JANUARY/FEBRUARY 1988
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db

THE SOUND ENGINEERING MAGAZINE

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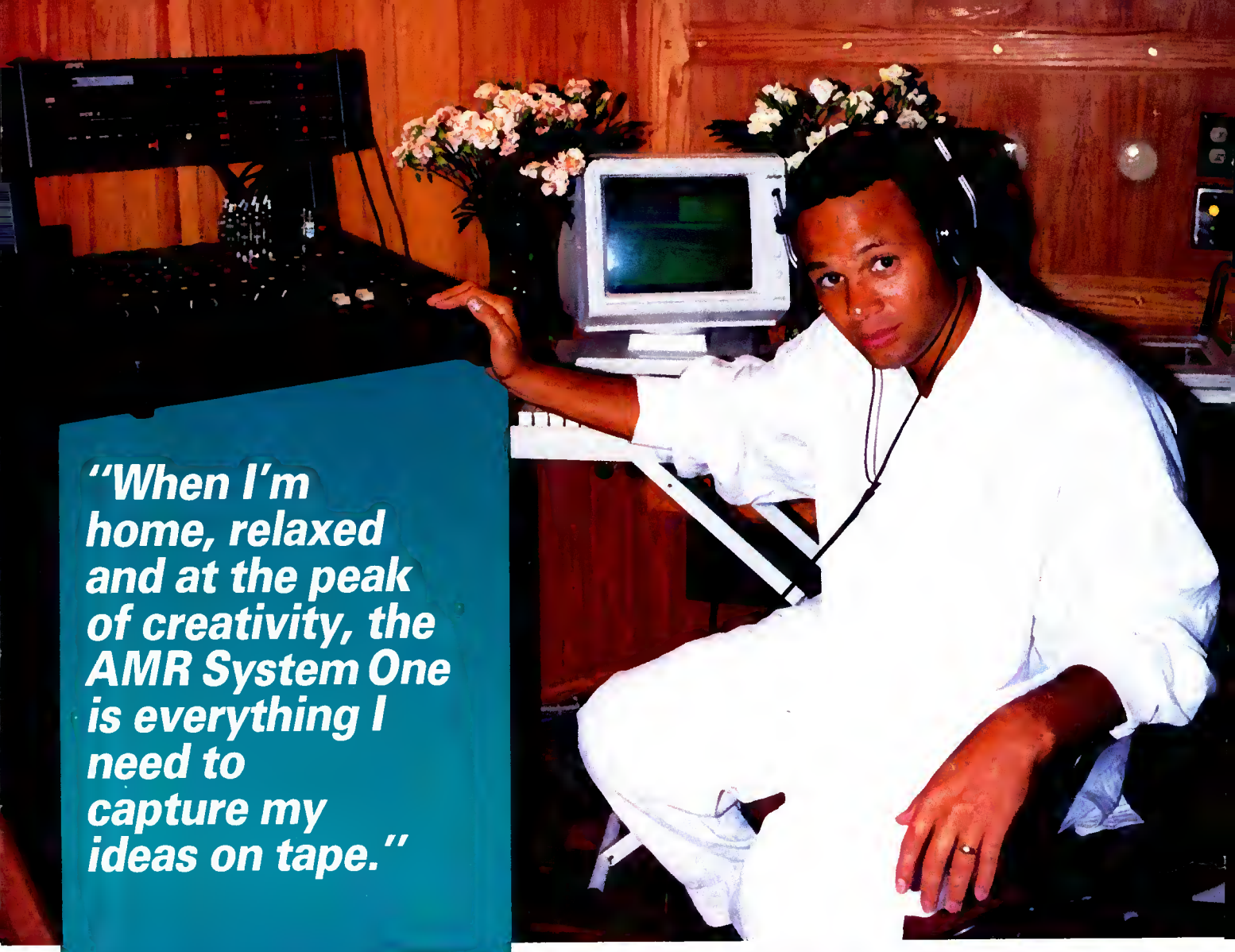

"When I'm home, relaxed and at the peak of creativity, the AMR System One is everything I need to capture my ideas on tape."

NARADA MICHAEL WALDEN

Narada Michael Walden is a world-class drummer, keyboardist, singer, composer and performer. If there's a musical role he can't handle, no one has thought of it yet. As a producer, he's turned out such hits as Aretha Franklin's "Freeway of Love" and Whitney Houston's "How Will I Know" (which he wrote and co-wrote respectively). As a drummer, he's played jazz, fusion, and rock with the likes of John McLaughlin, Jeff Beck, and Weather Report, and R & B with Rick James and Teena Marie.

Narada is an extraordinary musical craftsman. He demands the very best from his music and his equipment. His choice in personal multi-track recording gear is AMR. Naturally.

NARADA MICHAEL WALDEN recent awards:

1986 ASCAP Songwriter of the Year:
"Freeway of Love" Aretha Franklin

1986 ASCAP Song of the Year:
"How Will I Know" Whitney Houston

1986 Billboard's Producer of the Year

1985 Grammy

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JANUARY/FEBRUARY 1988 VOLUME 22, NO.1

About the Cover

• The 1987 Special Olympics for mentally handicapped youngsters offers an opportunity for them to compete in sports on a professional level. Entrants are grouped so that each level of capability is matched in the various field events.

On another level, the Special Olympics requires professional audio coverage exactly the same as any other major stadium-type sports event. The difference is that each of the manufacturers and installer/operators were volunteers. Our feature article, represented on our cover by the grand opening ceremonies, has been written for us by Bruce Bartlett (himself an engineer at Crown, a major contributor to the events) has a written a detailed account of the audio coverage that helped make the Special Olympics for 1987 the successful event it was. The article begins on page 25.

We also want to specifically thank the Bradley-Toner Agency and McCay Photographic of Mishawaka, IN, for the cover photo and the opening ceremonies photo in the article.

the sound contracting engineer

the recording engineer

the smaller recording studio

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HOW TO READ THE LABEL

The top line of your label contains information that enables us to find you on the computer. Without that we can't effect address changes or find your entry. The sample below is what most labels look like.

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The first sequence of characters is how we locate you. The next four numbers indicate the issue you have just received. Finally, the last four numbers represent the date of expiry *reversed*. Just read backwards: 9309 is Sept/Oct 1993.

Calendar

• A four-week program, comprised of six accredited graduate level courses in acoustics and signal processing, will be offered in June 1988 by Penn State's Graduate Program in Acoustics in cooperation with the University's Applied Research Laboratory. Courses offered include: Fundamentals of Acoustics, Underwater Sound Propagation, Sonar Engineering, Digital Signal Processing, Electroacoustic Transducers, and Acoustical Data Measurement and Analysis.

For more information contact:
Dr. Alan D. Stuart
Summer Program Coordinator
Penn State Graduate Program in Acoustics
PO Box 30
State College, PA 16804

• The upcoming schedule for the SYNERGETIC AUDIO CONCEPTS two-day audio engineering seminars is as follows:

Anaheim, CA- January 27-28
Seattle, WA- February 17-18
Orlando, FL- March 9-10

"Master Loudspeaker Designer's Workshop," conducted by Dr. Eugene Patronis and staff, will be held in Atlanta, GA on March 17-19.

For more information contact:
Synergetic Audio Concepts
PO Box 1239
Bedford, IN 47421

• The United States Institute for Theatre Technology, Inc. (USITT) is presenting the annual conference and Stage Expo '88 commercial exhibit show. The event is being held at the Disneyland Hotel in Anaheim, California from March 23-26, 1988. Stage Expo attracts suppliers and manufacturers of those products needed for live performances.

For further information contact:
RJA Exposition Management
486 Fullerton Ct
San Jose, CA 95111
(408) 225-6736

• The third edition of the Magis Exhibition of Equipment and Technology for Theatres and Cinemas will be held from March 22-25, 1988 at the Rimini Trade Fair Centre in Italy. The exhibition will include sound and P.A. systems, special effects, stages and mobile structures, and electronic editing and dubbing equipment. Promotion is aimed at technicians involved in the installation and hire of equipment for cinemas, theatres, shows and concerts, but also at lighting designers, cinema photography directors, set designers, show organizers and owners and managers of theatres and cinemas. The sixth edition of SIB (International Exhibition of Technology for Dance Venues) will be held from March 22-25, 1988, also at the Rimini Trade Fair Centre in Italy. db

It's like holding an isolation booth in your hand!

Compared to older microphone designs, the ATM63 is far better at rejecting sounds from the sides and rear. Even with a stage full of monitors and amplifier stacks. And as you get farther from unwanted sound, the ATM63 advantage sharply increases when compared to the others.

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On Taxes

MARK E. BATTERSBY

DEADLINE TAX PLANNING

● This is a confusing time of year. The tax year for the sound or recording engineer—and his studio or business operation—has ended cutting off all hope of making any more tax-saving moves. Plus, the impact of the Tax Reform Act of 1986 is just finding its way onto the annual tax return. Fortunately, there are still quite a few good moves that can be made between the end of the tax year and the deadline for filing that tax return that can substantially reduce that tax bill.

One good example of pre-filing planning is provided by the equipment or fixtures acquired before the end of the tax year. On the surface, it might appear that the sound or recording engineer has only two choices: straight-line depreciation or accelerated depreciation. But look at the basic depreciation rules.

As every engineer knows, sound and recording businesses and income-producing property (other than land) generally lose their usefulness or value over a period of time. Our tax rules permit an annual deduction or "cost recovery" of a portion of the cost. Under our present tax rules, recovery of costs is normally accomplished by using statutory accelerated methods. Long gone are the concepts of "estimated useful life" and "salvage value." This almost eliminates arguments with the Internal Revenue Service about depreciation, formerly a consistent source of litigation.

Depreciation or cost recovery currently looks like this:

● Personal property: accelerated 200 percent declining balance depreciation will be allowed for three-, five-, and ten-year class property. Cars and light trucks employed in the sound or recording business are now classified as five-year property.

● Luxury autos: ACRS (accelerated cost recovery system) deduction is limited to $2,560 for the year in which the auto was placed in service, $4,100 for the second year, $2,450 for the third year and $1,475 for all later years.

● Real property: straight-line depreciation over 31.5 years for all commercial property such as the studio.

Between the end of the tax year and the tax filing deadline is the time to not only place newly acquired property into the proper asset class, but to decide whether the ACRS method would be more beneficial in the long run than the only existing alternative, straight-line depreciation.

Straight-line depreciation merely means writing off one-fifth of an asset with a five-year life each year. Two hundred percent declining balance method means that 200 percent of the straight-line deduction is claimed in the first year and 200 percent of the straight-line writeoff of the remaining book value is claimed in each subsequent year.

Another tactic that requires thought is the first-year expensing option. Up to $10,000 of so-called "personal property" (signs, desks, typewriters, computers, fixtures, etc.) can be expensed or immediately written off subject to a phaseout on a dollar-for-

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The Carver PM-1.5 Magnetic Field Power Amp—For performance, reliability and sound.

On the Road Since the professional debut in 1983 of the Carver PM-1.5 Low Feedback High Headroom Magnetic Field Power Amplifier, the sonic excellence and reliability of this 21-lb., 450 watts per channel* powerhouse has been tested—and proven—on some of the biggest and toughest tours ever to go on the road. 108 Carver PM-1.5's were used by Clair Brothers on the Bruce Springsteen tour, and 180 PM-1.5's on the Michael Jackson "Victory" tour. In both cases the result was purely awesome power.

"Our new Carver amp racks pack twice the number of channels in about the same truck volume as the conventional racks they replace. In addition the average power per channel has increased while the average weight per channel has decreased. In the low end, for example, we now have 1,200 watts per cabinet where 650 watts were previously available. They take less room on the truck, they weigh less and our systems have more headroom than before. The Carver amplifier has allowed us to take a significant step in improving our sound systems." *CLAIR BROTHERS*

And not only a sound industry giant like Clair Brothers tours with Carver.

"We have toured Carvers with the following artists: Softcell, Paul Young, Johnny Mathis, Donna Summers, Howard Jones, Pointer Sisters, Psychedelic Furs, Lee Greenwood, General Public, George Thorogood. This is exclusive of our numerous one-nighters. The consensus of the performers is that the equipment sounds great. They have been amazed by the sound of the amps as well as their size and weight. As for reliability, out of 50 amps we had only one fail in the past year of touring. This is by far the best record we've had with any manufacturer of amplifiers. Sonically, the extra headroom is readily apparent. We, at Manticore unanimously agree that the PM-1.5 is incredible and is the only amp we intend to buy."

Tom Whisner (owner) MANTICORE

In the Laboratory The Carver PM-1.5 was rigorously tested by Len Feldman for MODERN RECORDING (February 1985). His laboratory test results also prove that the PM-1.5 really delivers. The following quotes from the Lab Report are reprinted with permission of MODERN RECORDING & MUSIC:—

"The first thing we noticed when we began to work with the Carver PM-1.5 was the ease with which the amplifier delivered almost limitless power to speaker loads which we had previously considered to be difficult to drive to loud levels. This is the sort of amplifier that just refuses to quit."

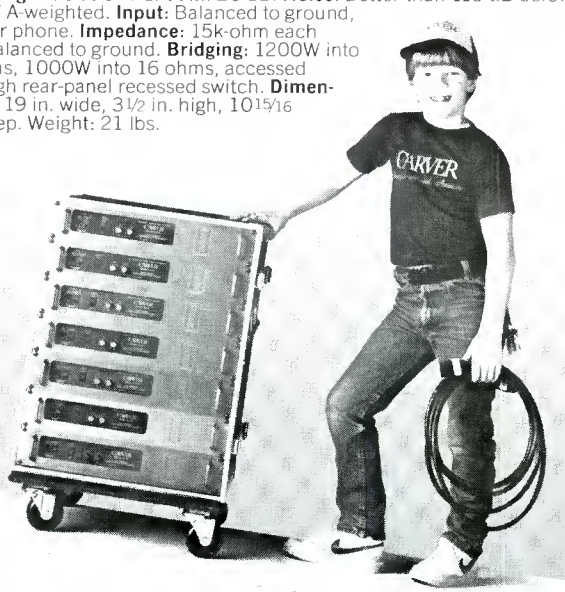
"The amplifier delivered a clean 480 watts per channel into 8-ohm loads with both channels driven for its rated harmonic distortion level of 0.5%. Even at the frequency extreme of 20 Hz. power output for rated THD was 470 watts as against 450 claimed by Carver. Furthermore, at rated power output, distortion decreased to an insignificant 0.015% at mid-frequencies and 0.007% at 20 Hz. When connected to 4-ohm loads, the PM-1.5 delivered 750 watts per channel for rated THD of 0.05%—far more than the 600 watts claimed by Carver. Clearly, when it comes to specs for a professional amplifier, Carver has taken a very conservative approach... All (manufacturer's claims) equaled or exceeded published specifications—usually by a wide margin."

"Carver has managed to deliver a tremendous amount of power in a small lightweight package at a very reasonable cost..."

"For the professional audio engineer or technician who has to move a lot of gear around much of the time and who expects total reliability and circuit protection, come what may, the Carver PM-1.5 represents, in our view, a real winning product. We will probably see it used increasingly by professionals in every area of sound reinforcement."

Now—don't you think you owe it to yourself to hurry over to your local Carver Pro Sound Dealer and *test your own PM-1.5*? Whether you run a megawatt sound company, a struggling bar band, or a recording studio gearing up for digital, the Carver PM-1.5 will pay you. In increased portability and reduced freight costs. In freedom from expensive blown drivers. In sheer sonic excellence.

***Power:** 8 ohms, 450 watts/chan. 20 Hz-20 kHz both channels driven with less than 0.5% THD, 4 ohms, 600 watts/chan. rms 20 Hz-20 kHz both channels driven with less than 0.5% THD. 16 ohms, 300 watts/chan. 20 Hz-20 kHz both channels driven with less than 0.5% THD. 2 ohms, 525 watts/chan. at clipping, 1 kHz, with less than 0.5% THD. Note: 2-ohm specification for information purposes only. Operation at 2 ohms is permissible but not recommended. **IM Distortion:** Less than 0.1% SMPTE. **Frequency Response:** -3 dB at 3 Hz. -3 dB at 80 kHz. **Damping:** 200 at 1 kHz. **Gain:** 26 dB. **Noise:** Better than 115 dB below 450W A-weighted. **Input:** Balanced to ground, XLR or phone. **Impedance:** 15k-ohm each leg, balanced to ground. **Bridging:** 1200W into 8 ohms, 1000W into 16 ohms, accessed through rear-panel recessed switch. **Dimensions:** 19 in. wide, 3½ in. high, 10 15/16 in. deep. **Weight:** 21 lbs.



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dollar basis where the engineer's total investment in qualified property exceeds $200,000 for the year.

Athough the asset expenditure or acquisition may have already been made, there is still the need to decide whether the expense is currently deductible or can only be deducted ratably over the depreciation period. Unlike the costs of running a sound or recording business which are currently deductible, expenditures for items of a more permanent nature (i.e., lasting more than one year) generally must be capitalized.

Whether the sound or recording operation actually made a profit or lost money is something else that can't be determined with any degree of accuracy until after the close of the tax year. At either end of the spectrum, tax decisions must be made before filing the annual income tax return. First, those losses:

A so-called "net operating loss" (NOL) arises when the expenses of a business exceed the income earned. A NOL is first carried back three years and, if not absorbed, carried forward for up to 15 years. Or, the engineer can choose to give up the carryback altogether.

Giving up the carryback might be appropriate where a sound or recording specialist, whose prior three years' income was taxed at low rates, expects to be in higher brackets in the future—or where a studio used the preferential long-term capital gain rates in prior years. In other words, if a loss resulted and sufficient income has been reported and taxes paid during the previous three years, then compare the tax benefits of a future year deduction with an immediate cash refund.

If last year was bad, but not bad enough to produce a loss, were estimated taxes overpaid? The incorporated sound or recording operation can apply for a"quickie" refund of those overpaid taxes. This must be done after the year has ended and before the income tax return is filed and, in any event, no later than two and one-half months after the end of the tax year.

It may be difficult to conceive, but under our tax law, there is such a thing as too much profit. Unless there is a proper business reason for a sound or recording corporation to accumulate earnings in excess of $250,000 ($150,000 for certain personal service corporations), a penalty may be assessed of 27.5 percent on the first $100,000 of current year excess and 38.5 percent on the balance. For 1988, and thereafter, a flat rate of 28 percent is applied.

Profitable studios should carefully document the business reasons for accumulating earnings. These should be specific both as to the proposed use and the amounts needed. Plus, there is also the *two and one-half month rule* which can be used as another avenue of escape from this penalty.

What could be easier than paying dividends within two and one-half months after the year ends. The *two and one-half month rule* allows shareholder income shifting, which might also be valuable for other reasons. If the dividends are large enough, the penalty tax problem would disappear for the current tax year.

An often-overlooked method of splitting income among family members involves giving stock in an S corporation to the minor children of parents who are also stockholders. This usually involves transferring the stock to one of the parents as custodian under a gifts-to-minors act—a transfer that should have occurred prior to the end of the tax year.

On the plus side, now might be a good time for such a transfer since income from an S corporation is allocated on a per-day, per-share basis. Thus, a transfer near the end of the year shifts only a small amount of the income for that year to the transferee.

If, however, income is split among family members as a result of such a gift made in earlier years, remember that for the first time, if the minor is under the age of 14, any unearned income attributed to him over $500 from the interfamily transfer of income-producing property will be taxed at the highest marginal rate of the parents (except where they are in a lower tax bracket).

Now is also an excellent time to put all of the studio's records in order. They will not only be needed to properly prepare the income tax return but also are required to comply with both the new tax law and the old tests for determining whether the activity is a hobby or a business for income

tax purposes. Plus, there are new, confusing tax rules governing meals and entertainment—an expense frequently overlooked by many sound and recording specialists.

Every sound and recording operation needs to review their accounting system to assure that meal and entertainment expenses that are not subject to the new 80 percent rule are separately identified. Plus, a review of the accounting records should be made to determine if they are sufficient to meet the new rules and substantiation requirements.

The Tax Reform Act of 1986 limited the deduction for meals (including meals incurred while away from home) and entertainment expenses to 80 percent of the amount that is otherwise tax deductible. Fortunately, this 80 percent limitation does not apply to the following items:

- Items taxed as compensation or excluded under the de minimis fringe benefit rules;
- Reimbursed expenses (the taxpayer making the reimbursement is subject to the 80 percent rule);
- Traditional employer- paid recreational expenses for employees and their spouses (e.g., holiday parties and summer outings);
- Meals provided in 1987 or 1988 as an integral part of a banquet meetings where more than 50 percent of the participants are away from home, at least 40 people attend and the banquet includes a speaker.

Once the records are assembled, it is a simple matter to pick out expenses that may get lost in the tax filing shuffle. Medical expenses, for instance, may be relegated to the personal income tax return as they have been in the past--but perhaps they no longer should.

Normally medical expenses are only deductible as an itemized expense on the personal income tax returns of the sound or recording specialists--and even then only in the amount they and other itemized deductions exceed 7.5 percent of the taxpayer's adjusted gross income. Self-employed engineers, however, may now claim a business expense deduction for 25 percent of their health insurance premiums for themselves, their spouse and their dependents.

It should be obvious by now that there are still many things that can be done before the deadline for filing that income tax return that will substantially reduce the annual income tax bill. Even with the assistance of a professional tax return preparer, the bottom-line rests in the hands of the sound or recording specialist. Will you allow this last opportunity to save on last year's taxes pass? db

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reds of new mixers.

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Ad Ventures

BRIAN BATTLES

• Editor's note: Brian Battles was busy with a special project—we suspect it was a vacation in some tropical resort—and claimed he didn't have time to personally write his Ad *Ventures* column this issue. He assured us, however, that his trusty assistant, Stan LaRibbet, would cover for him. The manuscript arrived too late to edit, so *db* takes no responsibility for the contents.

I've known Brian Battles for several years now, ever since we both was members of the Mexican pirate radio station XLAX in a little border village appropriately named San Guano de Puercos. We had quite a number of megahertz of power spread across a prolifical segment of both the AM, FM and shortwave dials. It was a once-in-a-lifetime episode of excitement and tribulation, as impressed upon us in no uncertain terms by the government officials who ceremoniously liberated us from our efforts directly following a landmark national election.

Back then, they wasn't no such things as Dolby noise reduction, Compacted Disks or even cassettes. In fact, when we first heard they was people using a new format of recordings on skinny tape in little plastic boxes, we thought they said *castanets*, so we pioneered a short-lived radio format of "All-Castanet Radio," which we thought would be the wave of the future, little did we know.

Anyhow, it's been a long time, and Brian and I have learned a lot. One of the strangest things we ever heard was when a friend of ours was opening his own professional eight-track studio. I says to Brian, now that's the silliest thing, 'cause everybody knows how bad those cartridges sound. But the joke was on us when we found out he meant eight-tracks were eight channels on reel-to-reel. That was like having four of the stereo decks we used. At the time it was hard to imagine being able to fill up eight whole tracks, but, believe it or not, we did some recordings since then that swallowed up more than 24 tracks at once. Course, most commercials don't need nearly that many, but it's handy to have if you can afford the equipment.

Yep, times have changed. A couple of weeks ago I was reading Brian an article on how to use SINKTEE time cold to hook up a tape recorder to a video tape so they'd match up with the mouths moving to the same timing as the voices, and he stopped me to show how you can now buy computerizated editing gear that let's you cut and splice without really cutting anything. It's all done on a typewriter with a TV set and some little flat squares called disks. These, as I understand it, are filled up with softwear and dada. You tape right onto these things like they was little square records. I don't think it'll catch on, though, cause you can't even see 'em when they're inside the player, so you never know what you're listening to. I did find out that using them disks for beer coasters gets people kind of irritated.

Brian says the current technocracy isn't quite ready, but that soon this computation-assisted digitary editing will be ideal for using on homemade recordings and for low-rent studios, 'cause of their precision and poten-

Microphones

In the studio, over the air or up on stage, there's a Fostex RP mic specifically designed for the job at hand. RP stands for regulated phase, a transducer technology which has been awarded over 20 international patents to date. These mics have the warmth of condensers, the ruggedness of dynamics and a sound as transparent as it gets.

Headphones

These are more outstanding examples of RP Technology. Model T-20 has become almost legendary among studio musicians, producers and engineers. Its flat response at any listening level and its comfortable design help you listen longer without fatigue. And the sound is so clear and well-defined, critical listening is enjoyable.

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Model MP-800 has 8 inputs and delivers 180 W per channel and Model MP-1200 has 12 inputs and delivers 250 W per channel. These rugged, road worthy stereo mixers have quiet running fans, digital echo, normalled connections at all critical patch points, stereo graphics on the mains and super monitoring flexibility. The best at any price.

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tial. You could try out an edit and if it didn't sound good you just would type a couple of things and the edit would be fixed up, pronto. And all without disturbing the original recording sounds. I guess this gadget just plays back the parts you tell it to leave alone and skips right over the parts you said to splice out. Nifty, but I'd feel like I was walking disarmed through Beirut if my studio didn't have razor blades in it.

Then he said another important breakthrough was DAT. I asked him which invention he meant by dat, since I seen dis and dat come and go many times in my years as a recording adventurer. Brian said it was *DAT* in capital letters, standing for something like Dignified Audible Tape. This is apparently a machine that controverts regular sound waves like on a normal tape deck into 1's and 0's that can translate back into music to play back. Somehow the 1's and 0's don't hiss or need to be noise-reducted when you record or dub generations. I'm pretty amazed at tape recorders that don't need to put sign waves out of the heads, but I wonder if the whole outfit would go haywire if a singer sang, "One, One, Zero, One, Zero..." into the mic. Brian says it's not likely, because the DAT machine's 1's and 0's stand for On and Off in a binaural manner of arithmetic. Somehow a catalog-to-digitary conversation circuit interprets it, like the news reporters did with Gorbachev's speeches to Ronald Reagan in December. If this is true, I don't care for the idea of politics getting into recording and music. Like those copycode legistrators trying to ban the notes of upper E and F so these DAT's won't work right.

Whenever a new audio trick comes along, everything's confusing and expensive, but sooner or later the rocks sink and the diamonds float, leaving the cream on the surface of the stream. That's why we have CD's. I never seen one that could do anything besides play back, but there oughta be CD's that record any day now, because I guess they've got new laser beams now that are strong enough to burn sounds right onto CD's, instead of just bouncing off the surface like the present ones. I like CD's, especially since they fit more songs than a 33 1/3 record, and they have remote controls. I got a remote control TV a few years back, and I like pointing that miniature calculator at the screen and changing channels. CD's let you change songs that way, plus you don't get your skips and Rice Krispies noises, even when they get old. The new ones have oversamplicating, but mine doesn't, 'cause I don't like to overdo anything. Brian taught me how important that is when he gave me my introductive lessons in EQ and setting levels.

I think I'm getting carried away from producing commercials, and this column's about them, so let's get to it. If you want to know how to get advertising clients to buy your commercial productions rather than the radio station's own jobs, you just tell them one thing: yours are better because it's your area of specialty and they should put up a small percentage of their advertising expenditution into a great spot, as long as they already blow it on air time. See, if they think radio is good for their message, then why not present a better image. Radio is, after all, imagination—that's why it's often called "the theater of the mind," so they have to consider how their image will be imagined by listeners who hear a better ad.

This goes also for businesses who have deejays do their ads. You can do better production work than the greater extent of most radio jocks, and for constancy's sake sponsors should also not want different voices and music on each station; therefore the advertising sponsor should hire you to magnify ROI (that's Return Of Investiture). If you have a neat haircut and wear a jacket and tie and carry a serious-looking business card, they'll at least probably listen to your theory. Then, since they expect it to cost a Federal Mint, you offer a reasonable fee that will set them straight on efficiency of costage. Using these business terminologies will help you with your incredibility when negotiations are under way. And don't omit the fact that the concern here should be the bottom balance sheet line, not their expendence on one facet of the overall marketing wargame plan.

I went with Brian on a client visit a while back where I learned a lot of this personal sales talent in actual action, and I even occasionally aided in the discussion. Like, when the fellow said that fancy radio commercials with custom musical jingles were for expensive companies like McDonald's and General Motors, I said "What's sauce for the goose is sauce for the gander," and I told him those big operations didn't get big by not doing professional advertising, quoting the time-worn maxiom of "From big oaks do little acorns fall." I believe it went quite well, since Brian assured me that he was sure I could return to the studio and clean tape heads while he concluded the meeting. It made me feel good to charge up the atmosphere to the point that the actual transactication was able to be finalized without my presence on the spot.

Yep, Brian Battles is one sharp guy, the Ginsu knife of commercial production is my saying, and I tell you, if he can do it, you certainly can, too. Probably with one hand tied behind your backside simultaneously.

TALKBACK MIC

If Brian was here he'd be saying thanks to Dean Heinbuch of Okolona, Mississippi for sending in another nice letter. Dean wanted to know if he ought to hire out his capability to use MIDI equipment and expertage to radio stations directly so he won't have to sell right to clients, but only provide the producing. I don't know enough to fill an airline ashtray about MIDI, but I assume that this Magical Instrument Directional Interspace will have great value to those of us who are too lazy to play real instruments, and if you add to that the money saved by not hiring living musicians, it just might catch on someday. I suspect Brian'll have more to expound upon that subject material next issue...Also, thanks to Mr. Wayne Gerbrandt of Fasttrack Studios in Denver for the welcome involvement and offer to help in a revolutional new project, to be announced soon...Keep your postal correspondences coming, because we both like to get a little mail that's not bills. db

Recording Techniques

BRUCE BARTLETT

HOW TO MAKE THE MOST OF YOUR STUDIO TIME

• You're ready to take that big step: your first demo recording in a professional studio. The months or years of musical practice will culminate in a tape that displays your band's abilities with the best possible sound.

But studio time is costly. Even a few hours in the studio can cost several hundred dollars. There are ways, however, to keep expenses down while getting all your music clearly on tape.

As a recording engineer, I can offer five tips to help you use your studio time most efficiently:

1. Practice your music.
2. Know session procedures.
3. Know what studios can do with the sound.
4. Plan your tracks.
5. Practice recording at home.

Let's look at each of these suggestions in detail.

PRACTICE YOUR MUSIC

Perfect your musical performance *before* you go into the studio. Practice until you can play without mistakes. I've recorded many bands who waste costly studio time rewriting parts or learning their songs. Do the musical work at home where it costs nothing.

There are exceptions to this rule. Sometimes a musical arrangement must be re-done for sonic reasons. The rhythm-guitar riff may be "crowding" or masking the vocal; the kick drum and bass may need to play more in-sync for a tighter sound with more impact.

You still are charged for this experimentation, so it's wise to practice recording at home to see if the musical arrangement hampers the sound of your recording. The arrangement may be too sparse, giving a thin sound, or too busy, causing a muddy sound.

KNOW SESSION PROCEDURES

There are three stages in making a studio recording: recording, overdubbing and mixdown. The rhythm instruments —drums, bass, guitar— are recorded first. Later, vocals and other instruments are added during the overdubbing stage. Finally, all the recorded tracks are combined or mixed to 2-track stereo in the mixdown stage.

When you go into the studio, you set up your instruments where requested (or wherever feels comfortable). The engineer will tune the drums, place mics, and plug in headphones. Then he will ask you to play your instru-

ments one at a time while he sets recording levels.

