a loudspeaker, a loudspeaker which can play back this music will be better than required to play back any jazz, classical, or rock music at fiendish levels!

Such a driver must have a cone system that will not break up, a very low distortion magnetic system, a very linear magnetic system and suspension, and very low "Q" overall.

During the development phases of the *m.a.r.s.*TM system into FRIED loudspeakers, every possible combination of cone material, suspension, etc. was tested and rejected! Rather, Chuck and I took the good points from various drivers -- then invented a new cone material -- and created the drivers which make the *m.a.r.s.*TM system possible. It can be said that, if there were no *m.a.r.s.*TM system, the nature of these drivers is such that the cause of more accurate sound reproduction, free of the artifacts of conventional drive systems *at any price*, would have been, and are carried forward immeasurably.

These drivers are by definition more linear than any previous drivers. And together with the linear design concepts that I have been championing to these many years -- transmission lines instead of "boxes", phase coherent *series* networks instead of any other crossover configurations -- indeed, proper phase coherence in general -- the new drivers justify the older concepts or, as one West Coast critic says, "it is as if Bud's designs were waiting for new drivers to emerge, along with the *m.a.r.s.*TM!"

In my living room, where I have been enjoying anew discs from the "golden Age" of recording in the States, my beloved discs from my involvement with London-Decca, which resulted so many years ago in the immortal "Ring" discs, I hear several phenomena that are well nigh unbelievable, but do exist:

- 1) Much greater and more natural program dynamics (from the extra "ambiance" information)
- 2) Much improved stability of solo images, whether voice in opera or solo instruments against orchestra -- the instrument stays in the middle, no matter where I sit!
- 3) Revelation of extra orchestral chords and instruments in the middle of orchestra and vocal crescendi: reformed because of the more natural ambiance retrieval of the *m.a.r.s.*TM system.

At the Stereophile Show (Hi-Fi '94), people who visited our demonstration, fresh from other rooms, were completely taken aback, "floored" might be the word -- indeed, while we played the prototype Beta, most of the time people thought they were hearing the mighty "Valhalla" system -- and they kept telling me how much better it was than their (names mentioned most frequently -- Thiel CS5, Meridian Digital, Apogee, B & W biggies, Dunlavy) loudspeakers -- all loudspeakers which are well respected in the profession!

As I Stated in Bud's Corner, there is no way for such loudspeakers without *m.a.r.s.*TM, to compete with our Beta with *m.a.r.s.*TM! And as I also stated in Bud's Corner, we are finally free of the polypropylene cone -- the "new" material I introduced to the States in 1981! So much the better.