Then he will adjust the *cue mix*—the balance among instruments heard in the studio headphones. If you have trouble hearing a particular instrument in the headphones, you can ask the engineer to turn it up.

Next, the engineer starts recording and *slates* the tape by announcing the song title and take number: e.g., "Treat Her Right, Take One." The drummer counts off the beat and the band starts playing.

The lead vocalist might sing a *scratch* vocal along with the instruments. This vocal track is not recorded, but is heard over headphones so the musicians can get a feel for the song.

When the song is done, the engineer can play back the tape. Don't expect this playback to sound like the finished product—refining the sound comes later during mixdown.

After the rhythm tracks for all the songs are recorded, it's time to do overdubs. The lead vocalist listens to the previously recorded tracks and sings along with them. The engineer records the vocal on a separate track. If a mistake is made, the vocal track (or any overdub) can be re-recorded without affecting the rhythm tracks. Other overdubs might include harmony vocals, solos, brass, etc.

Finally, after all the tracks are recorded, the multiple tracks are mixed (combined) and are recorded on the 2-track master tape. At this stage, the volume of each instrument is adjusted for a pleasing balance, along with the tone quality, special effects and so on.

KNOW WHAT STUDIOS CAN DO WITH THE SOUND

Professional recording studios are full of fancy equipment, flashing lights, and magical electronic processors to enhance your sound. It's easy to be intimidated or confused by all the options available. Just remember, you don't need to use everything in sight. The object is mainly to get your song across. Overproduction may obscure this goal.

Studios can control the following aspects of sound:

- "Tight" sound vs. "airy" sound
- Tone quality
- Mix
- Echo

- Reverberation
- Stereo placement of tracks
- Special effects

Let's examine each of these.

Tight sound vs. airy sound: Instruments and vocals can be made to sound close-up (by close mic'ing) or distant (by distant mic'ing). The engineer may use a combination of close mics and distant *ambience* mics. The ambience mics pick up room acoustics for a distant, open, airy sound.

"Tight" also means "highly damped" or "controlled overhang." The engineer may want to put a blanket in the kick drum and tape pads to the tom toms; this controls excessive ringing and tightens the beat.

Tone quality: The tone quality of each instrument—the balance between bass, treble, and midrange—can be controlled by the choice of microphones and by the *equalizers* (EQ) on the recording console. Equalizers are sophisticated tone controls something like the bass and treble controls in a home stereo system.

Each track can be Equalized independently. For example, you can add crispness (high frequencies) to the cymbals without affecting the tone quality of the vocals. Or you can remove a "tubby" tone from the kick drum without affecting the snare drum.

If the tone quality of a particular instrument doesn't sound right to you, ask the engineer to change it. You might say, "Could you make the drums a little brighter? I'd also like more bottom on the bass guitar and more bite on the lead guitar."

EQ can be applied during recording, during mixdown, or both. It's up to the engineer.

Mix: The mix—the relative loudness of each instrument —is controlled by *faders* in the recording console. Each track has its own fader or volume control.

If you want to hear more guitar in the mix, for example, just ask the engineer to turn it up.

Note that there are several different mixes going on in the control room at the same time. During recording, the engineer creates a *monitor mix* that is heard over the monitor speakers. The monitor mix is a pleasing blend of instruments and vocals that simulates the final product. The engineer also creates a *cue mix* heard over the studio headphones. The cue mix lets the musicians hear themselves clearly.

Some recording consoles permit two or more cue mixes to be made independently. One cue mix might emphasize the drums; another might emphasize the keyboards.

During overdubbing, the monitor mix and cue mix are a blend of prerecorded tracks and live microphone signals.

During mixdown, a 2-track stereo mix is created. This is the mix heard on the final product.

Echo is a discrete repetition of a sound, often used on rock 'n' roll vocals. The speed and number of repeats are adjustable.

Reverberation is a continuous decay of sound such as you hear after you shout in an empty gymnasium. Reverb adds a sense of room acoustics or spaciousness. It is used on vocals and most instruments, but seldom on kick drum or bass, because reverb

WHAT YOU DO WITH THE M-600 MIXER IS YOUR BUSINESS.

That's why we've designed it to meet or exceed your most demanding requirements. And made it the easiest, most flexible professional mixing console you'll ever work with.

The M-600 is modular. Which means you can custom configure the console to *your* audio or video production needs. The M-600 lets you choose up to 32 input channels, or you can start with 16 or 24 input channels and expand the board as your needs change. Optional stereo modules can also be added to provide even more line inputs for MIDI instruments and video production convenience.

Installation and wiring is exceptionally easy. The M-600 is the only modular mixer that's available with all the necessary finished cables and installation hardware. And that can eliminate a lot of installation hassles and expense. At the same time, no other mixer at its price gives you multi-pin, computer-type connectors for quieter, more secure connections.

But the real pleasures of the M-600 will only be evident after it's in your studio. Up to 64 stereo or 128 mono inputs can be accessed directly from the top panel. A patch bay can be added for fast, flexible routing. That's convenience.

The M-600 has all the features you'd expect in a professional mixing console. Like balanced insert patch points on all inputs, PGM busses as well as the stereo master buss for increased signal processing capability. Plus sweep-type parametric EQ, balanced inputs and outputs, phantom power, talkback/slate channel and all the audio performance you'll ever need. Without the exorbitant price you don't need.

So check out the M-600 modular mixing console. It's ready for fame when you are.

TASCAM

tends to muddy these instruments. The amount of reverb is adjustable.

Reverberation can be created mechanically by a spring unit or steel plate, acoustically by an echo chamber, or electronically by a digital delay unit. The more sophisticated digital reverbs can simulate rooms of any size.

Stereo placement or panning: The location of each instrument between the stereo speakers can be controlled by *pan pots* on the console. Each instrument can be placed left, right, center, or anywhere in between.

Bass, kick drum, and lead vocal always are panned to the center for easier record cutting and for a sense of solidity. Guitars and keyboards often are split equally left and right. Drums, piano and keyboards sometimes can be recorded in stereo, spread between the speakers.

Special effects: A *compressor* is always used on the vocals to keep their loudness constant. *Flanging*, *doubling* and *chorus* are interesting delay effects. A *noise gate* cuts out noise between musical notes, and can be used to cut off a reverberant "splash."

It's a good idea to listen to several records and find some that have a sound or production you like. Take these records to the studio, or send the engineer a cassette copy of them, so he can hear the production style you think complements your music. Then the engineer can plan his recording techniques in advance.

PLAN YOUR TRACKS

In general, the more tracks you record on, the higher the recording cost. If your song is a simple vocal with piano or guitar accompaniment, a 2-track stereo recording will do. The engineer will mix the vocals and instruments as you're recording. If the mix sounds wrong to you during playback, ask the engineer to change it and re-record. The mix you hear on a 2-track recording is the final product; there is no separate mixdown session.

A four-track recording might be suitable for a small rock or jazz group. Keyboards can go on track 1, a bass-and-drums mix can go on track 2, vocals on 3, and guitars on 4. If several instruments are mixed to one track, you can't easily change the mix *within* that track once it's recorded. For example, if the bass and drums are mixed together and recorded on a single track, you can't change the balance between bass and drums (except slightly with EQ).

Also, each track is mono. If you want a stereo drum mix, for example, it must be recorded on two tracks.

More than four groups of instruments can be recorded on a 4-track machine by the process of *bouncing tracks*. With this technique, you record three instruments on tracks 1, 2 and 3. You then mix these three tracks and record the result on track 4. Then you can erase tracks 1, 2 and 3 to free them up for recording more instruments. It's possible, through bouncing, to record up to nine instruments with only one generation loss.

Eight-track recording is much easier than four-track because you seldom need to compromise the stereo or bounce tracks. A typical 8-track

recording might be organized as follows:

Track 1: bass
2: kick drum
3: drums left
4: drums right
5: guitar
6: keyboards
7: lead vocal overdub
8: vocal harmony overdub

After all these tracks are recorded, it's relatively easy to mix them to a finished 2-track stereo master tape.

Sixteen tracks are needed for more elaborate productions. If you have only one guitar player, he can record rhythm guitar first, then overdub a lead-guitar solo. On the remaining tracks you can add synthesizer highlights, strings, horns, more harmony vocals, percussion, etc. In any case, work with the studio engineer before the session to plan your track assignments for each song. Include rhythm tracks and overdubs.

PRACTICE RECORDING AT HOME

Experiment with recording techniques at home to get an idea of what can be done in the studio. Try different mixes. Overdub instruments to see whether the overdub is musically effective. Try various effects and EQ to see what enhances your music.

Even if you record your band with just two mics and a cassette deck, the results will be valuable. When you perform a song, you tend to concentrate on your own instrument. But when you hear a tape playback of that song, you can listen to the song as a whole. You can better hear what works musically and what doesn't. It's less expensive to do this experimenting at home than in the studio.

There's a wide choice of excellent home-recording equipment. It ranges from a small 4-track cassette recorder/mixer to an open-reel recorder/mixer to a separate console and 16-track recorder. Some prominent manufacturers in the home-recording field are Ross, Cutex, Clarion, Vesta Fire, AMR, Audio Technica, Yamaha, Akai, Tascam, and Fostex.

You can learn recording techniques by reading this magazine, by reading the literature provided with the equipment, and by reading books on recording technology. It's also a must to work with the equipment until you learn its capabilities.

Let the studio engineer hear your home demo tape so he can become familiar with your music and production style.

By practicing your music, knowing what to expect in the studio, and recording at home, you can save costly time in the studio—and you'll know what you're doing! db

LEN FELDMAN

R-DAT — Where Do We Go From Here?

• By now, I suspect that everyone is familiar with the controversy that rages over the introduction of Digital Audio Tape Recorders (DATs) in the United States. By way of a quick review, some half dozen major record company conglomerates insist that distribution of DATs to consumers will result in an increased level of "piracy," ostensibly because copies of recordings made on DATs will sound better than those made on other state-of-the-art analog recorders. Several smaller record labels don't share that fear and are, in fact, eager and willing to produce software for the new digital medium.

As for the "superiority" of the copies made on a DAT machine it is important to understand the distinction between a true digital-to-digital recording process and the type of copying that can be done on a consumer-type DAT machine. The DAT standard, developed over several years by some 84 participating companies worldwide, specifically inhibits the user from making digital-to-digital copies of copyrighted material. Two built-in elements are involved. For one thing, consumer DATs are able to **record** only at a sampling rate of 48 kHz. CDs and future recorded DAT software employ sampling rates of 44.1 kHz, which these DAT units can play. Furthermore, even if one were willing to spend the thousands of dollars required for a professional recording sampling rate converter, a second inhibiting factor, known as a copy-inhibit "flag" in the digital subcode associated with the DAT format would prevent direct digital-to-digital copying.

Of course, professional DAT recorders, such as those exhibited at the recently concluded AES convention in New York have no such restrictions. In fact, the two pro machines introduced by Sony (the PCM-2500, an a.c. powered studio unit, and the PCM-2000, a portable DAT recorder for in-the-field mastering) can handle both sampling rates as well as the international 32 kHz sampling rate used for broadcast digital audio. The portable DAT recorder, Model PCM-2000, offers a fourth sampling rate at 44.056 kHz, the sampling rate common to earlier PCM adaptors used with video recorders.

Be that as it may, the anti-DAT forces have proposed an anti-copying solution that would also prevent copying via a digital-to-analog-to-digital route—a route that could hardly be described as one that can make "digital clones" with no degradation. In fact, many observers—including several legislators in Congress who have been given demonstrations of DAT—could not tell the difference between material recorded via the D-A-D path and the same material recorded on a top-grade analog cassette deck.

The proposed anti-copy scheme—the infamous"notch" located well within the audio spectrum and its associated sensing "chip" that would have to be incorporated in all DAT recorders sold in the U.S.—has been well documented by now. Here's where matters stand on the legislative front: Currently, the National Bureau of Standards is engaged in a major study to determine three things about the so-called "copy code" system proposed by CBS Records and the RIAA.

1. Does the digital copy-code scanner system achieve its purpose to prevent digital audio tape machines from recording?

2. Does the system diminish the quality of the recorded material into which the "notch" is inserted?

3. Can the system be bypassed and, if so, how easily?

Having read the details of the NBS plan for testing, I am convinced that they can only come to the same conclusion that many of us have already reached, namely, that the CBS Copy-Code scheme is an inferior, antiquated technology that does not belong in the world of digital audio. The NBS study is expected to be completed towards the end of January 1988, or in February. Presumably, the Congress of the United States (having nothing better to do) will turn its attention to this earth shaking legislative proposal. Hopefully, they will see it for what it is and will reject it out of hand.

A recent development in the corporate world may have some impact on this situation. As you may have read, Sony Corporation has struck a deal to purchase CBS Records for a reported $2 Billion! Sony management steadfastly maintains that their purchase of the CBS Records division is in no way related to the CBS-proposed DAT anti-copy debate. Indeed, they have retained the executives who have been the staunchest promoters of the copy-code scheme. Still, I (and others) find it hard to believe that a company that has been at the forefront of digital audio development and a leading hardware manufacturer of digital audio equipment for both consumer and professional will stand idly by while a major market such as the United States is deprived of a consumer product that is currently distributed in Japan and that is now beginning to arrive in Europe. (The European Economic Council voted against the

copy-code idea, and against any tax on DAT tape or machines, thereby opening the way for DAT to be sold in 11 EEC countries.) Only time will tell whether Sony intends to bring pressure on those executives who remain on board at CBS Records.

HOW GOOD IS DAT, ANYWAY?

While these legislative and political matters run their course, it occurred to me that you might be interested in knowing just how good DAT actually is and how well it can serve the small recording studio operator as an alternative two-channel mastering device. To date, I have had an opportunity to test no fewer than a half dozen DAT machines in my laboratory. I can tell you that even the consumer versions offer a tremendous amount of versatility from the point of view of the recording engineer, not to mention superb measured specifications. Let's talk about typical specifications first.

Because consumer DAT machines use a 48 kHz sampling rate when recording via their line inputs, frequency response actually extends a bit beyond that of CDs. Most of the machines I tested were flat within a fraction of a dB out to 22,000 Hz. Now, you might say that this slight additional spectrum is not of any great importance audibly, and you'd be perfectly correct. But consider this: in digital audio it's necessary to filter out any components above one-half the sampling rate frequency. As we've learned from the CD player experience, achieving high levels of attenuation with anything but digital filters means introducing severe phase shifts at the high end of the spectrum with multi-pole "brick wall" filters. It also means that tolerance buildups in the filter components can often work against you so that audio response falls off within the audio spectrum. By having those couple of extra kHz of leeway in a DAT recorder, less phase shift can be expected at the high end, and flat response at least to 20 kHz (if not all the way to 22 kHz) is more certain to occur in mass produced units.

As for signal-to-noise ratios achieved on first-production DAT recorders, they've all been averaging better than 90 dB—this including the complete record/play loop, not playback alone. At maximum (0 dB) record levels, THD has been below 0.005 percent and wow-and-flutter has been below measurable limits of any test equipment of which I know.

In the case of the recently announced professional DAT machines mentioned earlier, in at least one significant way they are actually better than the studio-type PCM-1630 or PCM-3324 digital multi-channel recording systems that have become almost a de facto standard in the industry. Unlike the consumer DAT machines that I have measured thus far, the "pro" units employ 2X oversampling digital filters; both the A/D and D/A converters employ such filters to assure minimal phase shift within the audio band during recording and playback.

DAT SUBCODE FEATURES

Most of the DAT machines I have had in the lab take advantage of the many subcode features built into the R-DAT standard. Specifically, you can assign numbers to selections as you record them, in addition to automatically assigning a "Start I.D."

code. Once selections have been numbered on a tape, you can easily access them or you can program the machine to play selections in the order that you choose. You can even re-number selections if you wish, or you can have the machine skip predetermined selections during playback. There are two aspects of this subcode system that are especially attractive. First, all of the subcode information can be applied to a DAT tape either during recording or at any time afterward. Secondly, if you do apply subcode data after the recording has been made, it does not affect the audio information itself in any way. The subcode area on the tape track is completely separate from the digital audio data area. The professional models introduced by Sony go a step beyond what's possible with the subcode configuration alone. The PCM 2000 uses one of the DAT format's auxiliary longitudinal tracks for recording and playback of SMPTE/EBU time code. It can be connected to a variety of external time code generator/reader equipment. A "Word Sync" input on this unit permits synchronization of digital audio signals as well. The a.c. operated studio unit (PCM-2500) offers three digital interfaces (AES/EBU, SDIF-2 and S/P DIF) for easy connection to a variety of studio equipment. Both wired and wireless remote controls are supplied with this unit for maximum operating versatility and convenience.

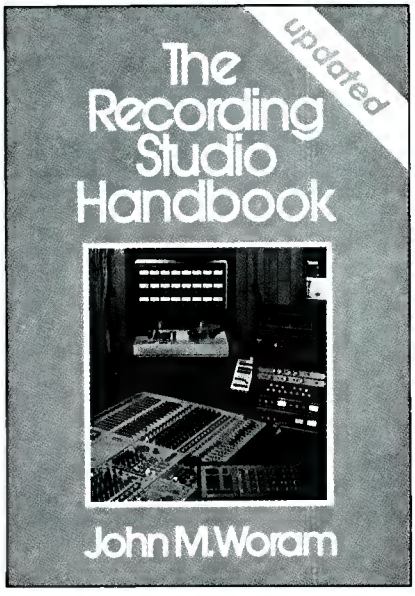
HIGH SPEED DAT SOFTWARE DUPLICATION

The very same record companies who have been so dead set against DAT have also maintained a boycott insofar as DAT software is concerned. Until recently, their argument against getting involved with DAT recorded software has been one based upon economics. They maintained that since the only way they could produce such software was using one-to-one real-time duplication (the master-plus-slaves approach), that the cost of producing DAT recordings would make them prohibitively expensive. (Of course, that procedure hasn't exactly stopped many of those same companies from making handsome profits from the sale of recorded video cassettes, most of which are also produced using real-time duplication techniques.)

Well, now that excuse goes out the window too. Sony Corporation has introduced a high-speed DAT software production system that works on the principle of contact printing from a fast-moving "mother" tape to blank tape. The recording process is 327 times faster than real-time duplication. To put it another way, an 80 minute DAT tape could be duplicated in around 15 seconds! If that doesn't tempt some of the reluctant software producers to take another hard look at DAT software, I don't know what will. Add to that the recent announcement by the Ford Motor Company that, beginning in June, their Lincoln Continental automobiles will offer a DAT player option and it all adds up to this. DAT is going to be a factor in both consumer and pro audio, regardless of what the consortium of major record companies do to try to stop it. You can't stop a good technology whose time has come. db

For Your Audio Library

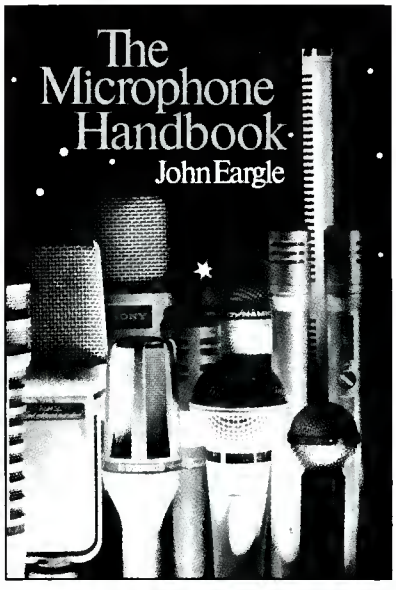
The Recording Studio Handbook



by John Woram **$39.50**

The Recording Studio Handbook is an indispensable guide with something in it for everybody. It covers the basics beautifully. It provides in-depth insight into common situations and problems encountered by the professional engineer. It offers clear, practical explanations on a proliferation of new devices. In this updated edition, among the items covered are: Transducers, signal processing, noise reduction, recording techniques and more . . . In addition, it has been expanded to feature three all-new chapters . . . chapters on the in-line recording studio console, digital audio and time code implementation.

The Microphone Handbook



by John Eargle **$31.95**

Completely up to date, this vital new handbook is a must for any professional whose work involves microphones. Among the topics covered are: Directional characteristics—the basic patterns, using patterns effectively, microphone sensitivity ratings, remote powering of condensers and proximity and distance effects. Other topics include: Multi-microphone interference problems, stereo microphone techniques, speech and music reinforcement, studio microphone techniques and microphone accessories. You'll find yourself reaching for it every time a new or unusual problem crops up.

Please send the books indicated below:

_____ copy(s) of The Microphone Handbook at $31.95 plus $2.00 for postage and handling per book.

_____ copy(s) of The Recording Studio Handbook at $39.50 plus $2.00 for postage and handling per book.

_____ Both books at $67.50 plus $3.00 for postage and handling. (Over 5% savings!)

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Editorial

A new year is beginning and the winds of change that blow with it bring new features to db Magazine. If you read this issue's cover, you will notice that *The Electronic Cottage* is newly added.

db Magazine is, of course, the practical magazine for the audio professional. But that role is ever-changing. Today, the recording industry is expanding from its traditional posture of major studios to sophisticated home or office, one-person systems. These computer-driven systems are a new part of the recording industry and **db Magazine** will be covering this phenomenon this year. The umbrella title will be *The Electronic Cottage*. We are grateful to author Alvin Toffler and his book *The Third Wave* for the origination of the title in this meaning.

The computer is having a *greater* impact on the recording industry, of course. It is computer power in the major studios that is allowing ever more sophisticated recording to be achieved. I speak of course of those synthesizer/disk-storage systems that this industry is embracing. You will see more articles about New England Digital, Fairlight, and Audio Frame, just to mention the leaders at this writing. But the march of technology will not be stopped. It's safe to say that before we reach 1990 there will be new systems, newer technologies. You will read about them in these pages.

The previous paragraph also brings back another march of technology that threatens to stop dead in its tracks. That is the R-DAT phenomenon and what improvements it can bring to the recording world. I'd strongly urge you to read Len Feldman's article on this very subject in this issue. I would also urge you to write your Congressional leaders to remind them that new technology does not need government controls.

The new technologies seem to be coming to the recording industry first, but a review of what we published in 1987 about new ways to do things, in both broadcasting audio and sound contracting, makes me sure that these disciplines will see their fair share of technological advancements in the coming years. You can also be sure that you will continue to read about them first in these pages.

L.Z.

BRUCE BARTLETT

Sound at the 1987 Special Olympics

A FITTING SLOGAN FOR THE 1987 INTERNATIONAL SUMMER Special Olympics Games was, "A time for heroes." This was also the world's largest sporting event of 1987. It represented a worldwide effort to recognize the skills and courage of mentally handicapped athletes.

The heroes were not only the 4,700 athletes from 72 countries who participated, but also the 12,000 volunteers who helped out, including hundreds involved with the audio systems at the Games.

Held at the campuses of Notre Dame and St. Mary's College in South Bend, Indiana, the Special Olympics ran from July 31 through August 8.

The Games were formally opened with a two-hour entertainment special, "The Special Olympics Opening Ceremonies," which was held August 2nd and televised on August 3rd by the ABC Television Network. Headlining the event were singers Whitney Houston and John Denver, entertainer Barbara Mandrell, and Boston Pops conductor John Williams. This extravaganza, which used 1,500 volunteers, took place before a capacity crowd of 70,000 spectators and athletes in Notre Dame Stadium. It was the first time a group of handicapped athletes were featured on prime-time television.

Figure 1. Opening day ceremonies at the 1987 Special Olympics.

ABC's Wide World of Sports devoted a 90-minute program to the Games on August 15. Veteran sportscaster Frank Gifford was the host of the show, and also appeared in the Opening Ceremonies.

PREPARATION

Tom Durell, a leading free-lance audio engineer, visited Crown International to prepare the audio systems for the Olympics. Tom was the sound engineer for last summer's Liberty Weekend and the 1984 Summer Olympics in Los Angeles. He also designs or operates sound systems for TV shows, TV commercials and movies. Crown International (of Elkhart, Indiana) is a manufacturer of professional power amplifiers, microphones, TDS Analyzers and related electronics. Working closely with Tom was Crown's Bill Raventos, Microphone Product Manager.

In the sound systems he coordinates, Tom often uses Crown amplifiers and microphones because, he says, "They make good stuff...they are not over-priced, and they don't fail. I like their hardware because I beat it to death, and it doesn't give us problems."

The International Special Olympics required several elaborate sound systems because much of the program included musical entertainment. In addition to the Opening Ceremonies, small concerts kept the spectators occupied and entertained. In all, there were 314 sound setups used in 8 days!

For the majority of the systems, a special computer program called *Avail* was used, with an operating system provided by Theos. This software allowed the system designers to assign sound systems and technicians to venues.

Data entered into Avail included the names of the available technicians, their capabilities, the equipment and the sound jobs that had to be done. The Master Event/Venue Listing indicated the date of the event, starting and ending time, type of event, venue location, operator skill level needed (A, B, or C), contact person with phone number and brief descriptions of events and/or sound systems needed. Specifically, Avail kept track of:

- The entire inventory of 2,000 pieces of equipment
- Over 30 venue sites
- Over 314 sound jobs that had to be done at those venue sites
- The technicians (more than 200 in the database).

This program enabled the sound crew to respond graciously whenever a frantic person would call and say, "Where is our sound system?" Bill Raventos would look at the Master Event/Venue Listing and see that no one had ever requested sound for that event. But, according to Bill, "With 20 minutes notice, out would go the van with some

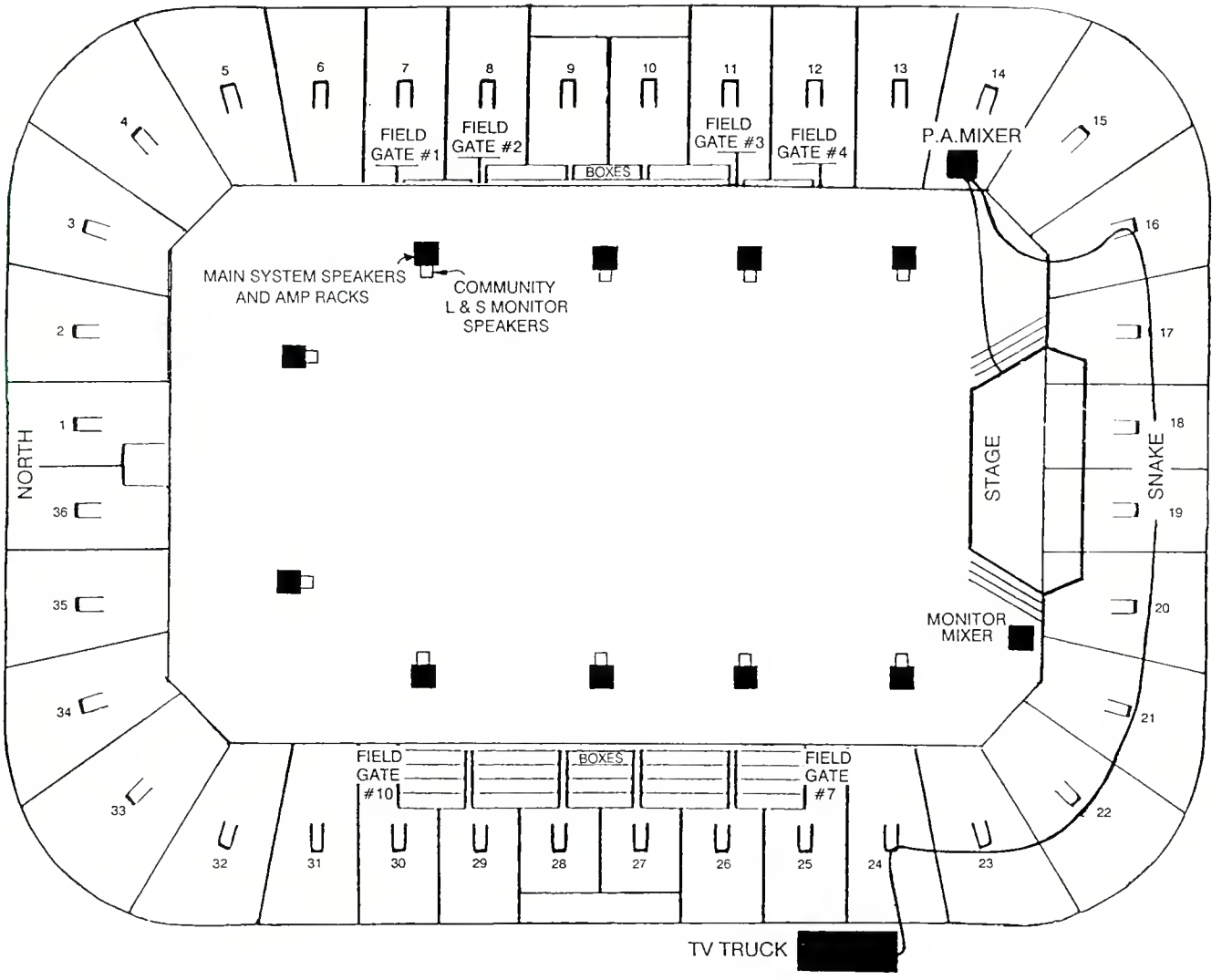


Figure 2. The sound system for the opening ceremonies.

stuff thrown in and within an hour we'd have a sound system up and going."

That same software allowed presetting of some systems. For example, suppose a standard small system was needed, which might consist of an EV Entertainer system with two extra speakers, two extra speaker stands, eight microphones, 1/3 octave EQ, perhaps auxiliary amplifiers, other signal processors, and so on. When there was a sound job of about that size, they simply punched a computer key and the whole inventory appeared on the printout for that particular setup, that day, and that location.

Tom Durell and Bill Raventos did scratch drawings for the Crown technicians who assembled the racks. Once the racks were assembled, all the technicians had to do was attach inputs and outputs, place speakers, and run the snake.

There were about 180 audio volunteers. About half of those spent a significant amount of time and approximately 45 of those were Crown employees.

THE OPENING CEREMONIES SYSTEM

This concert system was installed at Notre Dame Stadium for an audience of 70,000. Supplied and operated by dB Sound from Chicago, it was essentially the REO Speedwagon system, which dB Sound sets up and tears down five times a week.

For the Opening Ceremonies, the speaker layout and power requirements differed somewhat from the REO system. The dB-customized stadium system was left pretty much up to dB Sound. Additionally, Tom Durell specified speaker location and aiming. The system also used Community Light & Sound speakers for on-field foldback.

Microphones were split to go to different consoles for broadcast, sound reinforcement, and stage monitoring.

Ed Greene's remote truck was used for the ABC broadcast. The feed out to the truck was handled by one of the snakes (450 feet, 50 pair) that was donated by ProCo. Ed Greene mixed for ABC.

Because of television's visual restrictions, the speakers had to be put on the ground—no towers permitted. Consequently the house sound wasn't optimum, but still was quite good.

There were other video-related problems. The sound mixing console, which was set up in the stands by six men working 10 hours, was in the way of a camera shot. ABC wanted to move it 30 feet, but this would have been a major undertaking. Nobody wanted to pay the high cost of Union labor required. After two days of negotiation, a compromise was reached: the console was draped in black so it was not picked up by the camera.

Figure 3. The Soundcraft console used during opening ceremonies.

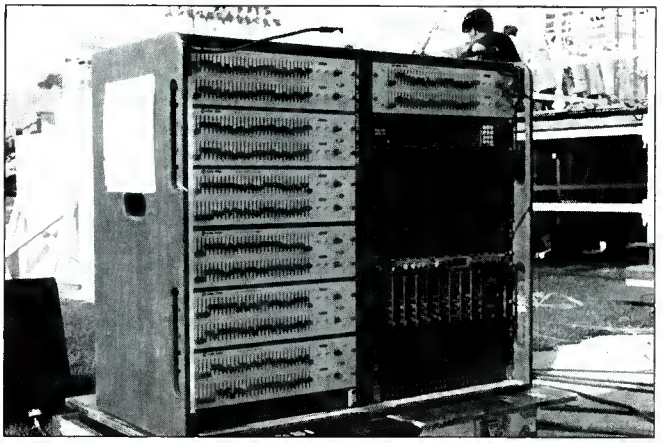


Figure 4. The equipment rack used for the opening ceremonies.

Clear Com communication systems were used between the stage and the mixing positions. They also were used for events that took place in the arena of the Notre Dame Athletic and Convocation Center.

INTERNATIONAL DANCE SYSTEM

This high-SPL concert system amplified a live band to provide dance music for the athletes before the Games. It used Crown Macro-Tech 1200 amplifiers, White EQ, Community Light & Sound 70 Series house speakers, Community stage monitors, Community 327 side-fill monitors, and a DDA console (DDA is a division of Klark Teknik). All connections were provided by Pro Co.

VIP RECEPTION SETUP

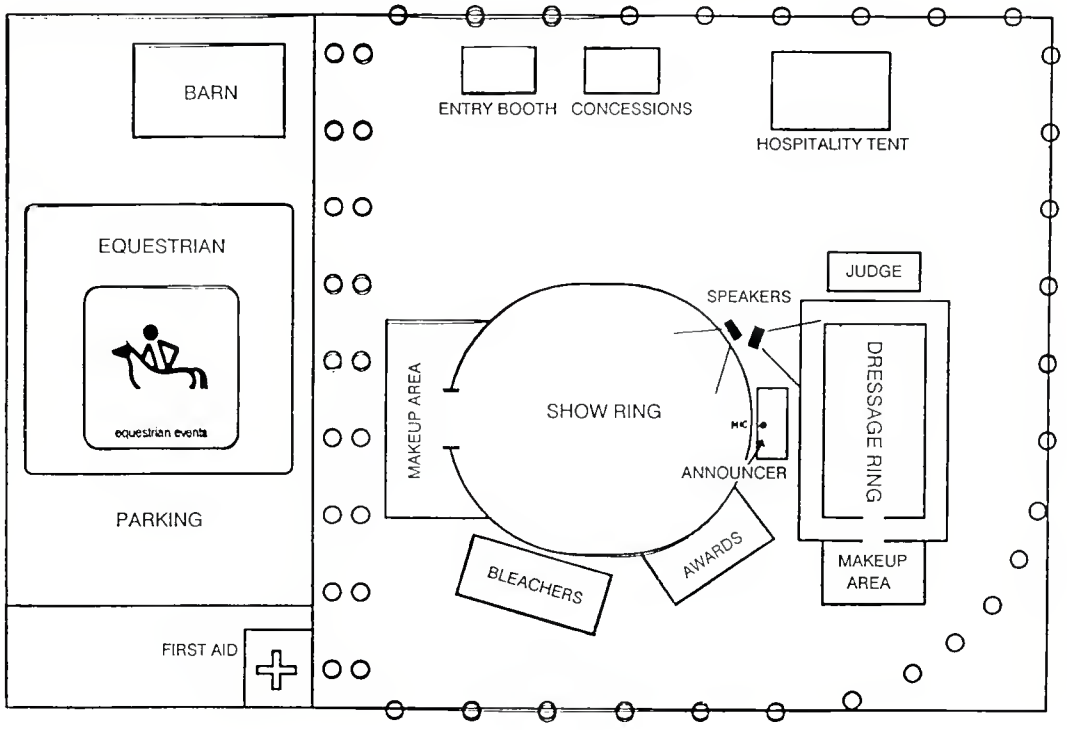
The VIP reception had an 18-piece jazz orchestra. For sound reinforcement, the designers used two stacks of Community Light & Sound speakers. In addition, there were EV Entertainer speakers strung out over an area about the size of a football field: the fountain area in front of Notre Dame Library.

This system kept blowing the supplied 15-amp breaker, so halfway through the program a generator was carted in by the sound crew for power.

LUNCHTIME ENTERTAINMENT SYSTEMS

There were three sizes of systems used for lunchtime entertainment. Large systems used stacks of Community speakers, floor monitors, Crown amplifiers, and a DDA console. Standard systems included an Electro-Voice Entertainer mixer/amplifier (used only as a mixer), four Entertainer speakers and stands, cables, and a standard rack. This rack was a portable Star Case unit containing two Crown Macro-Tech 1200 power amplifiers, a Crown D-150, and a 1/3 octave equalizer. Only a few small systems were used, which included two Entertainer speakers and the Entertainer mixer/amplifier.

Figure 5. The sound system used for the equestrian event.



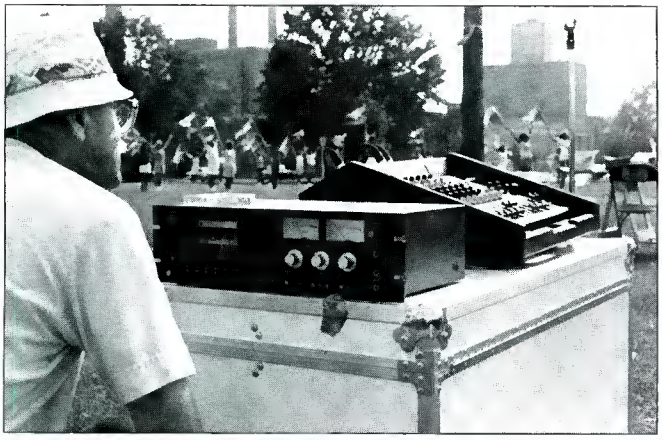


Figure 6. The background music/announcement system.

Figure 7. Up With People perform at Olympic Town.

The limit to the system powering often was the 15- or 20-amp breaker that was available to power it.

SMALL SYSTEMS

These were just one notch above background-music level, with one or two mics and a tape player.

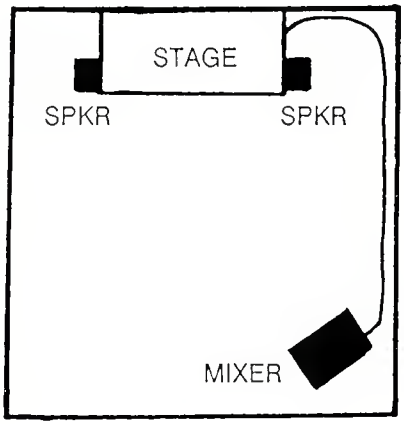
ATHLETIC-EVENT SYSTEMS

While the other systems were set up and torn down as they were used, several athletic P.A. systems were permanently installed for the duration of the Games. For example, the soccer system (which covered five soccer fields) used Electro-Voice PA30 horns which were put up on poles and left. The wiring was also left in place. At the beginning of each day, an operator went out to move the rack out of the storage trailer next to the soccer area, get it set up, get the speaker lines hooked up, and get the system running. At the end of the day the operator struck the system.

SMALL SPORTS SETUPS

The Bicycling and Equestrian events each had about 200 spectators. These events used an EV Entertainer system with a generator, because the system was out in the field away from AC mains power. The generators were 1200W and 2500W units made by Honda. According to Bill Raventos, they were impressively quiet.

Figure 8. The sound system for the main entertainment tent in Olympic Town.



THE AWARDS SYSTEMS

These systems were similar in size to the small athletic systems. Virtually every athlete who competed got an award. The award ceremonies ran continuously, with one microphone and a person announcing the names of the people standing on the graduated steps. After the awards were presented, a cassette tape of the Olympic theme was played, and the athletes went off and the next group went on. At almost every athletic venue, there was an awards system in addition to the main sports announcing system.

OLYMPIC TOWN

This venue was a 60 ft. by 100 ft. tent which had continuous entertainment for the athletes from 10:00 A.M. to 4:00 P.M. It was a permanent setup because security was good there. This job was a challenge because one act followed another all day long. The operator and his assistant had no idea what the next act was going to be until they were set up. The acts ranged from very simple (cassette playback) to very complex (Up With People, using 25 mics).

Figure 9. An E-V Entertainer speaker system was used in field coverage.

MICROPHONES

Nearly all the microphones were Crown CM-200 cardioid condenser units. According to Bill Raventos, Tom Durell was "ecstatic" about the CM-200s. Several sound engineers said that the microphones sounded "great." They were used everywhere, for instruments as well as vocals. The mics were reported to have no break-up, even on musical-instrument loudspeakers.

Crown Select Series wooden-handle microphones were custom engraved with the names of the participating celebrities. Oak-handle units were presented to Barbara Mandrell, Oprah Winfrey, Whitney Houston, John Denver, Don Johnson, and Jeff Margolis. Craig Golins received a microphone of ziricote wood, and Lee Miller used one made of laminated birch.

AMPLIFIERS

All the amplifiers were Crown, including seventy Macro-Tech 1200s and twenty D-150s.

CONSOLES

Other than the EV Entertainer System consoles, there were consoles made by DDA, a division of Klark Teknik. In use were three 16-input, 4-output consoles; one 22-input, 4-output console, and one 24-input, 4-output console permanently installed at Olympic Town.

LOGISTICS

Crew personnel were being trucked in and out all day long. There was a central warehouse about 2 1/2 miles from the campus. Supervisors made sure that each sound system got to the right place in time for setup, and that there were people to operate them. When each system was finished being used, the trucks were sent back to pick up the system and bring it back to the warehouse.

Generally the trucks rolled out two hours before each system was supposed to be in operation. That gave about 1 1/2 hour of setup time before each show.

For the lunchtime entertainment systems, for an 11:00 show, the trucks generally rolled by 8:45. Extra time was needed because every snake was taped down to prevent accidents; most of the systems were placed in an informal environment where people wandered around.

The special athletes were very curious about sound-system operations, and delighted in demonstrations by the operating personnel. It was fun to show the athletes how the equipment worked.

PROBLEMS

One day there was a massive power outage at Olympic Town. A radio call went out for help. Crown's Chief Microphone Engineer, Tom Lininger, had a truck with a large generator in use nearby. He got on the radio and it was decided to take the generator to Olympic Town, where there was a PA set up for emergency announcements. Within 10 to 15 minutes, they had a generator at the tent, had re-configured the power for the amplifiers so as not to stress the generator, and had the sound system up and going again. In the middle of the power outage they still could put on entertainment and make emergency public service announcements.

The Olympic people were very impressed. Although this extra effort was not expected, the sound crew felt—especially in the extreme heat—that the emergency system was important as well as entertainment, when everything else was shut down for the 3,000 athletes, parents, and coaches gathered there.

Vice President Bush's Secret Service men had to be reckoned with for the Closing Ceremonies. Setup time was cut short at 4:00 P.M. before the evening performance, and the area was sealed off as the Secret Service did their two-hour security sweep. The sound people were warned not to go anywhere near the Vice President without an escort. If a mic failed or something went wrong on stage, they were told not to move or they might get shot!

There were very few failures of audio equipment: two tape machines, two microphones, two power amps out of over 100, and two mic cords. That was the total extent of the failures, which is remarkable considering that over 300 jobs were done in 8 days.

The biggest problem was getting the equipment and its operators to the right place at the right time.

That mission was a success, thanks to the careful planning of Bill Raventos and Tom Durell, and thanks to the hard work and long hours of Ed Greene and ABC(Opening Ceremonies), plus hundreds of volunteers. Coordinating the 314 sound venues with hardly a hitch—and with excellent sound quality—was a outstanding effort which added to the success of the Special Olympics.

Much appreciated was the willingness and generosity of the following companies who loaned their equipment. Without it, the show would not have gone on.

THE CONTRIBUTORS

Community Light & Sound—speakers.
Klark Teknik Electronics, Inc.—signal processing devices and consoles.
Atlas/Soundolier—microphone stands.
Boardwalk and Baseball—Gladiator III spotlights manufactured by Strong International Co.
Teac/Tascam—high-grade cassette machines.
Belden Wire and Cable—wire.
Carol Cable Co.—cube taps.
Electro-Voice, Inc.—Entertainer systems, PA horns, extra speakers.
Star Case Co.—equipment cases.
White Instruments, Inc.—sound equalization equipment, responsible for other key contacts.
Pro Co Sound Co.—audio cable.
Sharp Communications—radios.
Tripp Lite Inc.—power strips.
Micro-Innovations—computer software.
Theos Software Corp.—computer multi-user operating system.
dB Sound of Chicago—sound system for Opening Ceremonies.
Whiteford Trucking—Large trucks and shipping services.
Shuford Mills—gaffer's tape.
Bradley-Toner Agency—logo, merchandise design, ads, photograph coordination.

ACKNOWLEDGEMENTS

The author thanks Bill Raventos, Libby Marshall, and Tony Satariano of Crown for supplying this information; and Wendy Murphy of Crown for transcribing the interview with Bill. db

JERRY JACOB

A Multi-Tasking Room on a Budget

THE FUTURE OF ANY INDUSTRY IS IN THE YOUNG MEN and women who enter its ranks every day. If these future leaders are well trained and properly prepared for the work and challenges that they face, the industry grows and remains healthy.

In the Recording and Video Post Production business the drop-out rate from inadequate preparation is very high. Today's complex technology, the innate ability to make creative decisions and the gift of using your hearing intelligently are all factors which contribute to the success or failure of a newcomer.

Given the highly subjective nature of much of what we do, the concept of formal training becomes much more difficult to implement than in many other less creative occupations.

Training for a successful career in audio requires far more than an understanding of electron flow or the knobs and faucets on a piece of equipment. It requires hours and hours of hands-on experience in real world situations where all of the senses are called upon to act in synergy.

There are few schools or universities in North America which are equipped philosophically or physically to accomplish the goal of sending a student out into the real world with a valid background in both the academic and practical aspects of our business. One such operation is Canada's Columbia Academy.

For over twenty-one years Columbia Academy of Radio, Television and Recording Arts has been providing training in the media arts. The last ten years have seen huge growth within the media arts division, with the result that there are now three Columbia Academy Colleges based in Vancouver, Calgary and Edmonton. All have recently moved into new, expanded, specifically designed facilities created to provide the student with the best expertise and technology available. The philosophy of practical, hands-on training is evident throughout the colleges which are all equipped with professional 24-track recording and broadcast studios for educational purposes.

Additions and corrections to this article were submitted by Allison Medd, Marty Hasselbach and Jerry Jacob, Vice President, Chips Davis, LEDE Designs Inc.

Chips Davis and I first visited Columbia's Headquarters in Vancouver, British Columbia in early 1986. Owner, George McNeill and Chief Engineer Marty Hasselbach were enthusiastic about the new 15,000 square foot Recording and Broadcasting College they were building in a new High-Rise overlooking the "Worlds Fair" site and Downtown Vancouver.

Columbia Academy had been successful offering students the highest level of training possible; the school is selective in its entrance requirements and enjoys an extremely high placement and success rate among its graduates.

George and Marty and the entire Columbia staff were also unified and emphatic in their demand that the new Columbia Facility be as technologically advanced as was possible.

A GOLDEN EAR...

Columbia shares our view that "A golden ear is a well trained ear." We believe that once someone has been trained to work in a neutral, accurate monitoring environment, their perceptual acuity is developed to a much greater degree than would otherwise be possible.

If you are trained to recognize and identify problems in a monitoring system, you won't be fooled by those problems the next time you encounter them. Learning in a linear environment, where you can actually control the sound you are putting on tape, makes the technical decisions objective. When the technical decisions are objective, the creative decisions can truly be subjective and creative. Trusting the accuracy of the subjective decisions makes for great engineers.

The new Columbia Classroom/Studio was to be a fully functional working recording and post/production environment. We were to approach its design as we would any other mid-budget real life operation. This facility was to be built to make records and be "on the air." It would rent non-classroom time to clients, producers and engineers just as any commercial facility would, for a profit.

Thus, with these criteria established, we set out to cope with the real world requirements of multi-functionality, physical location, lease conditions and budget of the project.

Many recording and post production facilities are now being built in leased space in high-rise and commercial office buildings. A major condition of Columbia's lease was

that the facility be acoustically isolated from sound leakage into the rest of the building. Never having dealt with recording studios, the building tenants and owners were justifiably paranoid. We were not so much worried about leakage out as with leakage in. Our consideration was to keep sound from the rest of the building out of the facility. We were building over a parking lot, next to a central HVAC (Heating, Ventilation and Air Conditioning) system and adjacent to a major street (sources of noise with which we are all familiar).

Figure 1. From left to right...
Chips Davis, Designer, Marty Hasselbach, Chief Engineer, Stan Yoshida, Technical Director, George McNeill, President and Mike Walls review the plans for the new Columbia Academy in the unfinished office building which is soon to become a studio. Note the bales of glass fiber already on site.

We were restricted by several limiting factors. The physical size of the studio and control room could not exceed 440 square feet, to exterior boundaries, due to the fact that we were to design within an area defined by four concrete columns which held up the building. Ceiling height was limited to a clear span of 14 feet total with air, sprinklers and building plumbing running directly overhead. The final restriction was, of course, budget. This room had to be realistically priced since student tuition and hourly rates for outside commercial projects would be based on good business practices given the cost of overhead.

This was a similar situation to the NBC Training Facility we had designed in the Uris Building in New York and to other recording studio and post production projects around the country.

Since much recording and post work is done within the control room with synthesizers and spin-ins we needed a functional, comfortable small studio, large enough to accommodate a combo, piano and drum kit, certainly not a symphonic orchestra. The control room, on the other hand, had to be large enough to accommodate up to a dozen students or an equal number of clients, ad agency and production guys during commercial sessions.

Given the fact that the bass response of a facility is determined by its dimensions, cubic volume and modal response, as always, the available ceiling height became the critical dimension. Many hours were spent at the computer calculating, modeling and then recalculating the ideal dimensions to achieve both the size and modal spacing requirements necessary to deliver an accurate stereo mixing environment at a reasonable cost.

Once the room dimensions and configuration were approved by the client our next job was to evolve design parameters that would result in the best cost/benefit ratio.

The decision was made to go with mid-field monitoring. Suspending speakers would eliminate the need for a monitor bridge which can be very costly in both space and construction expense. Building a monitor bridge in a control room of these dimensions can be an exercise in ego since the physics of the room dimensions would not support the lowest bass octave anyway. There would be little if any real advantage to using 18-inch bass drivers 2 Pi mounted when the throw from control room front to back was less than 15 feet.

It might be wise here to insert a word about overkill. DON'T! There are limitations within the laws of physics as to how much of a good thing will achieve a noticeable result. In some instances two layers of sheet rock might be more efficient than 4 layers given the improvement gained. Once adequate standards are achieved, a step to the next higher level could increase the cost of a facility way beyond the benefit.

At the same time the weakest link axiom holds as well, it's nuts to use double concrete walls between a control room and studio and then compromise that system with sliding glass doors.

YOU NEED SOLID RESEARCH

Many make the mistake of adapting ideas they have seen in studios that are "Hip, Slick and Cool" without really understanding the realities of the costs of those ideas both in dollars and sonic performance. Nothing beats a little solid research in getting results and saving money. Just because "Tom" did it is not good enough! In other words, if you don't know whether this will work or not, you can pretty much bet it won't! There are no simple or one magic number answers in the world of acoustics. Everything is interactive and relational.

Figure 2. The "Training" Room at Columbia Academy

The studio we designed for Columbia Academy takes advantage of many of the principals of L.E.D.E. Design (tm) that we developed in 1979. It has a semi-anechoic zone in the mixing position as related to early reflections coming from the path of the speakers. The rear walls are spaced in proper time relationship and are well diffused to solidify the stereo image and help in controlling room ambient energy.

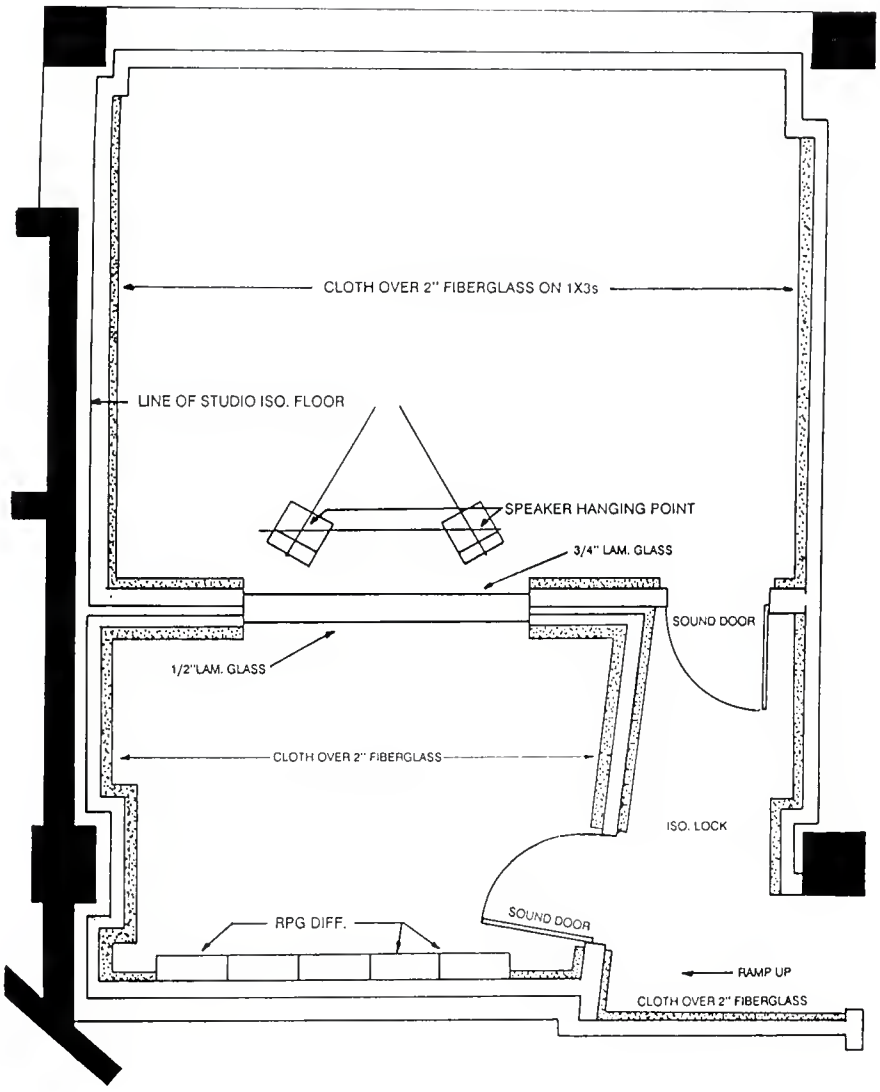


Figure 3. The floor plan of the studio.

The speaker/boundary interface is exactly calculated to couple the speakers to the room in the most efficient manner.

Hundreds of other details of construction specification and technique were also taken into consideration to assure that long periods of monitoring would result in exact translation, low ear fatigue, solid stereo imaging and acoustic neutrality without the use of outboard equalizers, gimmicks or devices. It's basically a straight wire system from console to amps to speakers.

Once the design is done much of the responsibility rests with the client. This is a good point to turn it over to Marty Hasselbach, Columbia's Chief Engineer.

FROM MARTY AND ALLISON

Once we decided to work with Chips Davis we knew that our ideas and needs would be accurately translated into a facility that really worked. We had some experience with acoustic designers and had found much left to be desired. Our selection was painstaking and cautious. The new Columbia Academy was to be our home and showcase for many years to come and it had to be done right the first time. George insisted on it.

The professionalism, personal interest and attention to detail we got from Chips assured us that we had made both the right technological and design decisions.

The actual building plans were absolutely complete. Every step, system, specification and detail was spelled out totally.

Chips and Jerry met with us and our contractors and subcontractors to go over each and every page with everyone associated with the project. The idea was to form a team, to involve everyone in all aspects of construction. The metaphor was that we were building a precision instrument and that every detail from each construction skill was just as important as every other. It was a system and all parts had to be perfect.

Where the norm for construction crews is to build within an accuracy of 1 inch to every 10 feet, here it was necessary to achieve tolerances of less than a sixteenth (1/16) inch in ten feet. This created some challenges which were not easily overcome.

The outside "shell" of the room was constructed from 3 layers of 5/8-inch dry wall on 14 gauge steel studs with 3-inch of rigid glass fiber between the studs.

The studs themselves were positioned on 1/2-inch Neoprene to avoid mechanical transmission of sound through the walls. A "floating" wooden floor consisting of 2 alternating layers of 3/4-inch high density particle board was screwed and glued to 2x4 joists positioned on Neoprene "pucks" that Chips specified. All possible air leaks were sealed with a non-drying acoustical sealant. Every layer of dry wall was screwed and glued and caulked on seams before taping.

Figure 4. Students work on both sides of the control-room glass.

Before the inner walls were built, all air conditioning, audio conduit and electrical runs had to be totally isolated from the existing structure with spring isolation hangers and decoupling hardware.

All wall penetrations were sealed and caulked and all conduit and duct work was decoupled between wall penetrations. Particular attention was paid to placement of air diffusers, dampers and duct work within the HVAC system.

Mechanical noise (both airborne and vibration) from HVAC systems is one of the most critical problems in studio construction. Close attention to the details of isolation is essential; one "shorted" isolation hanger can ruin both your day and your project.

The inner walls, like the outer walls, were constructed of 3 alternating layers of 5/8-inch dry wall on isolated steel studs. A minimum "Dead Air" space of 8-inches was designed between wall systems. The ceiling was hung on spring hangers to avoid mechanical contact with walls and to further reduce transmission of sound. Once the structure was basically completed, the small details such as proper door and window seals, interior acoustic treatment, (cloth covered rigid glass fiber) and diffuser location and installation were all implemented.

One important consideration in the control room design was the various purposes this room would have to serve: Lecture Theatre, Practical Classroom, Music Recording Studio, Mixing Room, Video Post Room and Professional Facility for outside clients.

To accommodate the various functions and configurations, tape machines were placed out of traffic patterns, a large producers/synthesizer desk with extendible wings was constructed on a raised platform behind the mixing desk and speaker throw and mix window were calculated to achieve a balanced response and accurate imaging throughout the room. In this manner all persons present would have good sight lines, accurate monitoring and lots of usable working space.

As is the case with many of Chips' rooms, the front of this desk was equipped with rack space for housing outboard gear.

EQUIPMENT NEEDS

Equipment needs also had to be included in the design and construction of the room. This facility is self contained drawing only power and HVAC from the building itself. Speakers chosen were UREI 809 Time Align Monitors, powered by JBL 6260 Amplifiers delivering 600 watts per side.

This amount of monitor power may seem extravagant, however, with the advancements in audio technology it was considered necessary to insure a very accurate and dynamic sound environment. Using adequate power results in less clipping and therefore less distortion and less ear fatigue. Accuracy is improved by increased damping of the speaker cones in their front to rear excursions. Lots of headroom, low distortion, accurate imaging, longer speaker life and linear response are all benefits of adequate power.

The studio is equipped with a 28 channel Soundtracs automated console, Otari MX80, 24/32 Track 2-inch recorder and a custom designed computer synchronizer control system to lock audio to video.

The software also enables the computer to automatically switch channels off and on against SMPTE Time Code. The facility also includes a professional armory of outboard gear, microphones, limiters, reverb and echo devices and digital processing toys.

All the theory in the world can't make up for practical experience and this is a point which is stressed by Columbia Academy. In the Recording Arts Programs the ratio of hands-on to theoretical training is 70/30. Each of the classes (6 or 10 months) undertakes actual recording projects for clients chosen by the Academy. This process involves everything from the original selection of material to be recorded right through to the finished product. The students learn not only how the techniques of sound recording but also live sound reinforcement, audio to video synchronization, and jingle creation and production integrate into the creation of a finished product.

The importance of practical training as a focal point in the curriculum is the key reason why Columbia Academy has become one of the most successful private vocational colleges in Canada.

NOTE

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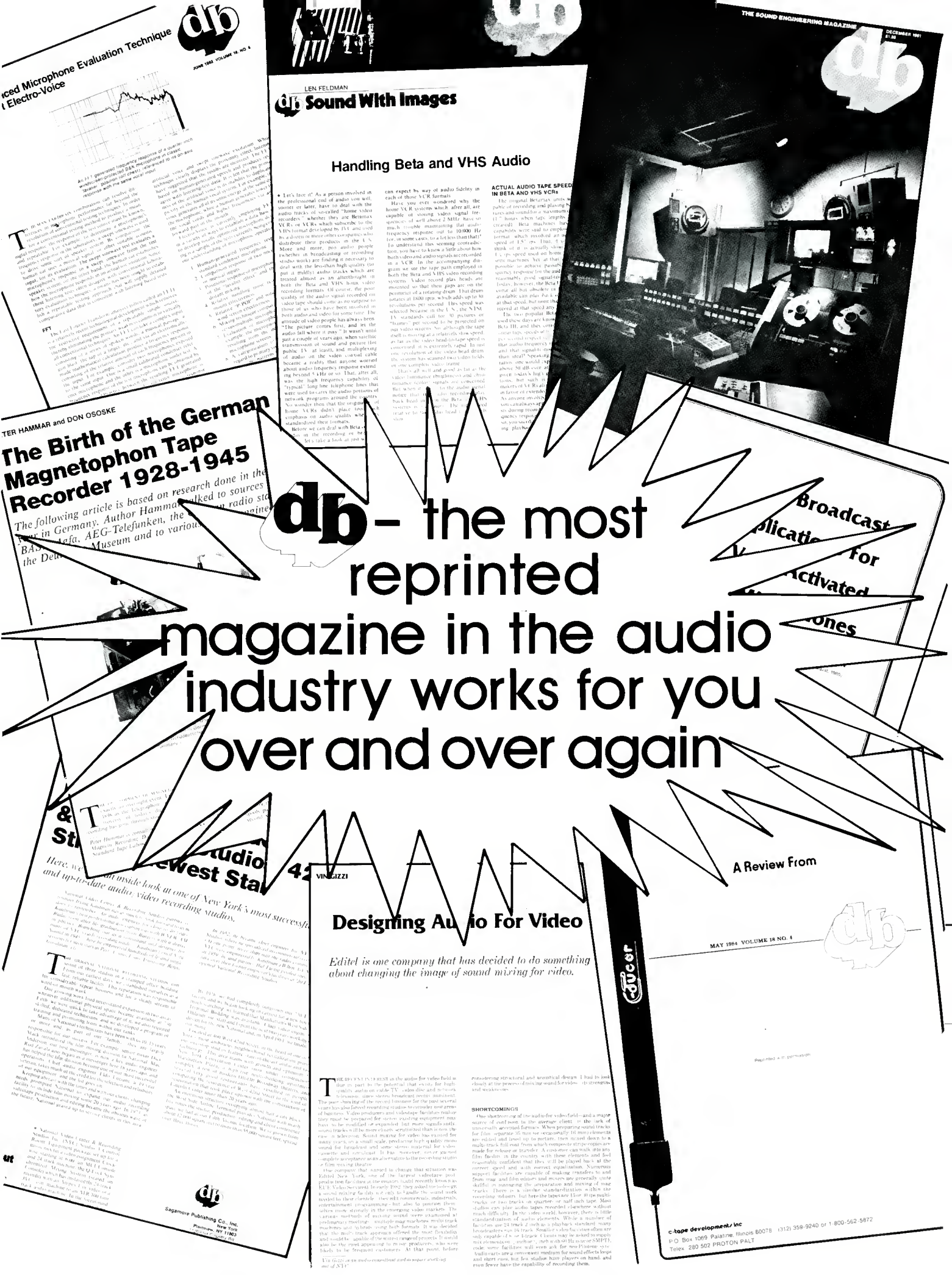


COREY DAVIDSON

Trendset Productions

In the Lefrak towers, Rego Park, New York, there is a small yet powerful commercial production facility known as Trendset Productions. I was informed about this studio by a car dealership that had commissioned Trendset to write, record and produce an ad campaign.