STUDIO V CROSSOVER LAYOUT

1/96

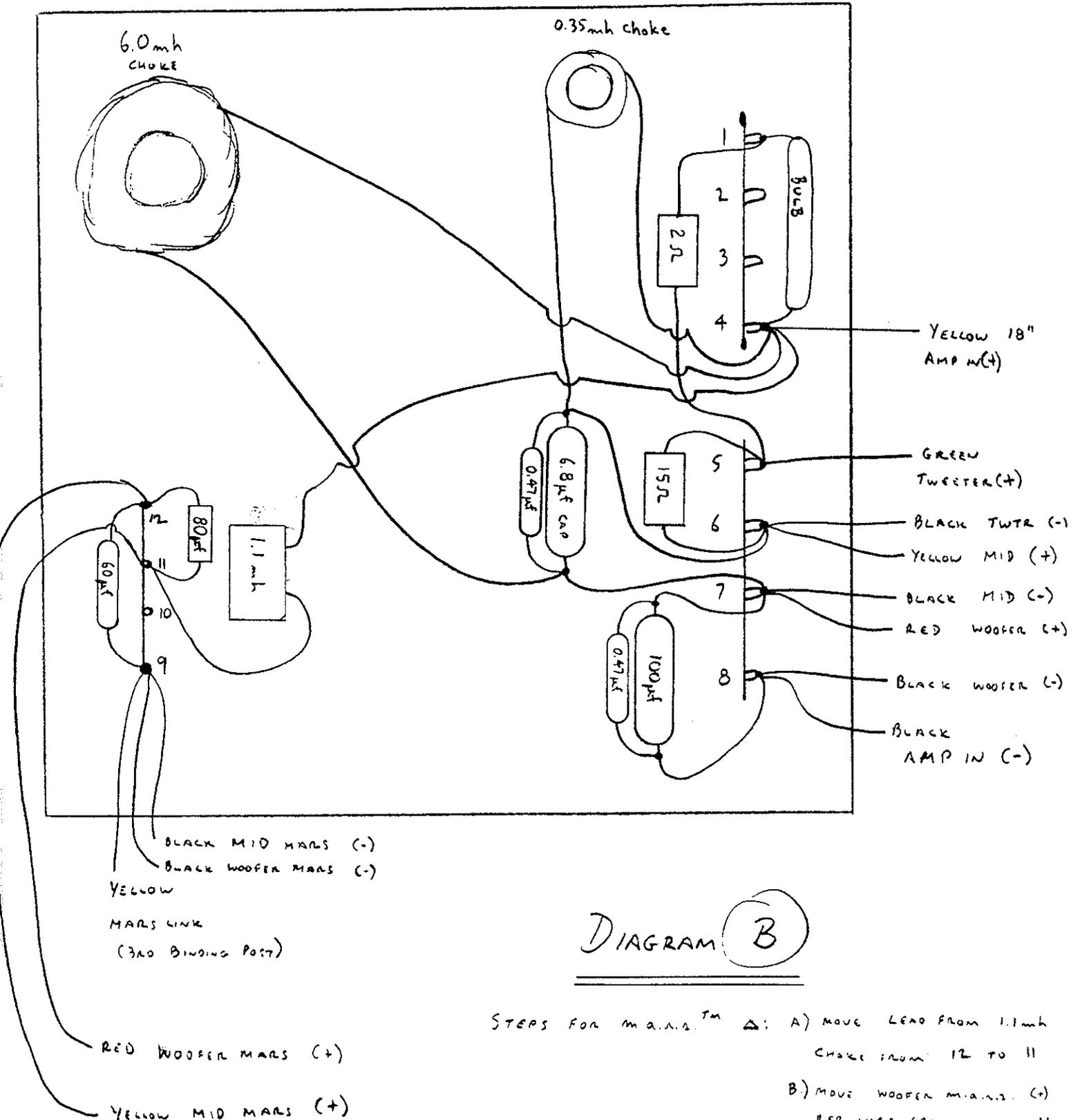
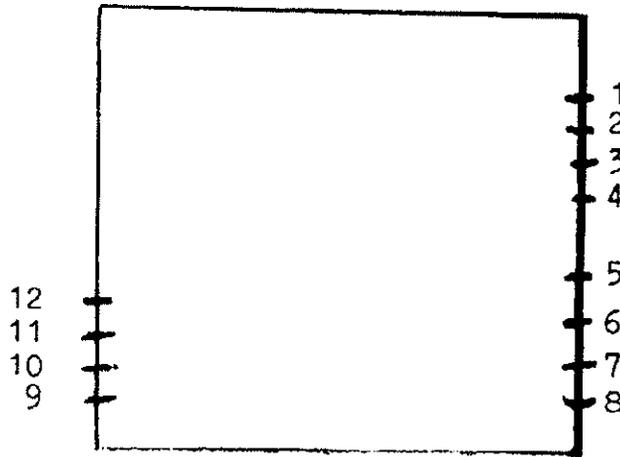


DIAGRAM B

- STEPS FOR M.A.N.A.™ Δ:
- A) MOVE LEAD FROM 1.1mh CHOKER FROM 12 TO 11
 - B) MOVE WOOFER MARS (-) RED WIRE FROM 12 TO 11.
 - C) INSERT NEW 80µf CAP BETWEEN POINTS 11 + 12.

Studio V Crossover Wiring



Terminal Position

Was

1. Blank	
2. Blank	
3. Blank	
4. Input +, yellow, 18" or 24"	Red
5. Tweeter +, green, 48"	Red
6. Tweeter -, black, 48"	B
7. Midrange +, yellow, 48"	R
8. Midrange -, black, 48"	B
9. Woofer +, red, 36"	R
10. Woofer -, black, 36"	B
11. Input -, black, 18" or 24"	B
12. MARS, Woofer -, black, 36"	G
MARS, Midrange -, black, 48"	G
10. Blank	
11. Blank	
12. MARS, Woofer +, red, 36"	w
MARS, Midrange, yellow, 48"	w
9. (Oops!!) MARS Link, yellow, 18" or 24"	w