APOLOGIES NOT NECESSARY

Upon visiting the Trendset studio I was greeted by Chuck McKibben and Gene Sicard. Gene immediately apologized for the mediocre surroundings and the absence of "world class" high-tech equipment. "Corey, you must be disappointed by what you see here having visited and worked in some of New York's finest studios...but first you must let us play some of our latest campaigns for you." Gene cues up a reel of audio tape and suddenly I am bombarded with back-to-back ads from various accounts. There is an eerie familiarity to the ads. I realize that I have heard every one of the pieces prior to my visit to Trendset. I wonder...did they really do these at this facility? Before I could recover from the whirlwind of radio spots, Gene declares, "Watch this!" He then cues up a VCR, hits play, eases himself down in his chair and watches me, waiting for my expression. There I sat grinning from ear to ear because I had seen all of the ads on local and national television networks. The audio for all of these was done here? Chuck replies, "Most of what you heard, about 75 percent, was done in its entirety right here. The remainder was pre-produced here and finalized at out-of-house multi-track recording studios." I am rightfully impressed and still grinning. If all the audio for visuals was done at Trendset, how did you match up the sound and picture using this little VCR and no SMPTE or sync in sight? Gene enthusiastically explains, "We sit there with a stopwatch, time each section of the visual, and jockey-in the audio...you know...the way they did it in the old days." I can't stop wondering what Gene and Chuck would do if they had a world-class studio of their own, complete with engineer.

Corey Davidson is the Technical Editor of db Magazine.

VERY COST EFFECTIVE

Gene and Chuck are very particular about the equipment that they purchase. Gene elaborates, "We will not buy a single piece of gear unless it can be proven to us that it will sufficiently increase our production and revenues. Right now we land some very strong accounts because we attain potent results with what we have and what we have enables us to keep our costs to a bare minimum. This savings is passed on to our clients. When it comes to production for advertising, our clients are only interested in how the final product looks and sounds."

Earlier in the interview, Chuck and Gene tried to fool me with a piece of music created for Cadillac. Their intention was to make me believe that this piece had been done in a larger out-of-house studio. And fool me they did.

MOTHERS OF INVENTION (NECESSITIES)

The move to commercial space can have its disadvantages. What if one has to move out? Is the time, energy, materials and construction that has gone into that space just a throw-away? Chuck answers, "Now you can understand the reasoning behind our minimalistic approach to construction. If we did choose to relocate, we could easily take our acoustic treatments with us. When we initially moved in here, the room was much too live for our purposes. Gene and I built panel absorbers that simply hang on the walls much like the way a picture would hang. There is a company that will sell you panels like this for $190.00 each. We needed many panels."

Gene says, "We did the whole thing for $190.00." Chuck continues, "The panels are comprised of compressed glass fiber ceiling tiles that measure 2x4 feet. We made frames with furring strips around the perimeter of each panel, then a couple of layers of glass fiber (the thin type) were added. The finished look was achieved with low cost material which covers the glass fiber and gives an unobtrusive appearance."

We walk into the vocal booth and its construction is explained by Gene. "The walls are simply sheet rock. The ceiling construction is simple hard-surfaced tiles to which we glued our custom acoustic absorber panels. We've totally killed room reverberation, however the isolation is not the best, so we do our air recording at very low levels." Chuck adds, "We found that total isolation wasn't necessary. We use one AKG 414 microphone in here. This mic enables us to control the timbers of our voice overs by

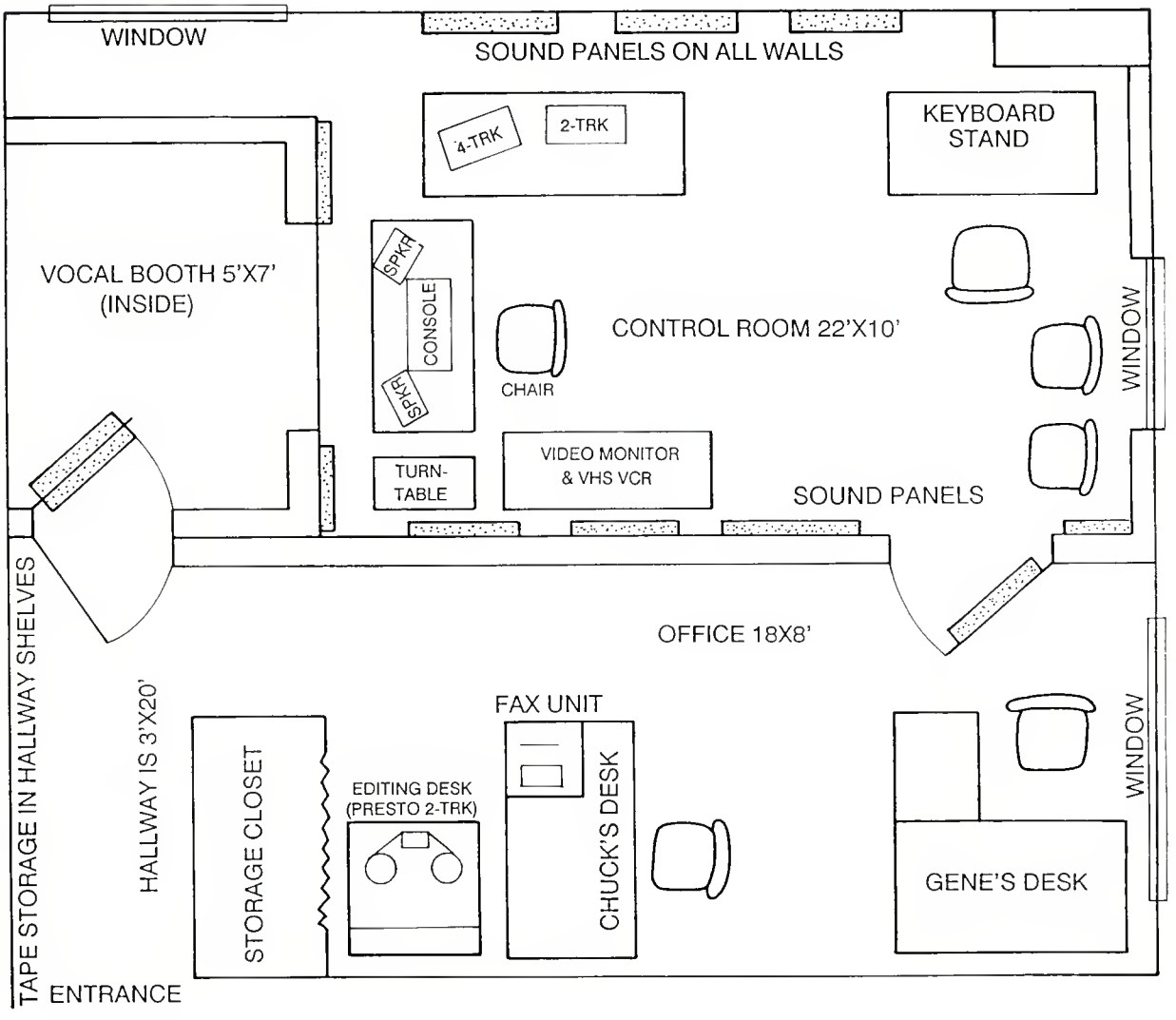


Figure 1. The studio floor plan.

changing angles and distances. Because the booth is so small, we often find it desirable to equalize voices to avoid an unnatural resonant quality at approximately 250 Hz. The 414 is most often used in the narrowest, most directional pattern possible. This multi-pattern mic gives us ultimate flexibility and an extremely clean vocal signal. If two actors are performing, we might use the figure eight pattern. With the equipment that we have, if you don't start with a really clean sound source, you're not going to have a clean signal at the other end. This equipment is not going to add anything good along the way other than sibilants, distortion and noise. God knows how good this mic would sound hooked up to a Neve console."

FEWER ELECTRONICS, LESS NOISE

In many of the larger world-class studios, some design engineers are looking for ways to eliminate the amount of the use of external mic pre-amplification, or the elimination of VCAs in the larger automated consoles in order to make way for moving fader automation.)

Chuck informs us, "We keep the signal path simple not just out of economic limitations but also by choice. Just last month we had a consulting engineer come in and tweak up our machines. He said that he noticed a very noise-free signal path. This is a guy who maintains 24-track studios all day long so I believe that his comments bear some weight."

BRAINS FOR SALE

Chuck and Gene decided upon a commercial plan of attack long before the construction and studio design work began. Gene tells me, "When we went into business, the first things that we decided upon were what we didn't want to be. We didn't want to be a recording studio. We didn't want to be renting the studio out on a per hour basis. We

work. We have accomplished some unbelievable things with this very limited array of hardware. For a really big project, we go out-of-house and take advantage of the things that a larger facility has to offer. Even in the event that we use an outside house, all of the pre-production work is done here. All the synthesizer voicing and drum events are programmed into the sequencer (Yamaha QX21). Sometimes I fill that little sequencer up to the brim. Maybe a computer is the next addition. They are getting cheaper all the time!"

Figure 2. Gene Sicard relaxes along side the keyboards.

The proprietors of Trendset Productions like to distinguish themselves as a think-tank rather than a studio. Chuck states, "We've had people call in and ask for an hourly rate. We're not interested in that kind of work. We are selling our minds, not our facility. The equipment is here to facilitate the realization of our projects. Furthermore, we don't have any production equipment for video because it is senseless for us to go out and buy thousands and thousands of dollars worth of video equipment. We are hoping to get into audio sweetening for video. The move into the realm of audio sweetening will be a major expenditure above and beyond any move that we have made so far."

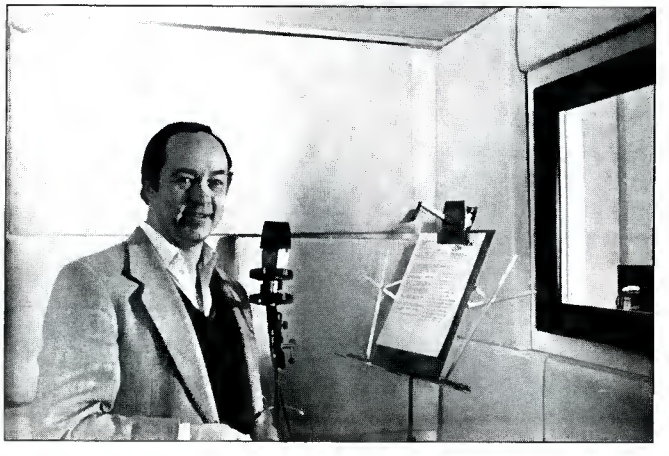
WINGING IT WITH VIDEO

Better than 50 percent of Trendset's productions involve working to picture. How does a minimalistic studio such as this one manage to take on a project that requires audio for video? Chuck explains, "Right now what we are doing is simply using VHS for reference. We're not doing anything that is *critically synchronized*. We are working with, for example, a 30 second music bed, maybe with a *sing* at the end." Gene adds, "To circumvent the problems surrounding synchronization we will usually attempt to complete the audio tracks first. This methodology works very well when we are in control of the project's conception from soup to nuts. In other words, for us, the preferred way of conceptualizing a piece is to create the audio tracks first, do the voice over, then *cut* (the video) to the music and voice over."

SPYING ON THE COMPETITION

Chuck tells us about his discoveries concerning other production houses and how those discoveries relate to the Trendset operation. "Before Gene and I teamed up, I worked for a major ad agency in a producer/director capacity. Recently, as an experiment, we (disguised as clients) called some of our soon-to-be competitors and gave them a typical assignment. We told them that we wanted do a demo and that we would need a couple of actors and a voice over announcer. We told them that we would also need a nondescript piece of music and that the piece was for the radio. How much? The reluctance to quote any kind of a price was to be expected, however, the pitch that followed is the kind of thing that we, at Trendset, avoid. This production house that we called proceeded to tell us that they would have to hire a music consultant that will perform a music search through the library at X number of dollars per hour. They told us that they would have to hire an arranger and composer. The arranger would have to hire the musicians to record. At that point I told the production house that we wanted stock music. They proceeded to tell me that we didn't want to use just any old piece of music. It was obvious that this agency was bent on selling us a jingle. These people sell jingles. That is what they need to do to survive. Whether or not you need a jingle, they will try to sell you one. By the time they had priced out a simple demo, we were well up into the three thousand dollar range. For Trendset's clients, this approach is totally unnecessary. We do a production for a few hundred dollars in an afternoon. As a case in point, a client will send us a newspaper ad on our FAX machine in the morning and say that they need a radio spot to go with it. We'll write the copy by that afternoon, FAX the copy back to the agency which will make whatever alterations and/or approvals, FAX the final approved copy back to us, we will use either stock or freshly composed music, do the voice tracks, send it out Federal Express that evening, and the station has it at 10:30am the next morning."

Figure 3. Chuck McKibben at the announce booth's mic.



A BIOGRAPHY WORTH MENTIONING

Chuck and Gene are not newcomers to this industry. As a matter of fact they both have impressive credentials spanning production, performance, composition, recording, and an ability to convey ideas quickly and simply. Chuck tells of his background, "I started as a disc jockey (age 14) for a 5000 watt radio station in Dayton, Ohio. That was my weekend gig for a number of years until I landed a position as an engineer/production assistant for Mel Blanc

(who single handedly produced the voices of the world renowned Warner Brothers cartoon characters such as Bugs Bunny, Elmer Fudd, Daffy Duck, Yosemite Sam, Sylvester and the rest). While working for Mel I enjoyed working with many other well known voice/personalities such as Jack Benny, Vincent Price, Rod Serling, Kirk Douglas, Gary Owens (radio announcer from Laugh-In), Jesse White (the Maytag repair man), Paul Frees (the voice of the Pillsbury doughboy), and many others. The environment with Mel exposed me to the heart of ad-oriented production." Chuck does 75 percent of the voice over work at Trendset. He continues, "I'm doing what I've always enjoyed doing. Now I finally have the total production input that I have dreamed of."

Figure 4. Gene, and Chuck, (in booth) at work in their studio.

Working with a musical talent such as Gene's completes the other half of the picture. Gene's extensive performance and compositional background yields the musical prowess required in order to realize any musical genre at any time...a true chameleon. Gene recalls, "I went to the State University of New York at Fredonia where I majored in voice. I was studying to be an opera singer. I then transferred to the Manhattan School of Music and, during my attendance there, spent three seasons on the road as a singer with the New York City Opera. Although the opera experience was an ultimately positive one, I realized that my heart was really in popular music and production. It was this love of popular music that inspired me to form my own band called The Trend. The Trend is an act that specializes in Motown, 50s and 60s pop, rock and R&B music. The band has been together for 9 years and has been very successful in the college and corporate circuits." Gene tells me that they had recently been invited to play at NACA (National Association of College Activities), have been booked to play a presidential fund raiser for Jack Kemp at the Baja Club, here in New York City and have also landed the June 5, 1988 corporate party for the Aetna Insurance Company on Alcatraz Island, San Francisco, California.

Gene informs me about his initial contact with Chuck McKibben. "I woke up one morning and decided that I wanted to write jingles. Being the aggressive kind of guy that I am, I opened up the phone book and started calling radio stations, introducing myself as a production company. I had no demo reel nor experience in advertising. I contacted this one company in Queens, New York and lo and behold I was teamed up with Chuck (a staffer at this company) to work on a project for the Price-Cutters chain. We did a complete six and a half minute show called The Adventures of Major Savings for which I wrote the music. Chuck and I began to discuss the possibility of starting our own production house that would satisfy the needs and demands of the market we were after. Together, we have built the company that we originally had in mind."

IN CONCLUSION

Chuck states, "At this point in time we are competing directly with radio stations who are more than willing to cut a client's spot for free. Having worked at a radio station for many years, I have a very good idea as to how lacking the station's production abilities are. The end result is the usual kind of stuff:

SAVE! SAVE! SAVE! NOW AT XYZ MOTORS DURING OUR BIG SALE! NOW! SAVE! AT XYZ MOTORS.

The way that we survive is by doing a much better job by putting a lot more thought into it. As an old saying goes: You are worth, from your neck down, minimum wage. From your neck up...anything that you can get. Gene concludes, "We have fulfilled a very important need for the smaller agencies, giving them top quality production for a dance. Not bad for two fat boys from Queens, New York." db

EQUIPMENT LIST

Tascam mixing console M-2A with meter bridge
JBL LX4-1 speakers
Tascam 32 2-track stereo recorder
Tascam 34B 4-track recorder
Tascam DX4D dbx unit
Coustic EI HEQ 7009 equalizer
AKG C-414-EB microphone
AKG N-62 ET microphone power supply
Onkyo TA-2090 cassette deck
Yamaha SPX-90 KM-86 digital effects processor
Harman-Kardon HK-490I amplifier/receiver
Technics SL-B100 turntable
Audio-Technica LS cartridge
Shure M-67 microphone mixer
dbx 163 compressor
Roland TR 707 drum computer
Yamaha QX-21 digital sequence recorder
Korg DW 8000 digital synthesizer
Korg synthesizer Poly Six
Korg DSS-I

Sound Reinforcement in the South Pacific

CHICAGO, AS THE BIRTHPLACE OF GOSPEL MUSIC, HAS contributed a plethora of gospel talent to the world. Among this select group are the Barrett Sisters, Delois, Billie and Rodessa. These three talented singers have traveled the world extensively, singing the Lord's praises and entertaining people from Europe to Africa, and were featured in the gospel documentary "Say Amen, Somebody." When USIA (United States Information Agency) considered talent to send to the South Pacific islands, the Barretts were an obvious choice. The people of this part of the world are Christian, and deeply religious. Not only are the Barretts consummate singers, but as experienced travelers they were prepared for the inevitable problems posed by a tour of this nature. It seemed a perfect match of music to region.

As a USIA tour veteran myself, (see **db February 1985, March/April 1985, July/Aug. 1985**), I was asked by the agency to function as production manager/sound engineer for the Barretts' tour. From May 27 to July 6 we were to visit New Zealand, Papua New Guinea, Solomon Islands, Vanuatu, Tonga, Western Samoa and Fiji. During tour preparations in early April, I enjoyed many conversations with Beverly Gerstein, the USIA officer in charge of programming tours for this part of the world. I found that conditions were going to be far different than on any of my previous trips. In the past, I could count on the USIA staff in the host country to provide important advance information concerning production details, help with transportation and customs, and provide any necessary equipment. However, on several of these islands there was no U.S. embassy or consulate, so we would be on our own, with only local sponsors to help us. Airline transportation was another major concern. Air Pacific and Polynesian Air, the two major island carriers, operate many prop planes that lack the cargo-carrying capacity of jets; since we would use these flights, the amount of equipment that could be carried with us would be severely limited in size and weight.

My first task was to contact the Barretts and ascertain their sound requirements. At that time, I was working as monitor engineer for the Winans, Detroit's gift to gospel. Our tour took us to Chicago on April 17, a fortuitous bit of scheduling. I invited the sisters to the evening's concert, and received a pleasant surprise. They already had tickets, as the Winans were one of their favorite groups! We met that evening and immediately hit it off. We discussed the inevitable compromises we'd be called to make due to cargo restrictions and lack of U.S. presence, and decided to carry all mics, stands, monitors and other stage equipment required by the three Barrett sisters and their accompanist, Charles Pikes. This would ensure consistency in the stage sound, which is essential for maintaining performance quality and comfort for the artist. An electronic piano would be included to cover us in the event that an acoustic piano could not be procured locally. I would carry a small console and a modicum of signal-processing equipment for the same reason, although I planned on picking up house speakers and amps in each location to cut down on our own cargo.

A CABLE HELPS GET IT TOGETHER

I then drafted a cable that would be sent to New Zealand, Papua New Guinea and Fiji, where we did have embassies. This spelled out basic system requirements: frequency specs, components desired and overall system power requirements, tailored to venue capacity. I also specified acceptable amplifier input connections and impedance, to ensure a smooth interface between my control equipment and our PA-du-jour. A copy of this was sent to Mike Mingo at the Pacific Islands Program Office. Mike was the USIA contact for the smaller islands, and would be accompanying us during that part of our tour. We hoped he could advise us as to the availability of adequate sound in those areas. New Zealand was the first to respond, and, as the sponsor there could provide pianos and the services of professional PA companies for us, we decided that there was really no need to send our gear there. We elected to ship the gear directly to Papua New Guinea, which eliminated dealing with the first two flight changes and the layover in Sydney necessitated by travel from Auckland to Port Moresby. The other reports gave me reason for optimism, although one concert in Papua New Guinea was a

Author's Note: *1987 has been a busy one for me. I've toured South and Central America with a Cajun band in the winter, the South Pacific with a gospel group in the summer, and I'm about to embark for Southeast Asia with a jazz quintet. As db Magazine's resident live sound engineer, I'm looking forward to sharing my experiences with you, starting with this article on the South Pacific. Look for more articles in coming months as I try to find time to write them!*

bit up in the air. Mike, however, was unable to get information from our sponsors on Vanuatu, Tonga, Samoa and the Solomons. All I could do was hope for the best; if worse came to worse I planned on trying to rent house PA from local hotel lounge bands, which are as common overseas as they are in the U.S.

The sound equipment for the three gospel singers and a pianist need not be extensive, but since the Barretts were used to and expected the best, I had to choose components that were small yet uncompromising in quality. For monitors I chose two E-V S-200 cabinets. These are two-way, passively crossed cabinets with a 12-inch woofer and small horn with a compression driver. It's a very small and lightweight system, and I was most impressed by the smooth, wide-band frequency response; with the processor engaged you can get bass down to a real 40Hz, and it seems to lack the peaks or dropouts in frequency inherent to most two-way designs. With power handling of 200 watts, I didn't have to worry about not getting loud enough. A Crown DC-300A amp provided monitor power, and a Yamaha GQ-2031 stereo 1/3-octave graphic provided both monitor and house EQ. I carried a Yamaha SPX-90 digital effects processor for reverb and any other use we might dream up. A 100-foot 11-conductor snake and plenty of AC cable allowed me to mix from a central location in the audience; mixing from the house is not a "given" overseas. I made sure to include a 28-amp multiple-tap Variac AC transformer to deal with the 240 volt 50Hz voltage I would encounter in places on this trip. The multi-tap arrangement allows me the flexibility of dealing with odd 110 and 130 volt setups, which are also encountered occasionally overseas. I brought a VIZ power line monitor, which would allow me to monitor real-time voltage fluctuations and make any necessary adjustments. For mics, I carried a Crown PZM 31-S and four E-V ND-757. The E-V ND series microphones have been on the market for just over a year, and have already made quite an impact. Their smooth, wide frequency range make them perfect for many applications, and the tight pattern gives exceptional gain-before-feedback. They feature remarkable sensitivity for a dynamic mic; this gives an excellent "reach," so you can still get workable gain with weak voices, or with the vocalist far off-mic. The 757s are also very consistent from mic to mic. Buy ten, and you can bet that they'll all be *very* close in response; try that with SM-58s some time. I could use them on piano too; a 757 on the lows and a PZM on the side gave a clean, balanced piano sound. I carried an Audio-Technica direct box for the Yamaha PF-15 electronic piano.

THE TRIP BEGINS

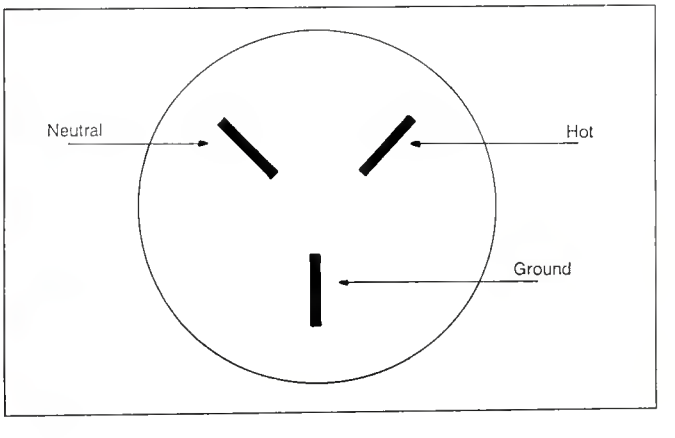
I left Detroit on May 22 for Los Angeles to handle business over the weekend, joining the sisters and Charles Pikes in Hawaii on Monday, May 25. Tuesday was a rest day that included a visit from Mike Mingo; we briefly discussed the schedule, and I was sorry to learn that, despite his best efforts, we still had no advance information from the smaller islands. He planned to arrive in the Solomons several days before us, and agreed to see what he could sniff out for me before we arrived. We bade goodbye to Mike (we wouldn't see him for two weeks), and at 1a.m. Wednesday we boarded our flight for Auckland, New Zealand. We arrived early Thursday morning (losing a day due to crossing the Date Line), and were met by USIA staffers who helped us transit from the international to the domestic terminal. The Barretts conducted a few press interviews at the airport before we continued on to Christchurch, our first scheduled performance stop. We were whisked to our hotel, and after a few more sessions with the local press we were left alone for some much-needed rest.

Friday was our first performance day. The Barretts conducted a live performance-cum-interview with Robin Harrison, a local radio talk-show host, at a beautiful Methodist church in downtown Christchurch. As we were an easy walk from the Christchurch Town Hall, where we would perform that night, I took the opportunity to duck out once things were rolling to have a look.

The Town Hall complex was quite large; we were scheduled to play the auditorium, which seated 2500. I located Kerry Griffiths, the sound tech for the hall, and got the guided tour. The hall was done up in polished hardwood, with acoustic reflectors on the ceiling and balcony facings (*Figure 1*). The single balcony wrapped around the floor seating area, actually continuing around the stage as a "choir section." It was an extremely live room, but with a fairly even decay of reverb across all frequencies. The house PA was comprised of JANDS mini-Concord cabinets, which contained a JBL 15-inch woofer, JBL 12-inch woofer, JBL 1-inch compression driver and JBL "bullet" tweeter. These cabinets were run 3-way electronic with JANDS J600S power amps. Three stage monitors were provided; each contained an 18-inch JBL woofer and a 1-inch JBL compression driver on a conical horn equipped with a perforated-plate lens. House electronics included a

Figure 1. The hardwood surfaces and acoustic reflectors at the Christchurch Town Hall auditorium.

Figure 2. An Australian-type a.c. power receptacle.



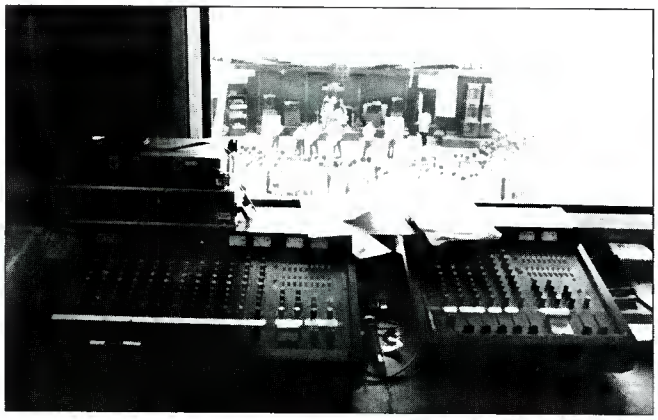


Figure 3. The mix point gear in Port Moresby.

JANDS custom console, UREI 1/3-octave room filters, a dbx 165 limiter and a Roland SRV-3000 digital reverb.

Because some of the sound gear would be required for another event, we would have to soundcheck between 3 and 4p.m. I returned to the church in time to catch the last few numbers, then enjoyed a brief tour of Christchurch. The soundcheck gave me an opportunity to refine my techniques for properly mixing the Barretts, and I wasted little time diving for the limiter. Billie warned me that they "sometimes get kind of loud," which proved to be an understatement. All three Barretts have strong voices, and their distance from the mic varied widely, too. I was quite glad I'd brought the E-V 757s; I could easily handle the varied working distance from the mic. Delois in particular had a dynamic palette ranging literally from a whisper to a scream. Her variety of tone and level on songs such as "This Little Light of Mine" created a tangible emotional impact on the listener, but also required the soundman to be clairvoyant to anticipate what she might do next! I faced situations where the vocal dynamics changed constantly with harmony parts and solo ad-libs. The dbx 165 was intended for overall house limiting, but due to the lack of patch points on the console, I was forced to compress earlier than really necessary for system protection to keep the vocals in the ballpark. It is my favorite vocal limiter, so I wasn't really in too bad a shape. Both Kerry and the hall manager approved of my attempts to keep the house volume low so as not to overly excite this very reverberent room. I could see that a louder, more amplified group could have real problems here. Monitor level was never a problem, as the sisters preferred a balance between acoustic stage volume and monitor volume. The crowd for our first show was on the small side (around 700), but made up in enthusiasm what they lacked in numbers. By the end of the second set the crowd was standing, stomping and clapping along. And to think we'd been told that Christchurch audiences were reserved. Several people even danced in the aisles, much to the amusement of the Barretts, who weren't really used to that!

Saturday, May 30 found us in transit back to Auckland, again met by USIA Control Officer Vivienne Barnett. She whisked us to out hotel and, after a brief break to freshen up, took us over to the local TV station, one of the 2 major stations in New Zealand. We were scheduled to tape a ten minute segment that afternoon for the Sunday AM Magazine. I found the sound pre-set when I arrived with the Barretts and Charles. AKG 451Es with cardiod caps and windblast filters were used for vocals, and the Rhodes suitcase piano was taken direct. I was ushered into the audio control room, where I wasn't allowed to mix, just to advise. We used a Yamaha REV-7 for vocal reverb and an SPX-90 for a bit of chorusing on the piano. The console was an older Neve, and we wasted no time using the on-board limiting for vocals. The sisters performed two numbers and did a five-minute interview. We discovered that this was the first visit of an American gospel group to New Zealand, and USIA felt that the TV piece would help educate a larger audience about gospel music, not to mention concert attendance.

MORE IN NEW ZEALAND

We had the next two days off due to the Queen's birthday holiday, and returned to our performing schedule Tuesday, June 2. Promoter Pat Shaw has relayed my sound requirements to Barton Sound, and engineers Doug Jane and Mark Stewart had everything ready when we arrived at the hall in the afternoon. The Auckland Town Hall Auditorium seated 2100, and had a large wrap-around-the-floor balcony; it didn't go behind the stage, like the one in Christchurch had. The hall was all wood and plaster surfaces, with windows along the sides, that featured a reverb time of 3 seconds and a few anomalous early reflections. The PA provided was only two-way: two Altec bass bins, each with 2 EK 140 15-inch woofers, and three radial horns (1-90 and 2-60), each with a JBL 2441, per side. These were powered with Barton custom amplifiers; crossovers were built into the racks, and were set at 1200Hz. House gear was comprised of a Yamaha EMX-300 console, a Roland SEQ-331 graphic and an AMS RX-16 digital reverb. The first thing I did on listening to program music was to have the high-end level backed off; with three horns versus four woofers it was high-end heavy to start with. Dipping 2kHz slightly on the system EQ seemed to minimize the early reflections, and smoothed out the brashness inherent in this hall. I asked that a limiter be added, and a dbx 160X was procured. Again, I was on guard against too much level in this grossly reverberent field. The only snag of the day occurred when Barton's piano PZM died during the check. After a slight delay, while cables and snakes were checked to no avail, I stepped in and diagnosed a possible fault in the power supply transformer. I'd experienced this before with my PZMs, and, by re-flowing the solder around the transformer/PCB connection, we were able to get the mic working again. The TV interview and Pat Shaw's tireless promotion paid off; we had a full house, which smoothed out the sound and inspired the Barretts. Delois had everyone singing along with "When the Saints Go Marching In," and the roof was really raised when the sisters walked out into the audience during their last number.

We reluctantly left Auckland early Wednesday morning for Sydney, Australia; we laid over and continued our trip to Port Moresby, Papua New Guinea the next day, traveling via Brisbane. We arrived around 2p.m., and were met by PAO Mike Anderson and his staff. While we collected baggage and cleared customs, Mike and I talked production. My sound gear had arrived safely, and the three Port Moresby shows had been advanced; sufficient PA would be provided for each. I asked to check each site personally, and Mike agreed; he would provide transportation for me. We were scheduled for media interviews that afternoon,

with a reception immediately after, so I took that time to go over to the Islander Hotel, our first venue in Port Moresby.

I was met at the Islander by Terry Payne, the hotel manager, who took me out to the pool. Our concert here was a benefit for the Ela Beach Library, which had burned down. We would perform at poolside, on a stage that was being constructed over the shallow end of the pool, playing to an audience seated around the pool. I checked the stage construction, which was good, and found that a baby grand would be provided for Charles. The stage had no cover, as it was not expected to rain, but it was *hot*, into the 90s with high humidity. I asked for a beach umbrella to cover the mix point during the day, as I didn't want the gear subjected to the intense heat. The PA turned out to be two E-V PI-100 cabinets and a power amp purported to do 200 watts/side peak. Although projected capacity was only 400, the distance from the stage to that audience, the wide coverage area, and the outdoor location made me fear that we'd be underpowered for this one. I decided to use my gear as PA, and use the hotel stuff for monitors, as I could count on the quality of what I had. A.C. power would be run from the adjacent poolside bar.

THE SUN BEATS DOWN

June 5 was another hot one in Port Moresby. My gear was delivered to the Islander around 1:30p.m., and I spent a hot afternoon in the sun setting up. I'd thrown some sunscreen in my bag, and I was thankful I had it! Power proved to be the biggest headache, I had to check several outlets in the nearby bar to find one that had a good earth ground and proper configuration. The power was 230V, 50 cycle, supplied from an Australian-type receptacle with a single 230 hot, a neutral at OV referenced to ground, and an earth ground (*Figure 2*). The Barretts eschewed sound check due to the heat, so I had a couple of local musicians (who were hanging out to hear my program music!) hop on stage and perform. I didn't want to do the show cold, as the evening's audience would include the cream of Port Moresby society, with leaders from the political, business, religious and cultural communities. The Barretts wisely chose more sensitive, introspective numbers that played to this type of audience. Another nice touch was contributed by Christine Payne. She arranged for dry ice to be dumped into the pool as the Barretts hit the stage. This created a thick fog that hung over the pool, swirling about islands of flowers anchored in the pool and the coconut palms around it. It was a flashy start, and the sisters took it from there. It wasn't a pleasant experience for me; the PA audibly clipped occasionally on loud three-part harmonies as I tried to fill the space. I received many compliments on the sound, and was assured by Mike that everyone could hear, even in the back. I guess by local standards it was good, but I knew better. I could take some consolation from Mike's information that the PA at our next venue really *was* adequate.

Saturday, June 6 was a day off, but I was again busy planning ahead. Mike picked me up around 10a.m. and took me to the showgrounds, where we would perform on Sunday and Monday. The Port Moresby Show is an annual event, comparable to a large state fair in the U.S. There were exhibits, demonstrations, food vendors of all types, a rodeo, ethnic dancing and live entertainment. A permanent stage was utilized for the entertainment; we started our tour of the grounds there. I went off in search of chief engineer Alun Beck, who was easy to find; a local group was performing when we arrived, and he was mixing. The mix point was located in a small shed built atop a concession stand

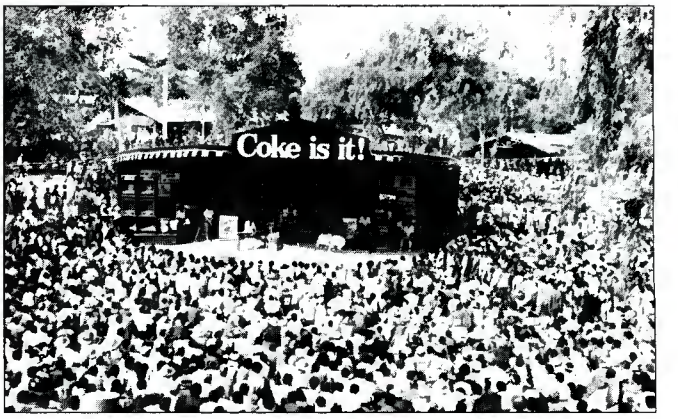


Figure 4. You can just see the stacks of Yamaha cabinets at the sides of the stage.

immediately in front of the stage. A large opening allowed the occupants to hear the PA, yet offered excellent protection from the hot sun; they even had fans! Alun invited me up, and I had a great vantage point to view the PA and control equipment. He explained that the system was provided by the local Yamaha dealer, supplemented by equipment from private individuals.

There were actually two discrete systems: Bose 800 speakers flown from the roof over the stage, and stacks of Yamaha cabinets on the sides of the stage (*Figures 3* and *4*). Power was provided by JANDS and Yamaha power amps, as well as a rack of Yamaha powered mixers. A Yamaha EMX-300 12-channel mixer was the primary house console, with smaller Yamaha and Shure mixers subbed into that for larger setups. Yamaha PF-80 and DX-7 keyboards were available for Charles. My major concern here was the location of the Yamaha stacks, which were actually behind the performing area; feedback would be a problem, evidenced by the band that I watched averaging at least one "tweet" per song. I decided that I'd use my mics for vocals instead of the Shure SM-58s provided; the E-Vs had a tighter pattern and were free of the upper-midrange spikes that were a major cause of the feedback. Before we left the grounds, we took a look at the ethnic dancing, one of the major attractions. Over 100 tribes from the hilly, jungle interior of Papa New Guinea were on the parade ground, doing their tribal dances in full paint, headgear and costumes – or, in some cases, lack of costume!

TIME FOR MORE PLANNING

Once back at the hotel, we discussed our last piece of business, the show on Bougainville next week. It seemed that air transportation would again dictate production needs. The flight from Bougainville to our next destination, the Solomon Islands, would be made in a twin Otter, a small prop plane with a capacity of 18 people and little cargo space. My gear would have to be shipped directly from Port Moresby to Honiara to avoid this, so we couldn't carry equipment to Bougainville. Mike had located a local band there that could provide a small Yamaha PA, and an upright piano would be procured for Charles. I made a call to Bougainville and spoke to Peter Garuai, who owned the stuff. It was only 300 watts, and, since the concert was outside for a proposed audience of 3000, I again faced a situation where we would be underpowered. There was no snake available, so I agreed to mix from the stage, no great hardship considering the size of the PA. I had to bring my mics and mic cords, as Realistic mics with 5-foot cords

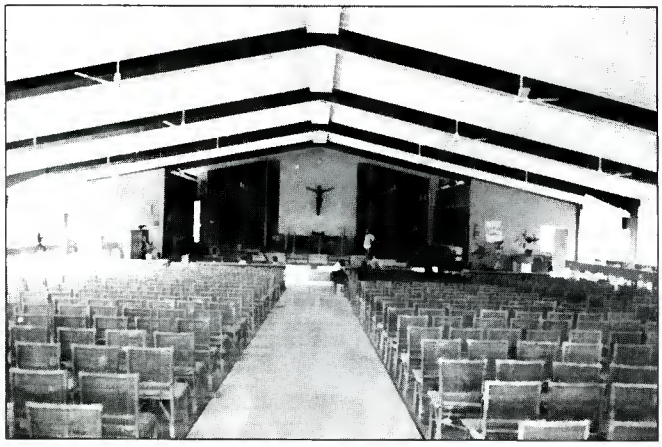
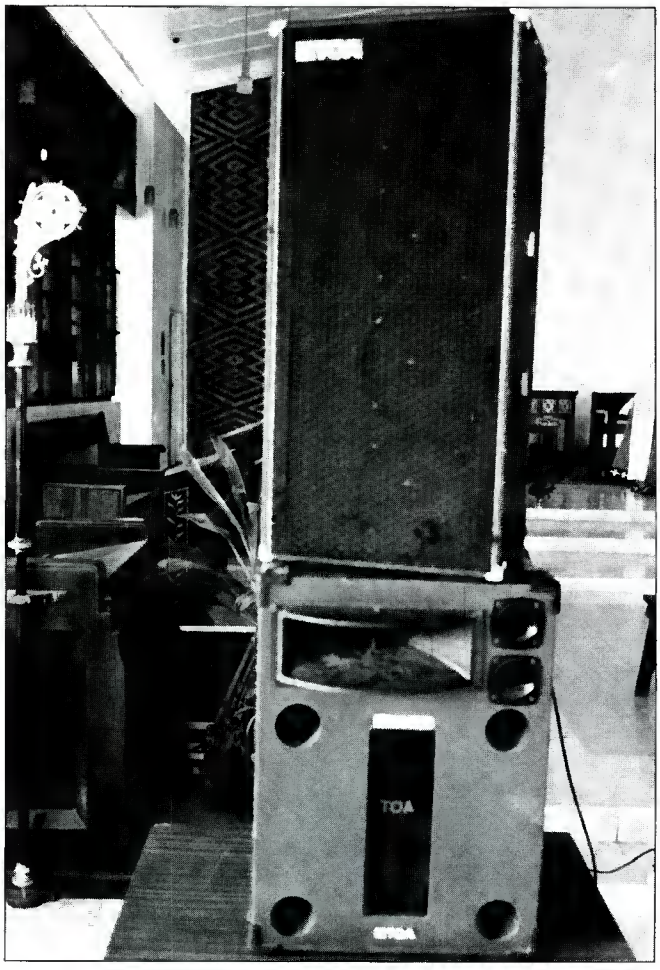


Figure 5. St. Barnabas Anglican Cathedral has open sides.

were the best he could do; fortunately, these would easily fit in my shoulder bag.

We performed Sunday and Monday at the Port Moresby Show as featured act of the day. In deference to the sweltering heat, the sisters were asked to perform only a single 50 minute set. I'd advised them to try and work the middle of the stage, staying away from the side stacks, and that helped the feedback problem enormously. Our audiences were huge—the promoters estimated 10,000 and 14,000 for the two days respectively—and very receptive to the music. Sunday night we squeezed in an extra performance at the

Figure 6. This is the speaker stack used at St. Barnabas.



Bethel Christian Center, a local revivalist church. They had a small PA, but the pastor (who had talked to me about our sound needs at a reception) wisely had brought in extra, and it *was* needed; the crowd spilled out into the parking lot and ringed the church, trying to see through the open-air side walls. It was like a Baptist meeting; the sisters sang and Delois preached between songs, with the crowd almost tearing off the roof with their impassioned response. The Barretts even tried a few verses in Pidgin, the lingua-franca of Papua New Guinea.

Tuesday, June 9 was our travel day to Bougainville, with a brief stop in Rabaul. History buffs will recognize both islands as major World War II battlegrounds. It was a crystal-clear day, and we enjoyed a great aerial view of the turquoise-blue Pacific, dotted with islands and small coral atolls, and the harbor of Rabaul, framed by a large volcano. Upon arrival in Bougainville, we were given a traditional greeting, with grass-skirted men and women chanting and dancing around us as we sauntered into the terminal. The weather was even more humid here, so we appreciated the air-conditioned ride to the hotel along the beautiful coast of this lush tropical island. Bougainville is located in the Solomon Islands chain, but is technically part of Papua New Guinea in what is called the North Solomons Province. Later that afternoon, we attended a reception/lunch in our honor. I ducked out early to go over to Independence Oval, in Arawa, to check out the performance site. No sound had arrived yet, and the stage was just being constructed: plywood sheets, braced with 2x4s, and laid over 50 gallon oil drums. I returned to the site a few hours later after a swim, and found we now had four Yamaha S4-115H speakers and a Yamaha powered mixer good for 600 watts total into these cabinets, so I was better off than I'd expected. As I played program music to tune the PA, a crowd started to appear—and kept coming and coming! By 7:30p.m., our scheduled performance time, there were people as far as I could see, but no Barretts. At 8p.m., a policeman took the mic and asked for the crowd to take care; the Barretts were being driven through this amazing mass of humanity. We finally got the performance in, and I'll bet that half of them never heard it, as the crowd was so large and the PA so small. Police officials estimated the crowd at 16,000, the largest crowd for any event at Independence Oval, including the country's independence. Fortunately, the crowd was well behaved or serious trouble could have occurred, as we had no security other than me!

ON TO GUADALCANAL

After a day off, we left Bougainville on Thursday, off for Honiara, Guadalcanal in our tiny prop plane. We had to land at Munda, a small island, to clear Solomon Islands customs. The airfield was an old coral concrete runway from World War II, and "customs" was in a two-room house. Once inspected and stamped, we flew another 1-1/4 hours to Honiara, where we landed at Henderson field, the famous Guadalcanal airstrip built by the U.S. during World War II. Mike Mingo was there to greet us—he would remain with us through Western Samoa—and helped get us safely ensconced in the Mendana hotel. Over lunch, we took stock of our situation. My sound gear had arrived the day before, and was being stored at the Mendana. Mike had contacted the Council of Churches, our sponsors, about local PA, and they had suggested a guy named Willie, who played in a local band and owned a small PA. As most of the venues here were small churches, he felt this system might work. We would also need our

Figure 7. St. Andrews school, another open-sided building, has a dome ceiling over the stage.

Yamaha PF-15 piano, as none of the churches had a piano. I rendezvoused with Willie later in the afternoon at the United Church, where we would perform that evening. He'd brought two TOA powered speakers and a TOA RX-16 console. I supplied the mics and stands, monitor system and snake. When I fired up the system, I discovered that the high end in one speaker was dead. All I could do was use the console graphic EQ to try and compensate. Power was 228V, 50 cycle, supplied with Australian receptacles. We didn't soundcheck, again due to the sultry climate, but the evening show went off without a hitch. I huddled with Willie and discussed extra PA for Sunday's concert at St. Barnabas Anglican Cathedral, which purportedly seated 3000. An augment could be procured but, apparently, fixing the faulty cabinet was impossible. I had to use this same system again Friday night, at the South Seas Evangelical Church. This church was slightly larger (750), and had an add-on wing located house left. My problem here was to get adequate coverage; I placed the fully functional cabinet on the end of the pulpit, straight away into the room. The other was panned slightly into the wing area HL, tailored with less bass, and run slightly hotter to compensate for the roll-off.

I enjoyed Saturday off, relaxing and investigating the many shipwrecks from World War II that litter the coastline. Sunday, June 14, we were back at it, with both an afternoon workshop and evening performance to deal with. Willie delivered the PA early to a local school, where we'd hold the workshop, and reported that the extra gear I'd requested had been procured. The workshop was very interesting; each group member would talk about a particular aspect of gospel music, and sing excerpts from songs to reinforce their point. Charles concentrated on musical embellishments and improvisation. As the workshop was winding down, I was asked a few questions about sound. This evolved into an hour-long session that continued long after the group had left! I tried to reinforce one main idea: when you're dealing with singers, make sure you can hear the voices and understand the words, especially when dealing with gospel music. I was able to cajole my "class" into helping load the PA, and several even came down to St. Barnabas to assist in the setup there.

St. Barnabas was large, a huge rectangular room with open sides (*Figure 5*). The marble pulpit area and linoleum floor made for a more reflective environment than the other churches we'd played. The extra PA was two TOA 38-SD speakers and a TOA RXA-212 powered mixer. These speakers sounded really good, and together with the existing PA, I had no trouble getting the level I needed (*Figure 6*). Power was available on either side of the pulpit, 230V, 50 cycle on Australian receptacles and all the grounds were functional. It was a good thing we had the extra gear, as we played to a capacity crowd, with even more folks crowding in on the sides.

NO DIRECT FLIGHTS TO VANUATU

Monday was our travel day for Vanuatu, which entailed an early start to clear customs. There are no X-ray machines in Honiara, so each piece of baggage or equipment must be hand searched. Mike went ahead, waving his diplomatic passport and talking up a storm; somehow he managed to get everything through without inspection. Of course, there are no porters either, so we ended up carrying everything ourselves, a sweaty job in the tropical heat. We left around noon, arriving in Vanuata in the evening after a stop to change aircraft in Brisbane. The weather was noticeably cooler here. We were met by local church leaders and taken to the Intercontinental Hotel in Port Vila.

Once settled in, Mike and I went to check out the hotel ballroom where we would perform tomorrow night. It wasn't large—maybe 350 maximum—but I saw no sound equipment. When I asked our sponsors about it I got a lot of puzzled looks, not a good sign. Mike made sure they understood what we needed while I checked power. The voltage was 230V, 50 cycle, but used ungrounded European-standard receptacles. Apparently the islands were formerly French, so power throughout Vanuata was supplied through an assortment of European and Australian receptacles. The hotel electrician could provide adapters and a grounded outlet here, so I was in good shape for tomorrow.

Mike called early Tuesday morning to advise me that Radio Vanuata could provide sound equipment for both our concerts here. I got on the phone to Tim Mason, the station's chief engineer, to describe our needs and arrange transportation. We met in the ballroon later in the afternoon to set up. Tim brought an Audio Developments 9x2x1 console, a TOA TA-412E power amp capable of 120 watts/channel, and two CES studio monitors, each with eight 5-inch speakers. This didn't get particularly loud, but worked fine for the small room. Mike came down during setup with another surprise; there was an opening act, local singers with a full backup band. I agreed to let them use my vocal mics and our piano, but the rest was up to Tim, who volunteered to mix them. He decided to let most of the band gear go acoustic, minimizing the extra work he'd do.

He also filled me in on the next venue, a large gym with horrid acoustics. We agreed on the need for more speakers and amps, something he could provide. The evening's concert was a benefit for cyclone relief; a bad one had struck Vanuata only a few months before our arrival. Not many people showed up, which Mike believed was due to ticket prices and lack of publicity. Mike mentioned that the concert tomorrow would be free, and hoped that today's media interviews would help spread the news of our arrival.

Wednesday, June 17 was the concert at the FOL gymnasium, and acoustics were as bad as advertised. Reverb time was almost 4 seconds, with bad nodes at 500Hz and 1kHz. Tim brought extra CES speakers, hanging the 4 from beams and pointing them into the bleachers on the side. Altec-Lansing Series 7 studio monitors, each powered by an Altec-Lansing 100-watt amp, were placed on each side of the small stage to cover the floor area. Only one power

outlet was available, at the opposite end of the gym, and it was Australian, but with a dead equipment ground. Power was 225V, 50 cycle, and I observed drops of as much as 5 volts during the day. At night, the voltage climbed to just over 230V. For this gig, I'd brought my electronics rack, with graphic and SPX-90, to help tune the system; I was able to increase intelligibility slightly with EQ. Despite the extra PA, in this huge space we were underpowered, but I didn't want to get too loud here due to the excess reverb. We again had opening acts, this time a variety of vocal groups from different churches. Fortune smiled upon me, as the place was packed for our concert and helped the reverb dry up. The Barretts, inspired by the large turnout of local choirs, really got into it, getting everyone to sing along on "Give It All To Jesus," a song that was well known everywhere we'd gone in the South Pacific so far.

TO TONGA

Our next stop was the kingdom of Tonga, the only monarchy left in the South Pacific. To get there, we had to travel via Fiji, enjoying a rest day there between flights. I spent much of that day advancing the Fiji dates, and met with the local music store owner who would provide our PA equipment. I left knowing that we'd be well equipped for our last stop—but what about Tonga? We arrived early in the afternoon Saturday, June 20, and we were met by the local council of churches, headed by Bishop Laitia. The weather here was cooler, in the high 60s, which felt cold after the humidity of Papua New Guinea and the Solomons. We were taken to the International Dateline Hotel, and arrived to find a huge party going on; it was the 21st birthday party for one of the royal family. Once we checked in, I met with Mike and the sponsors in his room to discuss production. My first concern was this evening; the sisters were scheduled to give a mini-performance at the hotel for the princess, who would host a dinner in our honor. I found that no sound had been procured for *any* of the shows, so we were on our own. I'd noticed that the band at the party had a Shure Vocal Master PA; I went down and talked to the bandleader, and convinced him to rent us his system for our shows here. It's not high on my list of favorite speaker systems, but I knew that I could make it work. The hotel concert was held on the "dance floor" section of the show area, where exhibitions of traditional Tongan dancing are held. I used half my Crown amp to power the Shures, the other half for the monitors. The secret to a Shure Vocal Master is to watch the low end; too much will make the speakers sound horrid. Sometimes a high-end boost can help, as there are no horns or tweeters in the cabinets. This worked okay, although I had to watch the 1-2 kHz area because the speakers were on a ledge behind the sisters. Power was available on the wall behind the bandstand, 235V, 50 cycle, on an Australian receptacle with a good ground. We performed four numbers, much to the delight of the princess and regular hotel patrons, who were seated around the performing area having dinner.

Figure 8. The speaker stack at the Civic Auditorium in Nadi.

Sunday was a two-performance day. The Barretts performed one guest spot *a cappella* during the morning service at the Centenary Church (the King's church); his majesty was in attendance. We were then treated to a Tongan feast: you sit in front of a long table covered with whole roast pigs, chickens, fish and more, eating with your fingers until you have to stop or burst! We were scheduled to perform several numbers as a regular part of the 8p.m. service at the King's church; this would involve Charles and the use of a PA. I suggested that we might tie into the small in-house PA, allowing me to control our mics and piano with my mixer, yet still leave the normal mics up and operational. We couldn't gain access to the church for setup until 6p.m., so things got kind of rushed; Mike lent a helping hand. The church seated about 2000 inside, with bleachers set up along the open sides for additional seating. The PA consisted of columnar cabinets mounted to the walls: three on each side of the rectangular church with one facing the royal boxes and another for the foreign visitors area, where I set my console. Power was obtained from the rear vestibule; it measured a whopping 250V, 50 cycle, and fluctuated as much as 10 volts. The Australian receptacle had no ground, but I created one out of a water pipe in the adjacent bathroom. There was no way to tie directly into the power amp/mixer without removing it from its permanent location, so I plugged my board into a female hi-Z mic receptacle. With careful level adjustments, this did the trick. We were only supposed to do five numbers, but the pastor surprised everyone in attendance by asking for more during the service! The sisters were only too happy to oblige.

Monday and Tuesday were performance days at St. Andrews School, in a church/auditorium next to the school proper. This was an open-sided building with a dome ceiling over the stage area, seating around 800 (*Figure 7*). Reverb time was around 2.5 seconds despite the open sides. There were plenty of Australian receptacles on the rear of the stage, supplying 240V, 50 cycle power. The first concert

was in the evening, and made us glad we still had sweaters—no balmy evenings here! The voltage fluctuated much more at night, dropping as much as 7 volts. I never observed any spikes. Tuesday was a matinee performance, timed to allow the school to attend. I had no shortage of willing laborers as a result, and found myself teaching a sound class as I tore down!

SAMOA WAS NEXT

Wednesday was both a day off and a performance day. Mike and I spent most of the day touring the island, and we finally enjoyed a rain-free afternoon on the windward side of the island. We left Tonga around 11p.m., and arrived in Western Samoa at 12:30a.m. Wednesday morning; as we'd crossed the Dateline, we now had Wednesday over again! Apia was about a half hour drive from the airport, so we didn't get into our rooms until almost 2a.m. I was picked up at 2p.m. and taken over to Apia Park, where we would play that evening in the gym. The gym had terrible acoustics, with a reverb time of around 3 seconds, as well as several discrete early reflections. I'd been told by the tourist bureau that the gym had a complete PA, and it did, if you wanted to announce scores! It was in no way adequate for us, and nothing else could be procured on such short notice. It was time to get radical. I set up my mix position on the side, where the scorers table was, and ran a feed into the house PA, which had no low end to speak of. The bleachers were on the opposite side of the gym, so I set my monitor speakers on either side of me, pointing in that direction. The "stage" was a mat on the floor, with about 150 chairs for floor seating directly in front. The rest of the audience would sit in the bleachers, looking at the side of the stage. I hoped to cover the main seating area and the floor area from this spot, while still washing onto the stage enough for the sisters and Charles to hear. I used the house PA to fill in the blanks. It worked, but only because luck was on my side, hardly anybody showed up. I got my power from the sound control room behind me, which was another story. When I plugged in my meter to check the voltage, the whole building went dark! I was blamed for this by the local techs, but meters do not blow power. It took a good half hour to restore power, and everyone was very circumlocutory when I inquired as to what happened. The receptacles were Australian, supplying 230V, 50 cycle power, and the ground was good.

After an enjoyable day off, we were back at work Friday, June 26. I spent the morning hiking up to the gravesite of Robert Louis Stevenson, which involved a steep climb up a mountain covered with rain forest. The view, however, was spectacular. I took a couple hours of rest, and drove over to the village of Leauva'a, about twenty minutes from Apia. Our venue was the village church, which seated about 1000 in a rectangular shape with open sides. The PA was 6 hi-fi cabinets, 3 flown from the walls on each side of the church, and a Pioneer receiver for power. I discovered that the two sides were wired out of phase, something I corrected, but again the PA wasn't really adequate for our needs. During the performance that evening, whenever the sisters hit loud unison harmonies, the PA would clip badly. This audience was also the rudest of the tour, talking constantly and loudly during the performance. I think we were all grateful to get this one out of the way. Mike Mingo left after the concert to fly back to Hawaii (we would go on to Fiji by ourselves), but before he left we conducted our post-mortems. It was apparent that trying to find adequate PA on the smaller islands of the South Pacific was impossible.

Figure 9. The Barrett Sisters in performance in Nadi's Civic Auditorium.

Mike applauded my efforts at making the shows happen in spite of less-than-desirable circumstances, and in the future would recommend that *everything* be carried along, even if it meant extra weight and more hassle planning travel.

Saturday was a short day. We left Apia for the airport, but our late a.m. takeoff was delayed as our flight was overloaded. As soon as the announcement was made I knew what was coming; sure enough, a look out my window confirmed that they were off-loading our gear. A representative came aboard and notified me officially of this, so when we arrived in Suva, Fiji, Sunday afternoon (we'd crossed the Dateline again), I huddled with Les McBee at the Polynesian's baggage desk and tried to determine when the gear would arrive. Full PA, including monitors, console and processing would be provided here, so we really weren't in too bad a shape, but I did need the mics and snake. Fortunately, scheduling changes favored us. Fiji had experienced a coup in May, and the political climate was still a bit shaky as the new leaders struggled with myriad economic and social problems. Our first few concerts had therefore been cancelled; we weren't scheduled to play until Thursday, July 2, in Nadi, and the airline assured us the gear would be delivered by then.

A BIT OF R&R

We now had a few days to kill, and Les had the perfect answer: a visit to Castaway Island, a small, privately-owned island with a resort hotel about a two hour sail from Suva. Several days of fun in the sun on a tropical island put a huge smile on our faces, and we returned to Nadi ready for our last few shows. Thursday and Friday we performed at the Civic Auditorium in Nadi. This hall seated about 1200, and acoustics were quite good. My gear arrived in time, and I used a PA comprised of Yamaha and Peavey cabinets (*Figure 8*), Yamaha monitors and Yamaha power amps. There was a grand piano for Charles, who was pretty sick of the PF-15 at this point, and he enjoyed having a real piano again(*Figure 9*). I made sure that we soundchecked Thursday, as Radio Fiji wanted to record both concerts, using a feed from me as well as ambience mics. They had also played the sisters' music extensively while we were "vacationing," and this resulted in two complete sellouts, with lines of people outside trying anything to get in. We'd added a little twist, with a local keyboard player and guitarist added to the last two numbers as a show of U.S.-Fijian musical solidarity. Thursday's concert was extra special as the Governor-General of Fiji and the U.S. am-

to all present: humble yourself and pray to God, and he will heal the land. Applause throughout the hall told us they'd received her message. The sisters continued to weave their special magic all night, with Rodessa turning "He's Got the Whole World in His Hands" into a high-note spectacular, and Billie showing off her low range on "Deep River." Friday's concert featured a guest appearance by Esther King, Fiji's well-known gospel singer, who joined the sisters in singing her new song "Peace and Harmony," written as an appeal for solidarity in Fiji's troubled times; it was a smash!

THE LAST DAY OF THE TOUR

Saturday was our last day of work, and it was a full one. The sisters and Charles gave a morning workshop to local choirs that was very well attended. As it was July 4, we then travelled across town to the U.S. ambassador's residence, where the sisters gave a mini performance on the lawn for the annual Independence Day picnic. I used a Yamaha EMX-300 and two small Yamaha speakers on tripods for that one, which was attended by Americans stationed in Nadi, and featured a good 'ole American barbeque, which sure tasted good after six weeks away from home. At 5p.m., we played a special hour-long concert at a local movie house that seated about 800, as an attempt to satisfy the many people who couldn't get tickets for the Civic Auditorium shows. I used the speakers from the ambassador's gig, with a more powerful amplifier, but the whole system died in mid-performance. The sisters continued acoustically while the PA guys made a mad dash back to their shop for a spare. Delois announced that the Devil was in the amp, and she was right—it was hot as hell! The new one showed up in time for the last few numbers, and the sisters finished with an impromptu song "Fiji, We Love You," which featured Delois' Louis Armstrong imitation.

Sunday marked the beginning of our long journey home. I must mention that due to the political situation in Fiji, *all* luggage is hand searched for every flight. Our baggage was checked in Suva; upon arrival in Nadi, we had to reclaim our bags, go to the international section of the terminal, and get them completely checked again. It is a pain, and you must allow enough time for this in planning departure schedules. The equipment was shipped air-cargo to Detroit, and after a Nadi-Honolulu-LA Sunday I finally arrived home in Detroit early Monday, July 6. db

Condensed Glossary of Audio Terms—Part II

DREW DANIELS

FOLDED HORN

A horn whose internal path length is folded to produce a more compact package.

FREQUENCY

The spacing in time, of events. In audio signals, frequency refers to the cyclic repeat of vibrations. In wire, the vibrations are electrical variations. In air, the vibrations are changes in air pressure. The ear hears air pressure variations with frequencies between about 12 times per second and 20,000 times per second or 12 hertz (hertz) and 20 kHz (kilohertz).

FREQUENCY DIVIDING NETWORK

(see CROSSOVER)

FREQUENCY RESPONSE

A measurement of how a device being measured responds to test signals of constant amplitude without regard to frequency, over a particular measurement range of frequencies. An electrical device whose specifications say it is "flat from 20 Hz to 20 kHz," will not cause any amplitude deviation in signals fed through it over that frequency range, as a result of changing the frequency of the test signal.

FULL SPACE

A sphere. An acoustic condition where there are no boundaries to reflect sound. A sound source hung in free space away from reflecting surfaces does not exhibit the same bass boost as it would if set on the floor or against a wall. (see HALF SPACE and QUARTER SPACE)

FUNDAMENTAL

Any pure tone. The pitch remaining when all harmonics (overtones) are removed from a basic frequency or musical tone, producing a pure tone. An amplifier or audio circuit that can pass a pure tone without adding any harmonics of its own is said to have low harmonic distortion.

Musical instruments usually produce tones rich in harmonics, giving each its particular sound or "timbre." Small loudspeakers will be heard to reproduce bass instruments even while producing little or no fundamental pitch because the ear and brain reconstruct the sound of the instrument based on prior knowledge of its timbre.

G

GAIN

An increase. Amplifiers produce gain by increasing voltage and/or current. Horns produce acoustical gain by concentrating the sound of loudspeakers to narrower angles and frequency ranges. Gain is specified in decibels (dB), and while an amplifier may be used to produce unity gain, or a net increase of 0 dB in voltage, it may produce some current gain.

GAUSS

The obsolete term denoting a magnetic flux density of 0.0001 tesla. The SI unit, tesla (T) is equal to one weber per square meter. The weber (Wb) is the unit of magnetic flux which, linking a circuit of one turn, produces in it one volt as it is reduced to zero at a uniform rate in one second.

GROUND

In electronic equipment, ground is the zero voltage reference point in the circuitry. Ground is referred to as earth because true ground on power lines is provided by a heavy electrical conductor such as a copper bar, driven into the earth to make an electrical return path. This is why you become "connected" to ground when standing in water and are subject to shock from electrical equipment that is not also properly grounded.

GROUND LOOP

An electrical circuit where two or more paths to ground (true 0 volts) have different voltages as a result of current flow through wiring or chassis elements. The minute voltages on some ground legs may find their way into equipment input circuits and be amplified, causing hum, buzzing or in the worst case, inaudible high frequency oscillations, sometimes at high power levels, that can ultimately cause

destruction of tweeter voice coils or even burn out amplifiers.

Ground loops are eliminated by tracing the small unwanted voltages with an oscilloscope to find and isolate their sources from other circuitry. Often, shields must be disconnected or chassis modified to prevent poor packaging designs from causing ground current flow. Sometimes, modifying internal wiring is the only thing that will eliminate a ground loop.

H

HAAS EFFECT

The effect of single strong echoes masking the real direction of sound sources. First described by Helmut Haas, the effect bears on our ability to discern sound source direction and understand speech consonants, in particular, when loudspeakers used for sound reinforcement produce sound arrivals before the original source (talker) or when these arrivals are too loud with respect to the original source.

HALF SPACE

One half of a sphere. An acoustic boundary condition where a surface causes low-frequency radiation from a speaker to be folded onto itself (the same acoustic power filling only half the amount of space), producing a 3 dB increase in sound pressure over what the source would measure if hung in free space away from reflecting surfaces.

HARMONIC DISTORTION

Distortion which is harmonically related to the fundamental signal fed through and audio circuit or system. Harmonic distortion is characterized by a harsh sound that ranges from a slight edge on some of the high-frequency components of a musical program, to the fuzz associated with electric guitar effects pedals.

HEADROOM

The reserve voltage or power level in an audio device or system. The difference in levels between the normal or "nominal" operating levels and the peak clean (undistorted) available levels. (see also NOMINAL OPERATING LEVEL)

HENRY

The henry is the inductance of a closed circuit in which an electromotive force of 1 volt is produced when the electric current in the circuit varies uniformly at a rate of 1 ampere per second.

HERTZ

The term hertz, abbreviated Hz, replaces the formerly used "cycles per second" or "cps." Named after Heinrich Hertz, the term applies to any regular, cyclic vibration or event. The term hertz always involves time (seconds) no matter what the period between repetitions of the event of interest; for example, a tone vibrating 1,000 times every second is said to be at a frequency of 1,000 hertz or 1 kilohertz (kHz). The earth spinning once around every day (86,400 seconds) rotates at a frequency of 11.6 microhertz (uHz).

HIGH CUT

(see LOW PASS)

HIGH PASS

A circuit or filter that stops low frequencies and passes high frequencies. A typical high pass filter use is protection of tweeters and compression drivers from the effects of over-excursion of their moving diaphragms. Low pass filters are used to attenuate or eliminate high frequencies from the drive to woofers so that they can operate in the frequency range where they are most linear (see LOW PASS).

HISS

The unwanted random noise associated with audio tape, unmodulated record grooves and noisy amplifiers and other audio circuitry. In circuitry, hiss is caused by the thermal activity of the molecules in the materials that electronic component parts are made of.

HYSTERESIS

The lag of effect or reaction after a stimulus as in the tendency of a magnet to resist being demagnetized or of a piece of iron to become magnetized after a magnetic field from a coil is introduced into it. Hysteresis in magnetic materials provides a means of measuring how well the material will function to provide a particular magnetic field in products such as loudspeakers. Magnetic materials such as alnico demagnetize and remagnetize easily, so care must be taken in the design of magnetic structures using alnico so that the magnetic source is protected from adverse magnetic fields like those produced by voice coils. Materials such as ferrites are innately difficult to magnetize and demagnetize, allowing more freedom in the design of magnetic structures without the same regard to adverse fields.

IEC

International Electrotechnical Commission. Also, the tape playback and record equalization standard specified by the IEC and used on many european analog tape recorders.

IEEE

Institute of Electrical and Electronic Engineers.

IHF

Institute of High Fidelity.

IM

Intermodulation Distortion. A form of distortion caused by two or more audio signal components that beat against each other to produce non- harmonically related pitches which do not sound musical because they are not part of tones or chords present in the original signal.

IMPEDANCE

The total amount of opposition to the flow of alternating currents in an electrical circuit which may comprise resistance, capacitance, inductance or reactance. Reactance is the imaginary part of impedance in the case where current and voltage are not in phase in an A.C. circuit due to the circuit's components and the frequency of the signal feeding through them. In such a case the impedance (ohms) may be negative.

IMPEDANCE, load

The input impedance encountered by incoming signals from an audio circuit. The impedance presented by the load to a source or network.

IMPEDANCE, matching

The use of inputs and outputs whose impedance is equal, taking into account the effects of total circuit reactance on signals passing from output to input in order to produce minimum phase shift, optimum frequency response and optimum power transfer characteristics in the circuit. The DIN (Deutche Industrie Normen) standard adopted in West Germany, calls for all devices to have input impedances 100 times larger than the output impedances of devices driving them, specifically, 100 ohms output driving 10,000 ohms input impedance. The logic involved is that sufficiently low output or source impedances are "stiff" enough to swamp out impedance effects in subsequent circuits—to prevent the tail-wagging-the-dog symptom inherent in systems for which impedance matching is the only other solution.

IMPEDANCE, source

That output impedance which, when shunted by a resistor whose value in ohms is equal to it, loses half its original output voltage. The output impedance of most modern circuits such as solid-state amplifiers, chip or IC amplifiers and so on is nearly pure resistance because their circuitry is followed by buildout resistors to protect their solid state components thus allowing circuit design based on source resistance without regard to reactive impedance effects at the outputs of electronic devices. Power amplifiers, on the other hand, generally have very low source resistance and impedance (see DAMPING).

INDUCTANCE

The term used to describe the electrical property of an inductor (coil or choke) in units of henries (H), millihenries (mH), microhenries, etc. The closest mechanical analogy of an inductor is an electrical spring; the inductor can store electrical energy fed into it and return it directly back into the circuit. The inductor tends to block the flow of A.C. currents depending on their frequency, and pass D.C. currents through.

INFINITE BAFFLE

A loudspeaker baffle that prevents the loudspeaker's rear radiation from entering the environment where the front radiation is being used. An infinite baffle may consist of either a wall extending out from the mounting surface of the loudspeaker such as when the loudspeaker is mounted in a hole cut in a wall, or a sealed enclosure filled with highly absorbent material such as fiberglass, for the purpose of soaking up the rear radiation.

INFRASONIC

Sound at frequencies generally considered to low to be heard (sounds in the range of 1 hertz to 15 hertz). Infrasonic sound can be felt if its power level is sufficiently high, and can cause nervousness and/or fatigue and disorientation in people exposed to it.

INPUT LEVEL

The level in units such as dB, volts or watts that a particular piece of electronic equipment receives at its input. Input levels are alternately described as nominal (the normal operating level) or maximum (the level above which distortion occurs). As an example, a piece of gear might have a meter marked "VU" and its specifications might say "nominal input: +4 dBu (0.775 volt), maximum input: +24 dBu (12.2 volts)." Feeding this piece of gear a 0.775 volt input signal should cause its meter to indicate 0 dB, and increasing the input voltage to 1 volt should make the meter indicate +2.2 dB when the unit's level controls are set to unity gain (see dB conversion table).

INSERTION LOSS

The loss in signal amplitude associated with passive electrical devices or circuit elements such as transformers, autoformers or passive high-level loudspeaker crossovers, that are inserted into the signal path of an electrical or electroacoustical system.

ISOLATION, acoustic

Refers to the attenuation of sound in adjacent acoustical spaces such as the isolation of the recording studio and control room by means of heavy double doors with air spaces and triple plate glass windows. The term is also applied to circuits in equipment such as mixers, in which isolation means the opposite of crosstalk.

J

JAN

Joint Army-Navy specification. Pertains to the stringent government specifications used for electronic components of specified quality or survivability or of tightly maintained quality control, and often means these parts will last longer, withstand higher temperatures, voltages, currents, etc., than their consumer counterparts.

JOULE

The joule is the work done when the point of application of 1 newton of force is displaced a distance of 1 meter in the direction of the force.

JUNCTION BOX

A box that provides cable terminations at jacks or connectors such as the XL-type microphone connections at the end of a multi-conductor microphone cable or "snake."

K

kHz

SI units abbreviation for kilohertz. One thousand cycles per second, or the repetition of an event, vibration or oscillation at a rate of one thousand per second. The term kHz replaces the obsoleted term kc (kilocycles).

KILO

The standard SI prefix for thousands. The prefix kilo must always be spelled and abbreviated in lower case lettering. See SI for more information on standard units and prefixes and their use.

L

LCD

Liquid Crystal Display. Display composed of mobile crystals in liquid suspension, which align themselves and polarize light in response to a small electric change. The crystals are manufactured in pockets within the display which correspond to areas of dark on light background.

LEAKAGE

The unwanted pickup of stray sound from sources other than the intended source feeding a specific microphone channel.

LED

Light Emitting Diode. A solid-state diode rectifier whose atomic properties cause it to emit light when electric current is passed through it. Current LED technology allows the emission of light from infrared through green frequencies, and visible light LEDs are available in colors from deep red to green.

LEDE

Live End, Dead End. A listening room design technique used primarily in recording studio control rooms, where absorptive material is placed near the loudspeakers and reflective material is placed behind the listener.

LEVEL

The amount of power present at some point in an audio system. Specifically, the term level refers to the power magnitude in either electrical watts or acoustic watts but is often incorrectly used to denote voltage. (see also POWER and SPL)

LEVELING AMPLIFIER

An alternate term for "compressor" or "limiter."

LIMITER

An audio amplifier whose output amplification rate of change is less than its input signal amplitude rate of change. While compressors are used to reduce the dynamic range of program signal either to make everything sound louder, or to automatically control sudden large changes in signal amplitude such as in the case of recording vocalists, limiters are used to prevent dynamic transient signal peaks from exceeding a pre-set amplitude. Limiters

are usually required when broadcast signals are fed to telephone lines, and are useful to prevent power amplifier clipping and overdriving in large sound systems. Limiters sometimes include circuits that allow the user to adjust the time it takes to start reducing the signal amplitude (attack), to ease up on the compression (release), and also the input and output gain. (see also, COMPRESSOR)

LINEAR

When the output of a device tracks its input accurately, it is said to be linear. In the case of audio equipment, the output would be directly proportional to the input.

LINE LEVEL

The average (power) level at which signal-carrying wires operate. In audio systems, operating "levels" are usually divided into three categories.

Mic level: -90 dBm (one picowatt) to -30 dBm (one microwatt)

Line level: -30 dBm (one microwatt) to +30 dBm (one watt)

Speaker level: line level or higher (audible from loudspeaker).

Typical levels that might correspond to a "0 VU" meter reading for these three categories are 2.45 millivolts (-50 dBu) for microphones, 316 millivolts (-10 dBV) or 1.23 volts (+4 dBu) for mixers, tape decks and signal processing equipment, and up to 70.7 volts (+37 dBV) for loudspeakers.

LINE OUT or LINE OUTPUT

An audio equipment output that supplies signals whose average magnitude is line level, between about 10 millivolts and 25 volts.

LINE RADIATOR

Usually, a speaker system in the form of a column of similar individual loudspeakers. Column speakers exhibit the same horizontal dispersion as a single loudspeaker element within the column, but narrower vertical dispersion due to sound wavelengths and the vertical dimension of the column. (see WAVELENGTH)

LOUDNESS

Sound volume as it is detected by the average human ear. Hearing is non- flat, and this non-flatness varies with changes in absolute SPL (Sound Pressure Level). The chart below shows curves of equal loudness for various absolute SPLs.

LOUDSPEAKER

A device for making audible sound waves, typically, an electroacoustic transducer that converts alternating current electrical oscillations fed to it, into acoustic oscillations (sound). The term "driver" is often used to denote individual loudspeakers within a speaker system, while the term "speaker" is often used to refer to the entire system comprising driver(s), enclosure and crossover.

LOW CUT

(see HIGH PASS)

LOW PASS

A circuit or filter that stops high frequencies and passes low frequencies. A typical low pass filter use is the hiss or scratch filter found on many preamplifiers or receivers to reduce static or record scratch noise, which is predominantly high frequency noise the ear is quite sensitive to. Low pass filters are used to attenuate or eliminate high frequencies from the drive to woofers so that they can operate in the frequency range where they are most linear.

M

MASKING

Masking is sound applied to an engineered environment to provide privacy in open office areas. The term "masking" refers to the so-called "cocktail- party effect" where certain conversations are hard to pick out because similar sounds mask them. The ear-brain can be fooled into not hearing certain sounds if other sounds at lower volume but sufficient complexity are simultaneously present. Pink noise is most often used to cause intentional masking; its spectrum is shaped or filtered and fed to loudspeakers hidden above an acoustical tile ceiling.

MICROBAR

A deprecated term for one millionth of a bar, the unit of atmospheric pressure replaced by the SI unit, the pascal (Pa). Atmospheric pressure at sea level reads 1,010,300 microbars. In terms of sound pressure level, the pascal represents 94 decibels, and the microbar represents 74 decibels. (see PASCAL)

MICROPHONE

An electroacoustic transducer which produces alternating current electrical signals proportional to sound signals to which it is exposed. Microphones are usually grouped into categories according to their directional sensitivity characteristics, their means of producing electrical signals, or the type of sound field they respond to i.e., some microphones respond to changes in air particle density (pressure microphones) and some to air particle motion (velocity microphones). Combinations of pressure, velocity or phase sensitivity can be employed in the design of microphones to yield nearly any desired pickup pattern.

MONAURAL

Having one ear. Monaural headsets (with a single earpiece) are typically used by telephone operators, stage managers and disco operators.

MONITOR

A device used as a reference for determining the integrity or quality of original program signals. Television monitors seldom have tuners or other extras, are adjusted for neutral color rendition (true color) and must have bandwidth (resolution) capabilities greater than the signals they are intended to display. Monitor speakers, like video monitors, should exhibit bandwidth that extends beyond the intended signal bandwidth, should be free of sound coloration and should have adequate resolution (accuracy) to make any faults such as ticks or hum audible to the operator. The dynamic range of both our eyes and ears, far exceed the capabilities of monitor devices to display or produce accurate facsimiles of life, so monitor use should include thoughtful adjustment of dynamics to make visual or sound images fit the capabilities of the monitor. These take the form of volume level adjustment for monitor speakers and brightness and contrast range adjustment for video monitors.

MONOPHONIC or **MONO**

Sound from one source, such as a single loudspeaker or earphone.

MULTI-MICROPHONE MONO

As used in multitrack recording of popular music, single microphone mono sounds are recorded onto various tape channels and then mixed together, using pan pots to adjust the left-to-right panoramic image position of each channel to create an impression of stereo sound when the final two-channel (stereo) program product is heard through headphones or stereo speakers.

MYLAR

Registered trade name of a particular polyester plastic manufactured by E.I. DuPont DeNemours Chemicals, Inc. Some of the many uses of Mylar include backing for recording tape, winding film for electric capacitors, and professional-use drum heads.

N

NAB

National Association of Broadcasters.

NANO-

The internationally used (SI) unit prefix designating divide by one billion or multiply by one billionth (1/1,000,000,000). The nano prefix is always written in lower case and always abbreviated simply by the letter n. Such prefixes are written with units such as meters (nm) or watts (nW) with no space between prefix and unit, but a single space after the numerical descriptor. The terms "250 nanowebers per meter" would therefore be written, 250 nWb/m.

NANOWEBER

One billionth (0.000000001) of a weber. The weber is the SI unit of magnetic flux. (see WEBER)

NEWTON

The newton is that force which gives to a mass of 1 kilogram an acceleration of 1 meter per second per second.

NOISE

Any unstructured and generally unwanted signal. Hum, buzz, hiss, crosstalk and rumble are typically classed as noise.

Random noise, as the name suggests, is noise consisting of random frequencies with random time and amplitude characteristics.

White noise is random noise whose various frequency components all share the same energy density characteristics, producing the same voltage at any particular discrete frequency over a period of time, thus causing a frequency response trend that rises the same number of decibels as the percentage of frequency increase. The 10 dB per decade of frequency (ten times power for ten times frequency) or 3 dB per octave of frequency (doubling of power for a doubling of frequency) is indicative of how many more discrete frequencies are crammed together in the same percentage of bandwidth spacing as frequency rises.

Pink noise is filtered white noise that exhibits a constant power in any band of frequencies of the same span percentage. For example the octave between 20 and 40 hertz contains only 20 hertz, while the octave between 2000 and 4000 hertz contains 2000 hertz. These two bands exhibit the same pink noise power, while the 2000-4000 hertz band would exhibit 100 times as much power if it were simply unfiltered white noise. Pink noise is used extensively as an audio measurement signal source because of its uniform power-per-bandwidth characteristic, and it has been said that music source material, averaged over a long time period, is roughly equivalent to pink noise in spectral energy distribution.

NOISE FLOOR

The intrinsic noise of an electronic device or system. The noise that remains in the absence of signal.

NOISE GATE

A circuit that attenuates or shuts off audio signals that fall below a threshold, usually set by the user. Noise gates are used to eliminate background hiss in sound systems and motion picture soundtrack restoration or low-level microphone leakage in multitrack, multi-microphone recording, etc.

NOMINAL OPERATING LEVEL

The design target signal level of audio circuits. For example, a crossover may have a noise floor of -80 dBu and a maximum output voltage of +24 dBu and call for a nominal operating level of +4 dBu which means that the nominal signal level will be 84 dB higher than the noise and allow for 20 dB of headroom.

O

OCTAVE

A doubling or halving of frequency. The numerical interval, for example, between 440 Hz and 880 Hz or 220 Hz is an octave.

OFF AXIS

(see AXIS, see POLAR PATTERN or POLAR RESPONSE)

OHM

The ohm is the electric resistance between two points of a conductor when a constant difference of potential of 1 volt, applied between these two points, produces in this conductor a current of 1 ampere, this conductor not being the source of any electromotive force.

OHM'S LAW

Physicist Georg Simon Ohm (1789-1854) described the relationship between electric current and resistance. Ohm's law states that the steady current through certain electrical circuits is directly proportional to the applied electromotive force, or, I=E/R where I is current, E is voltage and R is resistance. Equations solving for volts amperes and watts are derived from Ohm's basic equation. When calculating these quantities for A.C. circuits, the phase angle, theta, of the currents in the circuit must also be considered.

OMNI-DIRECTIONAL

Every direction. Omni-directional loudspeakers direct sound equally at all angles. Omni-directional microphones have equal sensitivity to sound coming from any angle.

OSCILLATOR

A device that oscillates. Sound is the oscillation of air caused by a mechanical oscillation such as that from a moving piano string or drum head. An electronic oscillator is a device containing circuits designed to produce electrical oscillations that are maintained, usually at a constant amplitude, and may have other specific characteristics, that suit them for use as circuit test signals.

OSCILLOSCOPE

An electronic test instrument which produces a visible image of electrical signals such as oscillations, on a viewing screen.

OVERLOAD

The condition in which equipment is stressed beyond its normal operating limits. For sound equipment, overload may take the form of clipping in circuits, overheating of amplifiers, burning of loudspeaker voice coils, or loss of circuit integrity or breakdown. Overload may also be thought of as system operation at levels higher than the levels at which operation is linear, the overload condition producing non-linear circuit or system behavior, such as distortion. (see DISTORTION)

P

PAN or **PAN POT**

A two-circuit volume control used to place the auditory image of a sound from a mixer channel between the left and right speakers.

PASCAL

The SI unit of pressure, abbreviated Pa and defined as a pressure of 1 newton per square meter. In terms of sound it is convenient to imagine air in a balloon where the pressure is equal on the inside surface. An air pressure oscillation of one pascal R.M.S. produces a sound pressure level of 94 decibels referred to the threshold of hearing at 20 micropascals (20 uPa), and is roughly equivalent to 2.2 watts per square meter or 100 nanowatts (0.0000001 watt) of acoustic power being absorbed by human eardrums.

PASSBAND

The range of frequencies, within the -3 dB limits at the ends of the range. The "audio passband," for example, of a loudspeaker, would be the loudspeaker's frequency range within its -3 dB lower and upper frequency limits.

PASSIVE NETWORK

(see CROSSOVER)

PASSIVE RADIATOR

The passive radiator or "drone cone" is a movable mass, suspended over an opening in a speaker enclosure where it is free to resonate. The principle of operation of the passive radiator is a simple substitute for an air mass in a duct that would otherwise be too large to fit into the enclosure.

PHASE PLUG

An acoustical transformer and filter consisting of a mechanical channel or set of channels that guide sound from the moving diaphragm of a compression loudspeaker, to the exit throat of the loudspeaker. The phase plug is designed to match the diaphragm's acoustical impedance to that of a horn, and to adjust the sound path length from various areas of the diaphragm to the exit throat to maintain uniform phase. Generally, the more nearly equal are the sound paths through the phase plug from diaphragm to throat, the better the high- frequency response of the loudspeaker.

PINK NOISE

(see NOISE)

POLAR PATTERN or **POLAR RESPONSE**

The magnitude of output as a function of off-axis angle for speakers, or the sensitivity as a function of off-axis angle for microphones. Typically, the device (microphone of speaker) is "normalized" on-axis, that is, the on- axis level is regarded as the 0 db reference and all measurements made off- axis then produce negative dB numbers. A horn said to have a polar pattern of 90 degrees, therefore, is one whose output level is -6 dB referred to its on- axis level, when measured 45 degrees off-axis.

POWER

Power is the conversion of energy to work. The unit of power is the watt (W). When complex signals such as music (time and voltage varying) are measured, a value for watts is derived by the use of R.M.S. (Root Mean Square) voltage divided by the load impedance to describe the amount of energy.

POWER BANDWIDTH

The frequency range over which a power amplifier can produce at least half power (-3 dB). This important specification is the actual indication of an amplifier's true power output capability, since many amplifiers are capable of much higher power outputs if frequency extremes such as those produced by music are ignored.

POWER RESPONSE

Like frequency response, power response is a measure of a loudspeaker's output with reference to its electrical input. Power response, however, includes the total sound energy radiated into the acoustic space around the loudspeaker rather than just on-axis. Flat power response, therefore, would indicate that a loudspeaker is radiating equal energy into all angles at all frequencies.

Q

Q

The term "Q" refers to the width of an effect. For example, a filter's Q is a measure of the frequency of the filter divided by the number of hertz contained within the band of frequencies bounded by the -3 dB points, thus an EQ filter at 1 kHz with a Q of 2 is 500 hertz wide at the -3 dB points. The Q factor of a horn is a measure of what part of a spherical pattern the horn radiates into (the beamwidth), therefore, where an omnidirectional source has a Q of 1 and the source placed on a reflecting surface has a Q of 2, a horn whose pattern is 90 by 90 degrees (one-eighth of a sphere), would have a Q of 8.

QUARTER SPACE

One quarter of a sphere. An acoustic boundary condition where two surfaces of a room cause low-frequency radiation from a speaker to be folded onto itself twice; once from each surface, producing a 6 dB increase in sound pressure over what the source would measure if hung in free space away from reflecting surfaces.

R

REACTANCE

The electrical characteristic of inductors and of capacitors, opposing the flow of A.C. electricity. Reactance is measured in ohms and may be negative, producing what is called an "imaginary" part of an impedance. Loudspeakers, for example, can be highly reactive, and under certain circumstances with certain signals, can feed 50 amperes or more back into a power amplifier driving them.

REFLECTION

Like light from a mirror, sound bouncing from a wall or other surface reflects. The amount and angle of sound reflection depends on the type and size of the reflecting surface, and the frequency (wavelength) of the sound.

REFLEX ENCLOSURE

A loudspeaker enclosure which uses the resonance of its internal air volume to assist the loudspeaker's motion, reducing distortion at low frequencies and extending low-frequency bandwidth.

REFRACTION

The bending of waves. Sound waves bend when they encounter boundary edges or air of a different temperature.

REMANENCE

The magnetic flux remaining in a magnetized material after a saturating magnetic field is applied and then removed.

RESISTANCE

Resistance to the flow of electric current. (see OHM)

RESISTOR

An electrical component made to resist current flow.

RESONANCE

The natural vibration or oscillation of mechanical or electrical systems at specific frequencies that depend on qualities such as mass and springiness (mechanical systems) or capacitance and inductance (electrical systems).

REVERBERATION TIME (RT_{60})

The time it takes for all reflected sounds in a space to decay 60 dB after the exciting sound source is turned off.

S

SABINE

The unit of acoustical absorption, named after Wallace Sabine. The sabine is the total absorbtion of sound by a surface area of one square foot.

SENSITIVITY

For mixers and amplifiers, sensitivity refers to the amount of input required to drive the circuit to its rated output.

For loudspeakers, sensitivity refers to the sound pressure produced by a given input voltage or power.

For microphones, sensitivity refers to the amount of electrical output produced by incident sound at a given sound pressure.

SI UNITS

The SI units are used to derive units of measurement for all physical quantities and phenomena. There are seven basic SI "base units," these are:

NAME	SYMBOL	QUANTITY
ampere	A	electric current
candela	cd	luminous intensity
meter	m	length
kelvin	K	thermodynamic temperature
kilogram	kg	mass
mole	mol	amount of substance
second	s	time

.pa

The SI derived units and supplementary units are listed here with applicable

derivative equations:

NAME	SYMBOL	QUANTITY	DERIVED BY
coulomb	C	quantity of electricity	A·s
farad	F	capacitance	A·s/V
henry	H	inductance	V·s/A

hertz	Hz	frequency	s^{-}
joule	J	energy or work	N·m
lumen	lm	luminous flux	cd·sr
lux	lx	illuminance	lm/m^2
newton	N	force	$kg·m/s^2$
ohm	Ω	electric resistance	V/A
pascal	Pa	pressure	N/m^2
radian	rad	plane angle	
steradian	sr	solid angle	
tesla	T	magnetic flux density	Wb/m^2
volt	V	potential difference	W/A
watt	W	power	J/s
weber	Wb	magnetic flux	V·s

NAME	SYMBOL	QUANTITY
ampere per meter	A/m	magnetic field strength
candela per square meter	cd/m^2	luminance
joule per kelvin	J/K	entropy
joule per kilogram kelvin	J/(kg·K)	specific heat capacity
kilogram per cubic meter (density)	kg/m^3	mass density
meter per second	m/s	speed, velocity
meter per second per second	m/s^2	acceleration
square meter	m^2	area
cubic meter	m^3	volume
square meter per second	m^2/s	kinematic viscosity
newton-second per square meter	$N·s/m^2$	dynamic viscosity
1 per second	s^{-}	radioactivity
radian per second	rad/s	angular velocity
radian per second per second	rad/s^2	angular acceleration
volt per meter	V/m	electric field strength
watt per meter kelvin	W/(m·K)	thermal conductivity
watt per steradian	W/sr	radiant intensity

DEFINITIONS OF SI UNITS

The **ampere** is that constant current which, if maintained in two straight parallel conductors of infinite length, of negligible circular cross section, and placed 1 meter apart in vacuum, would produce between these conductors a force equal to $2X10^{-7}$ newton per meter of length.

The **candela** is the luminous intensity, in the perpendicular direction, of a surface of 1/600,000 square meter of a blackbody at the temperature of freezing platinum under a pressure of 101,325 newtons per square meter.

The **coulomb** is the quantity of electricity transported in 1 second by the current of 1 ampere.

The **farad** is the capacitance of a capacitor between the plates of which there appears a difference of potential of 1 volt when it is charged by a quantity of electricity equal to 1 coulomb.

The **henry** is the inductance of a closed circuit in which an electromotive force of 1 volt is produced when the electric current in the circuit varies uniformly at a rate of 1 ampere per second.

The **joule** is the work done when the point of application of 1 newton is displaced a distance of 1 meter in the direction of the force.

The **kelvin** , the unit of thermodynamic temperature, is the fraction 1/273.16 of the thermodynamic temperature of the triple point of water.

The **kilogram** is the unit of mass; it is equal to the mass of the international prototype of the kilogram. (The international prototype of the kilogram is a particular cylinder of platinum-iridium alloy which is preserved

in a vault at Sevres, France, by the International Bureau of Weights and Measures.)

The **lumen** is the luminous flux emitted in a solid angle of 1 steradian by a uniform point source having an intensity of 1 candela.

The **meter** is the length equal to 1,650,763.73 wavelengths in vacuum of the radiation corresponding to the transition between the levels $2p_{10}$, and $5d_5$ of the krypton-86 atom.

The **mole** is the amount of substance of a system which contains as many elementary entities as there are carbon atoms in 12 grams of carbon 12. The elementary entities must be specified and may be atoms, molecules, ions,

electrons, other particles or specified groups of such particles.

The **newton** is that force which gives to a mass of 1 kilogram an acceleration of 1 meter per second per second.

The **ohm** is the electric resistance between two points of a conductor when a constant difference of potential of 1 volt, applied between these two points, produces in this conductor a current of 1 ampere, this conductor not being the source of any electromotive force.

The **radian** is the plane angle between two radii of a circle which cut off on the circumference an arc equal in length to the radius.

The **second** is the duration of 9,192,631,770 periods of the radiation corresponding to the transition between the two hyperfine levels of the ground state of the cesium-133 atom.

The **steradian** is the solid angle which, having its vertex in the center of a sphere, cuts off an area of the surface of the sphere equal to that of a square with sides of length equal to the radius of the sphere.

The **volt** is the difference of electric potential between two points of a conducting wire carrying a constant current of 1 ampere, when the power dissipated between these points is equal to 1 watt.

The **watt** is the power which gives rise to the production of energy at the rate of 1 joule per second.

The **weber** is the magnetic flux which, linking a circuit of one turn, produces in it an electromotive force of 1 volt as it is reduced to zero at a uniform rate in 1 second.

SI PREFIXES

The names of multiples and submultiples of any SI unit are formed by application of the prefixes:

MULTIPLIER	PREFIX	SYMBOL	TIMES 1, IS EQUAL TO:
10^18	exa	E	1 000 000 000 000 000 000
10^15	peta	P	1 000 000 000 000 000
10^12	tera	T	1 000 000 000 000
10^9	giga	G	1 000 000 000
10^6	mega	M	1 000 000
10^3	kilo	k	1 000
10^2	hecto	h	100
10	deka	da	10
0	—	—	1 (unity)
10^-1	deci	d	.1
10^-2	centi	c	.01
10^-3	milli	m	.001
10^-6	micro	μ	.000 001
10^-9	nano	n	.000 000 001
10^-12	pico	p	.000 000 000 001
10^-15	femto	f	.000 000 000 000 001
10^-18	atto	a	.000 000 000 000 000 001

Some examples: ten-thousand grams is written; 10 kg, 20,000 cycles per second is written; 20 kHz, 10-million hertz is written; 10 MHz, and 250 billionths of a weber per meter of magnetic flux is written; 250 nWb/m. Always use less than 1000 units with an SI prefix; "1000 MGS" is advertising hyperbole and should be written " 1 g " only.

SI prefixes and units should be written together and then set off by a space (single space in print) from their numerators. For example; use the form "35 mm" instead of "35mm" and "1 kHz" instead of "1k Hz ."

When writing use standard SI formats and be consistent. You should consult National Bureau of Standards publication 330, (1977) for details on usage.

Never combine SI prefixes directly, that is, write 10^{-10} farads as 100 pF instead of 0.1 micro-microfarads (uuF). Keep in mind that whenever you write out a unit name longhand, the rule is that the name is all lower case, but when abbreviating, the first letter is upper case if the unit is named after a person and lower case if it is not; examples: V = volt for Volta, F = farad for Faraday, T = tesla for Tesla, and so on. Letter m = meter, s = second, rad = radian, l = liter and so on. Revolutions per minute may be written only as r/min, miles per hour may be written only as mi./hr., and inches per second may be written only as in./s and so on.

In addition to the correct upper and lower case, prefixes and combinations, there is also a conventional text spacing for SI units and abbreviations. Write 20 Hz, rather than 20Hz. Write 20 kHz, rather than 20k Hz, and so on. Always separate the numerator of a unit from its prefix and/or unit name, but do not separate the prefix and name. -dd

SUB SONIC

Below the speed of sound. (see also, INFRASONIC)

SUBWOOFER

Loudspeaker system designed to produce or reproduce only low frequency sounds, typically below 150 hertz.

SUPERSONIC

Faster than the speed of sound (approximately 344 meters or 1130 feet per second at sea level). (see ULTRASONIC)

T

TESLA

The SI unit of magnetic flux density, derived by webers per square meter.

THIELE or **THIELE-SMALL ALIGNMENT**

The use of mathematical simulation of speaker system low frequency operation by calculating the values of the electrical analogies of loudspeakers and enclosures.

TIMBRE

Characteristic sound. Timbre is formed and affected by the ratios of harmonics to their fundamental, allowing for the difference heard in the same pitch played on different instruments.

TIME DELAY SPECTROMETRY

Time Delay Spectrometry is a method of measuring audio signals by creating a measurement "time window" through which signals pass without concomitant obscuring noise.

TRANSDUCER

A device which converts one form of energy directly into to another form of energy. Loudspeakers, microphones and motors are transducers which convert motion into electricity or vice versa. Light-emitting diodes and solar cells are transducers that convert electricity to light or vice versa, etc.

TRANSFORMER

A device used to isolate or to raise or lower an A.C. voltage from its input to its output. A typical transformer may consist of two separate coils of wire wound on a magnetic steel core. When an A.C. current passes through the input coil (primary) it produces an alternating magnetic field in the core, which in turn produces current flow in the output

coil (secondary). By winding a different number of coil turns for the secondary winding, the input voltage is raised at the output; by using fewer secondary turns, the output voltage is lowered. An isolation transformer uses the same number of turns for primary and secondary, maintaining the same input voltage at the output while severing the electrical connection of the two coil windings.

TRANSIENT

A momentary amplitude peak in program source. A pop from a switch or scratched record may form signal transients. Musical transients occur as a result of such things as percussion instruments, piano and guitar. Normal musical transients my have amplitude peaks as high as 40 dB above the average program levels, requiring headroom in the circuits and equipment used to reproduce them.

TRANSIENT RESPONSE

The response of audio equipment to sudden large changes in signal amplitude, such as those produced by musical transients.

TUNED ENCLOSURE

A speaker enclosure designed to use its internal air volume to aid operation of a woofer installed in it. Reflex or bass-reflex enclosures are one form of tuned enclosures. Tuned pipe enclosures use their internal air volume as a resonating air column like an organ pipe, driven by the woofer.

TUNED PORT

The vent in a reflex enclosure which causes the air inside the enclosure to resonate at a particular frequency, obtained by adjusting the vent opening size. When ducts (tubes or tunnels) are added to vent openings, the tuned frequency is lowered, allowing the use of larger vent area openings to achieve the same tuning frequency.

TWEETER

A loudspeaker designed to reproduce high frequencies only. Tweeters are typically used at frequencies beyond the center of the audio spectrum, which, if placed on a logarithmic scale like a piano keyboard, would be about 630 Hz.

U

ULTRASONIC

Beyond the range of human hearing. (see SUPER SONIC)

UNBALANCED

Wiring consisting of two conductors, usually one inside the other with the outer conductor shielding the inner conductor. The outer shield is connected to ground or chassis and the inner conductor carries the signal. Virtually all hi-fi signal wiring is of the unbalanced type, as is wiring inside TV sets, audio mixers and other audio equipment. (see FLOATING)

UNITY GAIN

No gain or loss. A device with unity gain would produce the same voltage at its output as the voltage applied at its input.

V

V-A

Volt-Ampere. Like watts, VA is used to describe the product of volts multiplied by amperes, but in circuits that exhibit reactance.

VCA

Voltage Controlled Amplifier. An amplifier whose gain can be controlled by varying an external D.C. voltage. Since this D.C. voltage is relatively simple for computers to provide, the inclusion of VCAs in mixers and mixing consoles simplifies remote control of volume levels or memorized mixing functions.

VOICE COIL

A coil of wire within a magnetic field in a loudspeaker, which produces magnetic fields in response to signals from audio power amplifiers. These fields cause the voice coil to move within the stationary magnetic field of the loudspeaker, moving the diaphragm attached to it and the air touching the diaphragm.

VOICING

The equalization of sounds produced by a system such as a piano or a loudspeaker so that the audio spectrum is produced evenly with all notes or frequencies at the same volume.

VOLUME
A popular term used to denote sound intensity level.

W

WATT
The watt is the power which gives rise to the production of energy at the rate of 1 joule per second. (see JOULE)

WAVELENGTH
The length of waves (from crest through trough to crest) produced by propagating sound, light or electromagnetic radiation. All radiation produces waves. Sound is the slowest propagating wave, traveling approximately 344 meters or 1130 feet per second. Thus sound waves produced by a 1000 Hz tone are about 0.344 m or 1.13 foot in length (1000 per second divided by 1000 = one cycle = one wavelength). Light and electromagnetic radiation in the vacuum of space travel at 299,792.4563 meters or about 186,282 miles per second. Visible light waves are on the order of 450 to 700 nanometers or 17 to 28 trillionths (10^{-12} or 0.000000000028) of an inch in length.

WAVEFORM
The shape of the wave produced by a sound. Such shapes depend on the content of harmonics of the sound, and can be viewed on an oscilloscope fed by a microphone or other sound signal source.

WEBER
The weber is the SI unit of magnetic flux. The weber is abbreviated with upper case W, lower case b (Wb). The concept of flux can be tricky to state. The International General Conference on Weights and Measures used the following wording to define the weber: The weber is the magnetic flux which, linking a circuit of one turn, produces in it an electromotive force of 1 volt as it is reduced to zero at a uniform rate in 1 second.

WET
The addition of reverberation to audio program source material makes the sound "wet" referred to "dry" sounds with no reverberation. (see DRY)

WHITE NOISE
(see NOISE)

WOOFER
A loudspeaker designed to reproduce low-frequency sound only. Some woofers are called full-range loudspeakers and are used alone e.g. ceiling speakers. Woofers in systems are usually used below about 3000 Hz.

X

XFMR
An abbreviation for "transformer."

XL or XLR CONNECTOR
Typically, a three-pin plug or receptacle with a metal shell, used for microphone cables and line level signal-carrying cabling.

Y

Z

Classified

NOW YOU CAN SOLVE incompatibility problems. Low cost conversion of consumer audio equipment to professional, balanced inputs and outputs with 40 dB level adjustment range and 600 ohm drive capability. Exclusive report explains proven design considerations, includes schematics, parts lists and source of boards and components. $5.00.

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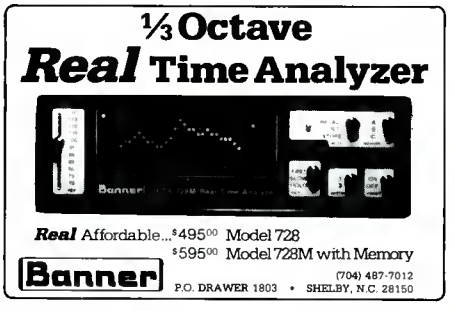

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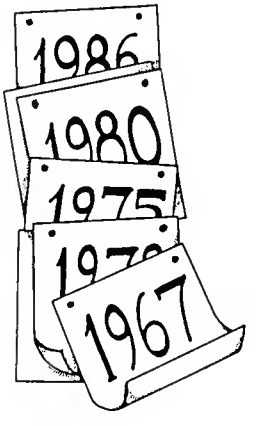

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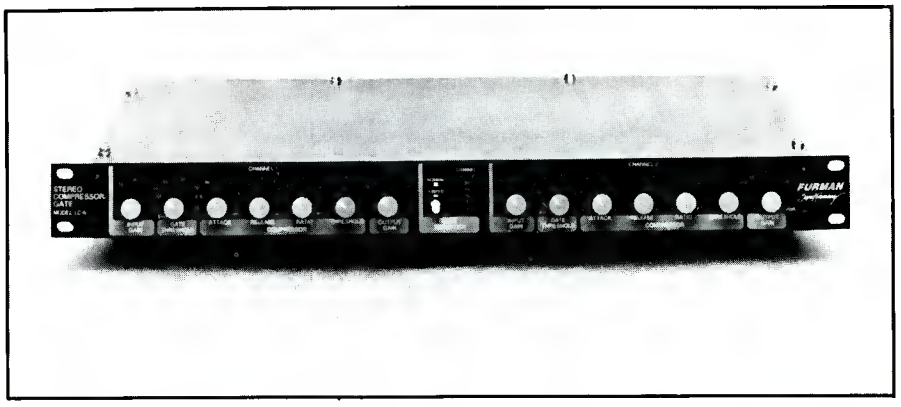
New Products

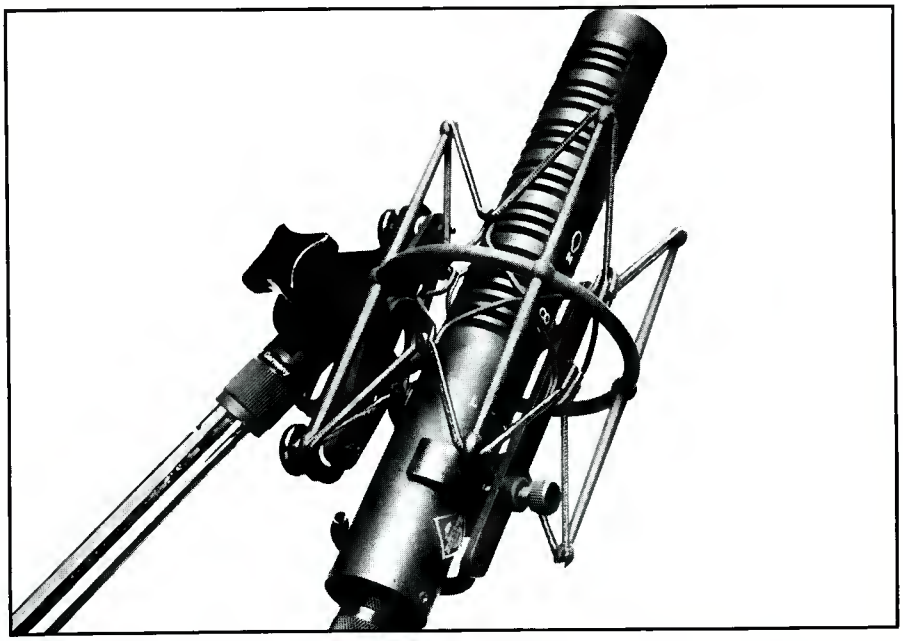
COMPRESSOR/GATE



• Furman Sound introduces the LC-6 stereo compressor/gate. It is two complete limiter/compressor/noise gates in a single rack-space chassis. Its gain processing is smooth, and its noise level is low. The two channels may be used independently or linked for stereo via a pushbutton switch. Each channel has a complement of seven controls and a bargraph LED meter indicating the amount of gain reduction. The input and output gain controls are calibrated directly in decibels. In the compress section, there are threshold, attack (100 μS to 1 sec), release (0.05 to 5 sec), and ratio (1.4:1 to full limiting) controls. The fast-attack noise gate may be used simultaneously with the compress section; each threshold may be set anywhere from -20 to +20 dBV. The gate provides 35 dB of attenuation when closed. Side-chain input and output jacks are provided on the rear panel to allow access to the LC-6's detector circuit. This permits patching in an equalizer to provide frequency-selective compression, or for special effects such as ducking a musical background under an announcer's voice.

Mfr.- Furman Sound, Inc.
Price- $419.00
Circle 70 on Reader Service Card

SHOTGUN MIC

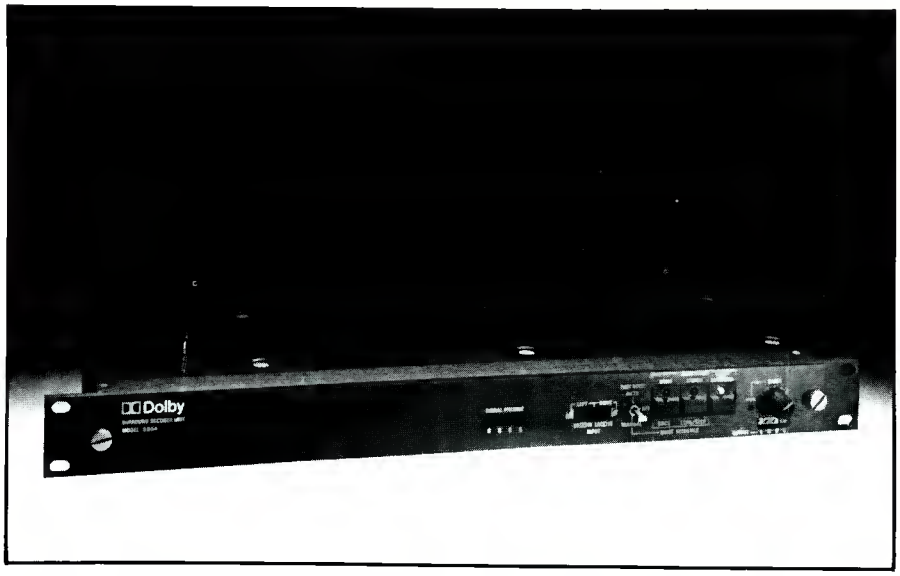


• Neumann introduces the RSM 190S condenser stereo shotgun microphone system. The RSM 190S uses the Mid-Side (MS) intensity stereo technique. It uses a hypercardioid capsule with a short interference tube for the M microphone. This gives it the "reach" associated with a short shotgun. The S microphone consists of a newly developed bi-directional capsule. Both capsules mount inside the interference tube. The RSM 190S systems consist of the following: RSM 190 mic, WSR 30 foam windscreen, KT 3 (5 meter) interconnect cable, MTX 190 active matrix box, AC 20 adapter cable, two IC 3/25 cables and an aluminum carrying case. Additional accessories include the SM 190 super mount with handle and FPY-5/8 mic boom yoke from Lightwave Systems in California.

Mfr.- Gotham Audio
Price- $2445.00
Circle 71 on Reader Service Card

SURROUND DECODER

• Dolby Laboratories, of San Francisco, California, announced the first professional Dolby Surround decoder, the SDU4, for studio installation. The SDU4 is designed for reference monitoring of Dolby Stereo or Dolby Surround program material in broadcast, audio-for-video and music recording applications. The installation of the SDU4 is primarily intended for facilities whose electro-acoustical properties conform to international standards for wide-range audio monitoring. The input program material can originate from any reasonably stable two-channel source such as video tape, motion picture film or stereo broadcast. Using the SDU4, compatibility in mono, conventional stereo or in fully decoded surround playback mode can be checked. The unit can also derive a center output signal for monitoring the mono compatibility of conventionally produced stereo material.



Mfr.- Dolby Laboratories
Price- $2200.00
Circle 72 on Reader Service Card

TURNTABLE

• Parasound Products Inc. has introduced the PST-1200 studio turntable. The PST-1200 is a manual, direct drive unit employing a Japan Victor DD motor and diecast aluminum platter with full speed start up in about a half revolution. Wow and flutter is less than .02 percent. A felt mat is supplied to facilitate slip-cueing and back cueing. The ±8 percent pitch control is located alongside the illuminated stroboscope. A pop-up cueing light retracts for transit. Start/Stop circuitry is accessed by both a large button on the unit as well as a rear panel jack and relay which may be used with a simple SPDT switch. Solenoid braking is indicated by an LED. The S-arm uses a standard bayonet shell and very low friction bearings for smooth operation. Calibrated anti-skating adjustment is also provided. Audio outputs are at gold plated RCA jacks and transferred by separate audio cords also with gold-plated plugs (supplied). The unit weighs 23 lbs.

Mfr.- Parasound Products Inc.
Price- $300.00

Circle 73 on Reader Service Card

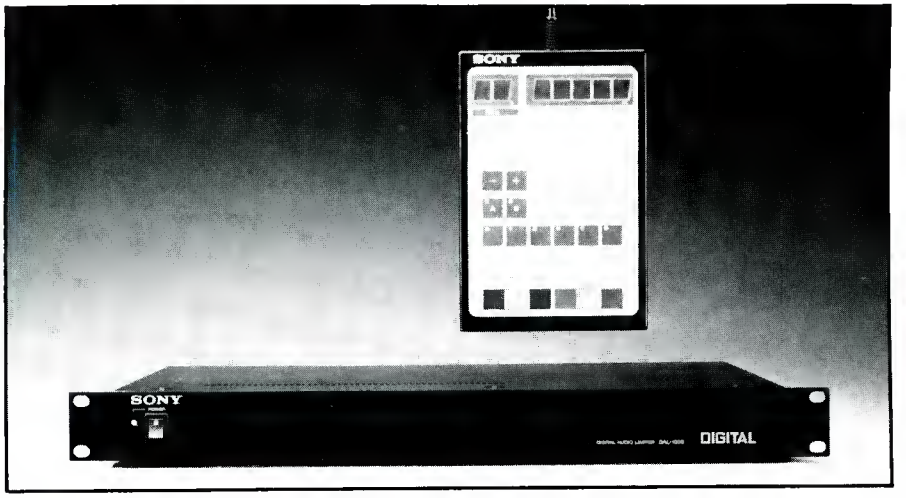
RACK SYSTEM

Circle 74 on Reader Service Card

• Klip Industries Co. has introduced "AudioRak," a rack system of anodized aluminum, available in brushed silver and brushed black. AudioRak can be supplied in front rack mount or in shelf version, and in standard sizes (36-inch, 48-inch, 60-inch and 72-inch). All units are semi-assembled for quick set up. AudioRak can be designed in any size or height per requirements. The system can be supplied with optional side panels and casters. Speednuts are used for Front Rak mount faceplates to hold them to uprights allowing for quick removal and replacement.

Mfr.- Klip Industries Co.
Price: range $204.95 to 314.95

DIGITAL EQUIPMENT



• The DAL-1000 digital audio limiter, the DMU-30 digital remote meter and new software for the PCM-3324 system provide greater control and flexibility to producers and engineers working with Sony digital equipment. The DAL-1000 is able to achieve "0 word" attack time. The compressor/limiter is also capable of six programmable preset memories for parameter setup, operates at three sampling frequencies (44.056 kHz, 44.1 kHz, 48 kHz) and uses a wired remote control for quick access from the console. Interface is possible with both Sony digital and AES/EBU formats. The DAL-1000 is 19 inches wide, 1-3/4 inches high and 12-5/8 inches deep. The DMU-30, digital remote meter, features a 32-segment LED-type metering section, as is found in the PCM-1630. This section provides a reference marker, capable of setting reference signal level within a range of -10 dB to -20 dB; a meter fine mode, for easier, more precise reading of the signal level in steps as large as 0.2 dB, and peak hold/auto peak hold, which holds the peak level until a higher peak occurs. The introduction of software for the PCM-3324 system enhances digital multi-track recording and editing with more options and flexibility. To be used with the RM-3310 remote controller, the new software makes it possible to change cross fades within the range of 1-1/2 milliseconds to 370 milliseconds. The enhanced remote controller also allows engineers to change the speed of the PCM-3324 within a ±12 percent range. For the increasingly important electronic editing function of the 3324s, a special mode is designed to facilitate more direct commands during the editing process. The PCM-3324 software enhancements will be available in December 1987 and for a limited time at no charge.

Mfr.- Sony Corporation
Price- $3,200.00 (DAL-1000)
$2,625.00 (DMU-30)

Circle 75 on Reader Service Card

People, Places... & Happenings

• **Delos International, Inc.** president **Amelia Haygood** offers congratulations on 25 years in audio engineering to **John Eargle**, sound engineer, author, educator, audio consultant and director of recording for the Santa Monica-based classical and jazz label. Mr. Eargle, who began his recording work in 1962 for **RCA Records**, was honored with a champagne reception during the recent Audio Engineering Society convention in New York.

We, at **db Magazine**, who have known John Eargle for most of those 25 years also offer congratulations.

1987 INDEX

INDEX BY TITLE

INDEX BY COLUMNIST

INDEX BY AUTHORS

Model	Dimensions, H,W,D	Cabinet Finish	Front Screen Finish	Impedance, ohms	Frequency Response +/- dBs	Bass Speaker Size, in.	Bass Speaker Type	Midrange Speaker Size, in.	Midrange Speaker Type	High-Frequency Driver, Size	High-Frequency Driver, Type	Crossover(s)	Weight, lbs.	Price	Features
ALTEC LANSING CORPORATION															
9872-8F	21.02 17.76 9.02	tan paint	tan cloth	8	80-20k	12	cone			horn		2k	43.5	$716.00	2-way, high SPL, small package, controlled wide angle pattern for improved off axis listening.
9812-8A	13.3 26.5 17.52	gray poly paint	black cloth	8	60-13k	16	cone			horn		500	105.4	$1700.	
310	23 14.6 12.25	oak grain vinyl	black fabric	4/8	65-20k 4	10	cone	4	cone		cone	3k/ 10k	30	$252.00	Small enough to hang on wall. Contains 25 watt amp.
312	29.1 16.2 12.2	walnut grain vinyl	black knit fabric	4/8	55-20k 4	12	cone	5	cone		cone	1.2k/ 7k	41	$340.00	Low distortion, wide dyn. range.
9813B	25.5 15.5 13.5	rift-cut oak	black knit fabric	8 8	60-20k 80-20k	10 12	cone cone	4	cone		horn horn	700/ 5k 2k	27 43	$576.00	Full range featuring high SPL from a small package. $696.00
APOGEE SOUND, INC.															
AE-2	10.5 32 10	black tex/ paint	grey foam	16	63-19k	2-8 cone				1-in 3x5	horn	4k	38	$1025.	Unique wide angle design, works as under or over balcony speaker, choir monitor, or single source appl(s).
AE-3	16 12.5	black tex/ paint	grey foam	8	70-18k 4	10 10	cone			1-in 3x5	horn	4k	40	$620.00	Tremendous power/size in vocal range ratio, commercial mount fittings available.
AE-5	23 14 16	black tex/ paint	grey foam	8	53-17k 4	12	cone			1-in 5x13.5	horn	1k	78	$2045.	Exceptionally clean, natural high freq. repro., designed to form large arrays from small building blocks.
AE-6	14 23 15.5	black tex/ paint	grey foam	8	53-17k 4	12	cone			13.5 5	horn	1k	78	$2065.	High power, wide range output, multi-angle design, polar response for optimum stage coverage.
AE-10	22.5 32 24	black tex/ paint	grey foam	8 4	38-120	2-15	cone					100	138	$1625.	Powerful bass reproduction from minimum size, designed for efficient truck pack.
AE-12	30 44.8 22.5	black tex/ paint	grey faom	8	35-120 4	18 (2)	cone					100	60	$1910.00	Excellent transient response, designed for efficient truck pack, built-in rigging hardware.
3x3	45 29 30	black tex/ paint	grey foam	L-8 M-8 H-16	53-19k 4	15 (2)	cone	2.13 28	horn	2x3	horn	1040 7.6k	265	$3985.	Extremely high power, wide range output, fully horn loaded, designed to array for concert sound rein.

Model	Dimensions, H,W,D	Cabinet Finish	Front Screen Finish	Impedance, ohms	Frequency Response +/- dBs	Bass Speaker Size, in.	Bass Speaker Type	Midrange Speaker Size, in.	Midrange Speaker Type	High-Frequency Driver, Size	High-Frequency Driver, Type	Crossover(s)	Weight, lbs.	Price	Features
BOSE CORPORATION															
802-II	13.5 20.5 13	black formed foam	black plastic cloth	8 3	50-16k	4.5	cone	4.5	cone	4.5	cone range	full	31	$826.00	Uses eight 4.5-in. identical helical voice coil drivers, delivers clean natural sound, high power handling.
402	23.25 8.125 7.25	black formed foam	black plastic cloth	8 3	90-16k	4.5	cone	4.5	cone	4.5	cone range	full	15	$508.00	Smaller than the 802-II, ideal for extreme portability.
Acous-16 ti-mass	black 22.25	black formed	N/A steel		50-18k 3	12	cone woofer	4.5	cone	4.5	cone	200	72	$2500.	Features an integral digital switchmode amplifier, capeable of delivering 122dB SPL in music appl.
101-MM	6 9 5	black formed foam	black steel mesh	4	90-16k	4.5	cone					5		$126.00	Natural, transparent sound for near-field monitoring applications.
CARVIN MFG. CORP. See our ad on Cover III															
850H	26 20 14	ozite	black metal	8	60-20k	15	cone			5x15	horn	1.4k	56	$269.00	Bi-ampable full range, 150 watt RMS (300 watts peak).
960H	31 24 15	ozite	black metal	8	55-20k	15	cone			5x15	horn	1.4k	80	$319.00	Increased bass punch in a port/horn loaded speaker sys., full range rein ***
980H	32 24 18	ozite	black metal	8	50-20k	15	cone	5x15	horn	3x4	tweet	1.4k 5k		100 $399.00	Offers wider response and in depth from a 3-way port/loaded sys. Compact, high SPL.
1330 H	32 28 24	ozite	black metal	8	55-4k	15	cone						100	$270.00	Woofer system in a horn/port loading technology. Offers natural bass response quality and off-axis response.
R-550H	H12 28 22	ozite		16	500-18k			7.25 24.7	horn			1.4k	55	$329.00	Exponential upper midrange horn with Renkus-Heine SSD-1800 driver.
3000E	24 42 24	ozite		4	50-500	18	cone					500	130	$419.00	Folded bass bin designed for maximum output from a positive pressure sys. Long throw characteristics.
1200E	16 28 22	ozite	black metal	8	160-4k	12	cone					2k	78	$279.00	Features EVM Pro-Line 12-inch woofer for natural mids. It is a classic loaded midrange designed cabinet.
820H	22 17.5 12	ozite	black metal	8	70-20k	12	cone			3.5x 10	horn	1.4k	43	$219.00	A small full range P.A. in a compact enclosure, for small clubs, bands, keyboards.

Model	Dimensions, H,W,D	Cabinet Finish	Front Screen Finish	Impedance, ohms	Frequency Response +/- dBs	Bass Speaker Size, in.	Bass Speaker Type	Midrange Speaker Size, in.	Midrange Speaker Type	High-Frequency Driver, Size	High-Frequency Driver, Type	Crossover(s)	Weight, lbs.	Price	Features
CETEC-GAUSS See our ad on page 21															
5350	32 21.8 14.75	black paint	black plastic	8 5	45-20k	15	cone	10	cone	5	horn	800/ 3k	87	$1495.00	200 watts RMS, club system, 98dB sens.
5280	34.75 24 16.25	brown carp	black plastic	8 5	40-15k	18	cone		15	7.5x	horn	1.5k	100	$1215.00	200 watt RMS P.A. sys. 104dB sens.
5220	28 19 13	black paint	black plastic	8 5	60-16k	12	cone		15	7.5x	horn	1.6k	66	$1165.00	200 watt RMS P.A. sys. 98dB sens.
COMMUNITY LIGHT AND SOUND, INC.															
CS35	23.75 17.25 13.5	black carpet	black cloth	8	60-18k 5	15	cone			PZT	horn	2.5k	43	$319.00	Available in wood grain formica.
CS28M	14 15 23	black carpet	black cloth	8	70-18k 5	12	cone			PZT	horn	3k	32	$297.00	Available in wood grain formica.
CS25	18.25 15 13.5	black carpet	black cloth	8	70-18k 5	12	cone			PZT	horn	3k	32	$269.00	Available in wood grain formica.
CS45	33.5 18 18	black carpet	black cloth	8	50-18k 5	12	cone			PZT	horn	3k	80	$490.00	Available in wood grain formica.
CS70	26.75 33.5 18	black carpet	black cloth	4	45-18k 5	12	cone	2	horn	PZT	horn	700/ 4k	135	$899.00	Sens. is 105dB (1w,1m), 1500 watts, available in wood grain formica.
CS60B	33.5 33.5 22	black carpet	black cloth	4	35-800	15	cone					150	150	$888.00	Sens. is 105dB (1w,1m), 1500 watts, available in wood grain formica.
CS52	33.5 18 18	black carpet	black cloth	4	40-20k 5	15	cone	6.5	cone	PZT	horn	500/ 5k	82	$549.00	Equally suited for studio monitoring, available in wood grain formica.
CS38M	17.5 17.5 25	black carpet	black cloth	8	60-18k 5	15	cone			PZT	horn	2.5k	41	$349.00	Available in wood grain formica.
ELECTRO-VOICE															
MTH-4	36 36 30	black carpet	nylon cloth	2x4 8/8	160-20k 3	10 (4)	CD horn (4)	2 horn	CD (4)	1.25 CD horn(4)		160/ 1.6k	357	$4675.	3-way active horn loaded Manifold technology for high level concert sound reinforcement.
MTL-4	36 36 30	black carpet	nylon cloth	2x4	40-200	18 (4)	cone						263	$2825.	Low frequency system for high-level concert sound reinforcement.
S- 1803	35.5 28 19.4	black carpet	steel	8	50-16k 3	18	cone	6	VMR	1	CD horn	600/ 4k	134	$1242.	200 watt 3-way keyboard system with high acoustic output and efficiency

Model	Dimensions,H,W,D	Cabinet Finish	Front Screen Finish	Impedance,ohms	Frequency Response +/- dBs	Bass Speaker Size,in.	Bass Speaker Type	Midrange Speaker Size,in.	Midrange Speaker Type	High-Frequency Driver,Size	High-Frequency Driver,Type	Crossover(s)	Weight,lbs.	Price	Features
S-1503	28.7 24.4 13.8	black carpet	steel	8	65-16k 3	15	cone	6	VMR	1	CD horn	600/ 4k	105	$992.00	Similar to above.
SH-1810	47.6 24.8 24	black carpet	steel	8	35-20k	18	cone	10	CD horn	1	CD horn	250/ 2.5k	153	$2052.	300 watt 3-way full-range all-horn loaded frontal system for high SPLs biamp-able with tweeter protection.
SH-1810S	32.8 24.8 11.2	black carpet	steel	8	35-20k	18	cone	10	CD horn	1	CD horn	250/ 2.5k	112	$2190.	Similar to above but packaged as a modular system with separate sub-woofer and mid/high cabinets.
S-200	24 15 8.5	molded plastic	steel	8 3	50-15k	12	cone			1.5 Dome	Super	2k	36	$1398.	300 watt full range, can be carried in one hand. Constant directivity over 100 degree by 100 degree area.
SH-1502 ER	31.9 24.7 16	black carpet	steel	8	62-20k 3	15	cone			1	CD horn	1.6k	81	$580.00	200 watt, extended range features titanium high-frequency driver.
SH-1512 ER	31.9 24.7 16	black carpet	steel	8	55-20k 3	15	cone			1	CD horn	1.6k	75	$610.00	Similar to 1502ER but with direct radiating woofer for extended bass.
GALAXY AUDIO															
Hot Spot	6.75 10.94 6	black white	charc foam	16	100-18k 6	(2)5-inch cone drivers							8		Compact stage monitors. ***
Hot Spot V.C.	6.75 10.94 6	black white	charc foam	16	100-18k 6	(2)5-inch cone drivers							8		Same as above with a volume control.
Hot Spot P.A.	6.75 10.94 6	black white	charc foam	8	100-18k 6	(1)5-inch cone driver							9		Powered monitor with 35watt amplifier, dual inputs, mixable, with 3 bands of 3 EQ. Doubles as small P.A.
Pro Spot	19 27 13.5	simul. wood	color foam	8	80-20k 6	15	cone	5	cone		piezo	330/ 10k	42		
JBL PROFESSIONAL															
G-730	21 17.9 11.5			8	70-17k	12	cone			2	horn	2k		$447.00	P.A. stage system. 102dB sensitivity (1w,@ 1m), 300w program power.
G-732	32.3 24 17.3			8	45-17k	15	cone			2	horn	1.5k		$597.00	P.A. stage system. 104dB sensitivity (1w,1m), 300w program power.
G-733	20.25 26.25 12.75			8	50-17k	10	cone	8	cone	3	horn	3k		$549.00	P.A. stage system, 102dB sens., 400w program power.

Model	Dimensions,H,W,D	Cabinet Finish	Front Screen Finish	Impedance,ohms	Frequency Response +/- dBs	Bass Speaker Size,in.	Bass Speaker Type	Midrange Speaker Size,in.	Midrange Speaker Type	High-Frequency Driver,Size	High-Frequency Driver,Type	Crssover(s)	Weight,lbs.	Price	Features
G-734	27 22 11.3			8	50-17k	15	cone			2	horn	1.5k		$429.00	P.A. stage monitor, 102dB sens., 300w program power.
G-731	16 18.25 21.75			8	70-17k	12	cone			2	horn	2k		$468.00	P.A. stage monitor, 103dB sens., 400w program power.
4599B	40.2 29.6 18.8			4	35-20k	18	cone	10	cone	3	horn	500/ 2k			Sensitivity is 103dB (1w,1m).
JOE'S SOUND AND SALAMI CO.															
15UL	24 19 18	black spakle	black metal		40-2k	15	cone						40	$370.00	Ultra-light cabinet utilizes honey-comb/birch construction. Delivers clean, tight bass at high SPLs.
15AA	24 18 17	black spakle	black metal		50-2k	15	cone						55	$401.00	Available in "PRO" line (constructed from rigid wood-chemical alloy) and "CBB" formats.
18AB	30 24 22	black spakle	black metal		35-1k	18	cone						75	$529.00	This "PRO" unit is a highly compact subwoofer for reinforcement and instrument use. Extra 3dB below 200Hz.
18MW	48 30 22	black spakle	black metal		35-1k	18	cone						120	$849.90	Highly compact subwoofer for reinforcement and instrument use. 3dB louder below 200Hz.
MEYER SOUND LABORATORIES, INC.															
UPM-1	18 6.75 7	black tex	grey foam	16	70-20k 4	5	cone	5	cone	2x5 horn	piezo	17		$900.00	Ultra compact, high power, arrayable, freq. response alignment circuitry, driver protection.
UPA- 1A	23 14 14.5	black tex	grey foam	8/ 16	55-16k 4	12	cone				horn 60 x90dg.	1.6k	66	$2490.	Compact, high power, biamplified system, arrayable, with recessed handles.
MSL- 3	57 21.25 30	black tex	grey foam	4/ 8	75-20k 4	12 (2)	cone		horn 70deg. radial		piezos		265	$4590.	High power, arrayable, large scale VHF tweeter array, biamplified system, THD < 0.1% at max. rating.
500 ser- ies	32 20 14	black tex		8	30-16k	15	cone				horn	1k	110	$5390.	Includes 2 speakers and 1 amplifier Amp: 1200 watts total, DC protected
650- R2	45 30 22.5	black tex	grey foam	4	30-100 4	18 (2)	cone						180		Sub woofer, high power, vented, drivers capeable of long excursion, Baco tread self-lube casters.
USW-1	22.5 31 19.25	black tex	grey foam	4	40-100 4	15 (2)	cone						125		Sub woofer.

Model	Dimensions,H,W,D	Cabinet Finish	Front Screen Finish	Impedance,ohms	Frequency Response +/- dBs	Bass Speaker Size,in.	Bass Speaker Type	Midrange Speaker Size,in.	Midrange Speaker Type	High-Frequency Driver,Size	High-Frequency Driver,Type	Crossover(s)	Weight,lbs.	Price	Features
PEAVEY ELECTRONICS CORPORATION															
115 Int	21.8 30.5 16.75	carpet	black grille cloth	8	50-20k 3	15	cone	1	horn	rng twet	sup	800/ 1.2k	85	$549.00	Three-way Xover,BlackWidow, Structure Speaker.
112 IntÁ	23.75 16.75 12	carpet	black grille cloth	8	75-20k 3	12	cone	1	horn	rng	sup	2k	63	$499.00	Three-way Xover, 12-inch coaxial.
SP-4	52.75 25.75 19.25	carpet	black grille cloth	8	40-16k	15 (2)	cone	1	horn		horn	1200	135	$649.00	Two-way, powered, passive Xover, trapezoidal design.
SP-2	31.06 23.69 17.06	black paint	black grille cloth	8	60-16k 3	15	cone	1	horn		horn	800/ 1.2k	93	$470.00	Two-way, 90 by 45 degree dispersion, stand adapter.
HDH-1	59.25 27 27	carpet	black grille cloth	H-8 M-8 L-4	40-16k 3	15 (2)	cone	12	cone	2	horn	300/ 1.2k	256	$1699.	Aeroquip flying hardware, manifold configuration, high power handling.
3020 HT	38.38 36.5 18.25	carpet	black metal	4	45-20k 3	15 (2)	cone	10 (2)	cone	1	horn sup	250/ 500/ 1.2k	161	$899.00	Four-way, high level, wide bandwidth, passive Xover.
1510 HT	30.25 25 14.25	carpet	black metal	8	55-20k 3	15	cone	10	cone	rng	sup	250/ 500	83	$499.00	Compact three-way, one Scorpion Plus, one 10-inch Supertweeter.
118 IntÁ	36.75 26.63 20.5	carpet	black grille cloth	8	40-20k 3	18	cone		horn	1	sup	800/ 1.2k	133	$599.00	1801-8 Black Widow, CH-3 horn, HT94 Supertweeter.
RAMSA PANASONIC															
WS-A10	6.13 9.81 6.13	bk/wh molded resin	bl/wh metal	6	80-16k	4.75	cone					5.8k		$100.00	Compact, thermally protected, magnetic shielding (isolates from A/V equip.), various mounting hrdwr opt
WS-A80	11.13 17.06 9.312	bk/wh molded resin	bl/wh metal	8	65-18k	8	cone				CD horn	2.5k	16.5	$250.00	Compact, thermal prot., carrying handle, optional brackets. Doubles as a stage monitor.
WS-A200	15.56 21.94 10.75	bk/wh molded resin	bk/wh metal	8	70-20k	12	cone				horn	2.5k	35	$475.00	Thermal prot., can be stacked or easily mounted to walls or ceilings.
WS-A240	15.56 21.94 10.75	bk/wh molded resin	bk/wh metal	8 3	35	12	cone						35	$349.00	Vented sub woofer, stackable, can be configured to take advantage of coupling effects.

Model	Dimensions,H,W,D	Cabinet Finish	Front Screen Finish	Impedance,ohms	Frequency Response +/- dBs	Bass Speaker Size,in.	Bass Speaker Type	Midrange Speaker Size,in.	Midrange Speaker Type	High-Frequency Driver,Size	High-Frequency Driver,Type	Crossover(s)	Weight,lbs.	Price	Features
RENKUS-HEINZ INC.															
FRS121 B		black carpet	black metal	8		12	cone			1	horn 70x110deg.	1.6k	42	$996.00	
FRS 151 B		black carpet	black metal	8		15	cone			1	horn 55x95deg.	1.6k	75	$1080.00	
FRS 152 B		black carpet	black metal	4		15	cone (2)			1	horn 55x95deg.	1.6k	121	$1450.00	
FRS 152DB	48.25 20.25 18.25	black carpet	black metal	4		15	cone (2)			2	horn 55x95deg.	1.2k	125	$1560.00	
SR-121		black carpet	black metal	8		12	cone			1	horn 50x90deg.	smart	44	$1398.00	
SR-1		black carpet	black metal	8		15	cone			2	horn 55x90deg.	smart	70	$1576.00	
SR-2		black carpet	black metal	8		15	cone (2)			2	horn 40x60deg.	smart	120	$2520.00	
MR-1 Stack		black carpet	black metal	4 8 4		18	cone (4)	2.4	horn 60x 80deg	2 55x 5deg	horn (2)	smart	506	$8740.00	
SHURE BROTHERS INC.															
3200	24.88 16.63 12.38	black vinyl	black metal	8	60-13k	12	cone			1.5	horn	2k	38	$450.00	Time Sync Xover reduces phase distortion, uniform on/off axis resp. 98dB SPL (1w,1m).
TANNOY NORTH AMERICA INC.															
B-50	19 14 16	black paint	black metal	8	50-20k 4	12	cone			2	horn	2.2k	46	$798.00	Dual concentric driver, point/source phase coherent,high SPL, arrayable (central clusters).
P-100	29 19 16	black paint	black metal	8	50-20k 4	15	cone			2	horn	1.8k	75	$998.00	Same as B-50 (driver size change).
J-200	29 29 20	black paint	black metal	8	35-20k 4	15	cone			2	horn	1.8k	110	$1168.	Same as above, different driver.
C-150	29 19 20	black paint		8	40-110 4	15	cone					110	74	$1118.	Small tandum tuned, allows for extended low freq. response and ease of placement.
T-300	42 29 30	black paint	black metal	4	45-170 4	15 (2)	cone					170	181	$1698.	Twin 15-in. direct radiating bass bin, flat at high SPLs.

Model	Dimensions,H,W,D	Cabinet Finish	Front Screen Finish	Impedance,ohms	Frequency Response +/- dBs	Bass Speaker Size,in.	Bass Speaker Type	Midrange Speaker Size,in.	Midrange Speaker Type	High-Frequency Driver,Size	High-Frequency Driver,Type	Crssover(s)	Weight,lbs.	Price	Features
YAMAHA MUSIC CORPORATION See our ad on page 18															
S300	28.8 22.5 15.4	black poplar plywd	stym mesh	8	50-20k	15	cone	8	cone	comp drvr		800 4k	65	$615.00	Wide dispersion reinforcement system
S4115 HII	32.4 25 18.4	black plywd	black metal mesh	8	50-16k	15	cone	1.7	comp driver			1.2k	97	$645.00	Horn loaded, bass reflex, carbon fiber cone, C.D. horn. ***
S2115 HII	22.4 26.5 26.4	black plywd	black metal mesh	8	50-16k	15	cone	1.7	comp driver			1.2k	77	$615.00	Stage monitor version of S4115HII.
SW-118A	29.4 25.2 18.4	black plywd	black metal mesh	8	30-2k	18	cone					sub	95	$545.00	Bass reflex.
YORKVILLE SOUND															
Elite SW600	26.5 22 21	black ozite	black metal	8	50-1.4k 3	18	cone						95	$595.00	Max SPL is 127dB, includes speaker stand adaptor, speaker protection.
Elite SW-1000	42.5 28 22	black ozite	black metal	4	38-1.4k 3	18	cone (2)						165	$1150.	Max SPL is 132dB, includes speaker protection and castors.
Elite M160M	16.5 12.5 17.25	black ozite	black metal	8	50-16k 3	10	cone			9 5	horn	4k	33	$425.00	Max SPL is 118dB, speaker protection
Elite M600M	19 23 18	black ozite	black metal	4	50-16k 3	10	cone (2)		9	horn 5		1.8k	77	$845.00	Max SPL is 130dB, includes speaker stand adaptor, speaker protection.
Elite M160	17.5 13 12	black ozite	black metal	8	65-19k 3	10	cone			9 5	horn	4k	33	$395.00	Max SPL is 118dB, speaker stand adaptor, speaker protection.
Elite M400	22.5 19.25 13	black ozite	black metal	8	60-20k 3	10	cone (2)			5 5	horn	4k	62	$645.00	Max SPL is 123dB, speaker stand adaptor, speaker protection.
Elite M600	19 23 13	black ozite	black metal	4	50-16k 3	10	cone (2)			9 5	horn	1.8k	77	$825.00	Max SPL is 130dB, speaker stand adaptor, speaker protection.
Elite MX1000		black ozite	black metal	4 3	55-19k	15 (2)	cone			16 5.5	horn	2.5k	154	$1050.	Max SPL is 135dB, speaker protection, castors included.

MONITOR SPEAKERS

Model	Dimensions, H, W, D	Cabinet Finish	Front Screen Finish	Impedance, ohms	Frequency Response +/- dBs	Bass Speaker Size, in.	Bass Speaker Type	Midrange Speaker Size, in.	Midrange Speaker Type	High-Frequency Driver, Size	High-Frequency Driver, Type	Crossover(s)	Weight, lbs.	Price	Features
ALTEC LANSING															
937	24 18 16.25	black tex paint	black grille	8	70-15k	12	cone				horn	3k	46	$844.00	Monitor/P.A. system, small, light, efficient, well suited for stand mounting.
9842- 8A/8D	24.1 28.1 14	gray poly paint	black grille	8	35-20k	16	cone				horn	1.5k	70	$1180.	For recording and broadcast. 96.7dB sensitivity.
9844- 8B	24 31 16	gray walnut veneer	black grille cloth	8	35-20k	12 (2)	cone				horn	800	90	$1500.	High efficiency for recording or broadcast, as well as reinforcement in churches and halls.
9849- 8B	24 20.5 15.25	gray lacq	black grille cloth	8	40-20k	12	cone				horn	1.5k	60	$1144.	Compact studio monitor, extended low response and high SPL.
APOGEE SOUND, INC.															
AE-1	16 10.25 8	black tex paint	grey foam	8	63-19k 4	8	cone			1-in 3x5	horn	4k	18	$350.00	Hi-fi response with low distortion, clean transparent reproduction of voice and music.
AE-6	14 23 15.5	black tex paint	grey foam	8	53-17k 4	12	cone			13.5 5	horn	1k	78	$2065.	Extremely high power, wide range output, multi-angle design, unique polar response for optimum coverage.
CARVIN MFG. CORP. See our ad on Cover III															
750H	22 18 13	ozite	black metal	8	70-20k	12	cone			3.5x 10	horn	1.4k	43	$219.00	A full range monitor, narrow directivity and flat response makes it an excellent stage/vocal monitor.
790H	26 20 14	ozite	black metal	8	60-20k	15	cone			5x 15	horn	1.4k	56	$269.00	A full range monitor designed for high SPL instruments (drums, keys, etc.)
CETEC-GAUSS See our ad on page 21															
5225	16 23.6 16	black paint	black plastic	8 5	70-15k	12	coax					1.6k	50	$990.00	200 watt stage monitor. 100dB sens.
5226	16 23.6 16	brown carpet	black plastic	8 5	80-20k	12	cone			5	horn	3.6k	50	$805.00	400 watt stage monitor. 101dB sens.
7228	18 21.5 16.5	walnut	brown cloth	8	40-18k 3	12	coax					1.6k	73	$1480.	200 watt studio monitor. 91dB sens.
7258	24 29 19.5	walnut	brown cloth	8	40-18k	15	coax					1.2k	116	$1585.	200 watt studio monitor. 96dB sens.

Model	Dimensions,H,W,D	Cabinet Finish	Front Screen Finish	Impedance,ohms	Frequency Response +/- dBs	Bass Speaker Size,in.	Bass Speaker Type	Midrange Speaker Size,in.	Midrange Speaker Type	High-Frequency Driver,Size	High-Frequency Driver,Type	Crssover(s)	Weight,lbs.	Price	Features
COMMUNITY LIGHT AND SOUND, INC.															
RS440	32.75 25.5 24	black enamel		8	45-18k 5	15	cone	6.5	cone	1	horn	380/ 1.1k/ 12k	135	$1199.	Equally suited for performance. One piece glass-fiber face plate.
RS- 327i	32 19 18.125	black enamel	black cloth	8	45-18k 5	15	cone	2	P.C. horn	PZT	P.C. horn	450/ 3.5k	98	$730.00	Equally suited for performance. One piece glass-fiber face plate.
RS	24.5	black	black	8	60-18k	15	cone	2	P.C.	PZT	P.C.	450/	65	$665.00	Equally suited for performance.
325i	18.5 14.5	enamel	cloth		5				horn		horn	3.5k			One piece glass-fiber face plate.
RM 325i	25 18.8 22.5	black enam.	black cloth	8	60-18k	15	cone	2	P.C. horn	PZT	P.C. horn	450/ 3.5k	85	$765.00	Equally suited for performance. One piece glass-fiber face plate.
ELECTRO-VOICE															
FM- 1502	22 22.5 27.9	black carpet	steel	8	65-20k 3	15	cone		1	CD	horn	1.5k	72	$786.00	300 watt, 2-way constant directivity monitor with aligned, vented enclosure and durable construction.
FM- 1202	19.4 19.4 24.4	black carpet	steel	8	75-20k 3	12	cone		1	CD	horn	1.5k	65	$618.00	Similar to 1502, more compact.
Sen- try 100A	17.3 12 11.2	black vinyl	cloth covered	6 3	45-18k	8	direct			1.5	dome	2k	28	$265.00	High efficiency model with extended low range, uniform dispersion.
100EL	17.3 12 11.5	black vinyl	cloth covered	6 3	45-18k	6	direct			1.5	dome	2k	33	$545.00	Powered system with 100A features.
500	24 27 13	black vinyl	cloth covered	8 3	40-18k	12	direct			1.5	dome	1.5k	70	$520.00	For broadcast/recording uses. Has vented design and 50 watt amp.
505	19.5 25.6 18.75	black vinyl	cloth covered	8 3	40-18k	12	direct			1.5	dome	1.5k	60	$520.00	Similar to 500, designed to provide flat low freq. response in a quarter
FOSTEX See our ad on page 11															
RM765	15 9 8.7	matte		6.5	70-20k 3	6.5	coax cone			2	print ribn	5k	14	$250.00	Coaxial design for time and phase coherency and excellent imaging.
RM780	17 10 10.7	matte		6.5	58-20k 3	8	coax cone			2	print ribn	5k	19	$330.00	Near field monitors that handle high power levels.
RM865	24 13 13	matte		6	50-20k 3	10	cone	6.5	coax cone	2	print ribn	250/ 5k	45	$399.00	

Model	Dimensions,H,W,D	Cabinet Finish	Front Screen Finish	Impedance,ohms	Frequency Response +/- dBs	Bass Speaker Size,in.	Bass speaker Type	Midrange Speaker Size,in.	Midrange Speaker Type	High-Frequency Driver,Size	High-Frequency Driver,Type	Crssover(s)	Weight,lbs.	Price	Features
SP7	5 7 4.9	black paint	black metal	7.5	120-20k 3	4	cone						5.3	$99.00	
SP11	7 14 8.4	black plas	black metal	8	60-18k 3	4 (2)	cone						12	$240.00	Built-in power amp.
SPA11	7 14 8.4	black plas	black metal	8	60-18k 3	4							17	$349.00	
LS2	29 26 20	black		8	45-20k 3	12	cone		wood horn		horn	1.2k/ 7k		$1649.	Studio monitors.
LS3	36 31 29.5	black		8	38-20k 3	15	cone		wood horn		horn	1.2k/ 7k		$1999.	Has high efficiency, low distortion and wide dispersion.
RP 2001	51 21 11	black		6	30-45k 3	12								$1750.	Time coherent design.
RM- 800	15 8.63 8.63	black wood	dark blue	8	60-20k 3	6.5	cone		flat rib	CD	horn	6k	14		New RM design with high power (regulated phase) tweeter for smooth piston-like diaphragm excursion.
RM- 900	17 10.4 10.63	black wood	dark blue	8	55-20k 3	8	cone			flat rib	CD horn	6k	19		As above, both have wider dispersion for a larger "sweet spot" listening position. Phase and time coherent characteristics
JBL PROFESSIONAL															
4408	17.5 12 11.7			8	40-27k	8	cone				dome	2.5k		$225.00	89dB SPL (1w,1m), 100w program power
4410	23.3 14.5 11.5			8	35-27k	10	cone	5	cone		dome	800/ 4.5k		$357.00	91dB SPL (1w,1m), 125w program power
4425	25 16 14.8			8	40-16k	12	cone				horn	1.2k		$849.00	91dB SPL (1w,1m), 200w program power
4430	35.8 21.9 15.8			8	35-16k	15	cone				horn	1k		$1260.	93dB SPL (1w,1m), 300w program power.
4435	35.8 38 20.4			8	30-18k	15 (2)	cone				horn	1k		$1716.	96dB SPL (1w,1m), 350w program power.
Urei- 813C	36 31 26			8	40-18k	15 (2)	cone				horn	1.2k		$1996.	101dB SPL (1w,1m), 150w program power.

Model	Dimensions,H,W,D	Cabinet Finish	Front Screen Finish	Impedance,ohms	Frequency Response +/- dBs	Bass Speaker Size,in.	Bass Speaker Type	Midrange Speaker Size,in.	Midrange Speaker Type	High-Frequency Driver,Size	High-Frequency Driver,Type	Crossover(s)	Weight,lbs.	Price	Features
Urei- 815C	32 43.3 24			8	40-18k	15 (3)	cone				horn	1.2k		$2496.	103dB SPL (1w,1m), 150w program power.
Con- trol- 15	15.25 9.875 9			4	75-20k	6.5	cone				dome	3k		$297.pr	92dB SPL, 175w program power. mounting brackets and accessories are available.
JOE'S SOUND AND SALAMI CO.															
18UPS	24 21 16	black spakle	black metal		50-500	18	cone					40		$407.00	Ultra-light cabinets, allow musicians to have the performance of an 18-inch speaker.
SA12	28 14 17	black spakle	black metal		70-18k	12	cone			1	horn	1.6k	55	$780.00	Slide-Align is a solution to an acoustic problem. Moving the high component eliminates time offsets.
12BE	18 15 14	black spakle	black metal		70-2k	12	cone						35	$329.00	A compact, enclosure for reinforcement or musical instruments. Arrayable for reinforcement.
10SX	13 20 12	black spakle	black metal		75-8k	10	cone						29	$282.93	Versatile single 10-in. enclosure suited for bi-amped bass rigs, synth and guitar cabinets, reinforcement.
KLARK-TEKNIK ELECTRONICS, INC.															
Jade- I	13.5 6.25 9.9	black tex epoxy	none	20k 10k	55-17k 3	8	cone Neofl.			1.3 dome	soft	2.5k	48.5	$1995.	2-way active powered monitor sys., 100 watt MOSFET amplifiers, custom EQ, 107dB sensitivity.
KLEIN & HUMMEL (GOTHAM AUDIO CORP.)															
098	15 10 7.25	gray	black cloth	4.7k	50-16k 2.5	8	cone	1.5	dome	0.75	dome	800/ 6k	26.4	$1315.	Active, tri-amplified, 2 electronic Xovers with location dependent equalizer. (amps: 1-100w,2-50w)
096	20.7 12.4 11.4	gray	black cloth	4.7k	50-20k 2.5	10	cone	2	dome	0.75	dome	600/ 4k	48.4	$2270.	Active, tri-amplified (3-60w), 2-electronic Xovers with location dependent equalizer.
092	31.5 17.3 11.8	gray	black cloth	4.7k	50-17k 2.5	10 (2)met	cone metl	3.5	cone	1	dome	500/ 3k	66	$4195.	active, tri-amplified (1-120w,-2-60wz), 2 electronic Xovers with location dependent equalizer.
MEYER SOUND LABORATORIES, INC.															
UM1- A	14 14 22.5	black tex	grey foam	8/ 16	55-16k 4	12	cone				horn 60dg. CD	1.6k	66	$2350.	Compact, high power, biamplified system, recessed handles.
833	32 20 14.75	black satin	black grille cloth	8	35-18k 3	15	cone				horn 40x 80dg.			$5990.	Active control electronics, subsonic filters, phase and frequency correction, extremely high power.

Model	Dimensions, H,W,D	Cabinet Finish	Front Screen Finish	Impedance, ohms	Frequency Response +/- dBs	Bass Speaker Size, in.	Bass Speaker Type	Midrange Speaker Size, in.	Midrange Speaker Type	High-Frequency Driver, Size	High-Frequency Driver, Type	Crossover(s)	Weight, lbs.	Price	Features
PEAVEY ELECTRONICS CORPORATION															
112HS BW	16.5 22 13	black paint	black grille cloth	8	80-16k 3	12	cone			1	horn		32	$289.00	Features the Black Widow with CDH multi-flare high freq. horn.
FlexA Mon.	13.94 9.5 6.25	black Tolex	black metal	8	100-14k	8	cone			1	horn		16	$159.00	Compact with 8-inch woofer, high frequency horn.
PIONEER															
TSM-1	43.31 35.44 28.06	maple	brown	4	29-20k	15 (2)	cone			7 6.13	horn	650	319	$7500.	Provides high power at all frequencies, offers clear directivity and high SPL of 126dB/w at 1 meter.
TSM-2	26 31.44 24.19	maple	brown	8	29-20k	15	cone			8 6.13	horn	650	205	$5750.	For the small studio or editing room. 300w power handling and max SPL of 120dB/w at 1 meter.
RAMSA PANASONIC															
WS-A70	11.13 10.31 9.19	bk/wh	bk/wh fabric	8	50-18k	8	cone				comp driver	2k	17.5	$200.	Compact monitor, magnetic shielding, thermal protection for high and low frequency drivers.
RENKUS-HEINZ, INC.															
SMS 121B	15 28.25 17.75	black carpet	black metal	8		12	cone			1	horn 70x 110dg.	1.6k	42	$996.00	
SMS 151B	15 33.25 19	black carpet	black metal	8		15	cone			1	horn 55x 95dg.	1.6k	63	$1080.00	
SMS 151DB	15 33.25 19	black carpet	black metal	8		15	cone			2	horn 55x 95dg.	1.2k	67	$1190.00	
W121	15.25 28.25 17.5	black carpet	black metal	8		12	cone			1	horn 50x 90dg.	smart	54	$1398.00	
W121H	16.25 15.75 25	black carpet	black metal	8		12	cone			1	horn 50x 90dg.	smart	50	$1398.00	
W-1	15 33.25 19.25	black carpet	black metal	8		15	cone			2	horn 55x 95dg.	smart	71	$1576.00	
STUDER REVOX AMERICA, INC.															
2706	24.5 15.1 13.5	hard wood grey	black cloth	4	42-20k	12.5	cone	2	dome	1	dome	720/ 2.5k	48	$750.00	Professional monitor loudspeaker.

Model	Dimensions,H,W,D	Cabinet Finish	Front Screen Finish	Impedance,ohms	Frequency Response +/- dBs	Bass Speaker Size,in.	Bass Speaker Type	Midrange Speaker Size,in.	Midrange Speaker Type	High-Frequency Driver, Size	High-Frequency Driver, Type	Crossover(s)	Weight,lbs	Price	Features
TANNOY NORTH AMERICA INC.															
Cou-gar Wedge	22 22 16	black paint	black metal	8	100-20k 4	15	cone			2	horn comp	1.8k	55	$1098.	Dual concentric wedge, phase coher-ent, wide dispersion, high gain before feedback.
PBM-6.5	11.88 8 8.5	grey vinyl	black cloth	8	57-20k 3	6.5	cone			0.75	dome	2.6k	11	$298. pair	Dual concentric, point source,phase coherent, hard wired crossovers, gold-plated high current switches.
NFM-8	18 11.8 8	black paint		8	55-20k 3	8	cone			0.75	dome	1.8k	25	$799.00 pair	As above, plus medite cabinets, additional bracing, gold-plated terminals with 10 gauge wire acceptability.
SGM-10B	20.5 14.5 10	walnut veneer	black cloth	8	55-20k 4	10	cone			2	horn comp	1.2k	40	$1598. pair	Same as above.
SGM-12B	23 16 11	walnut veneer	black cloth	8	55-20k 4	12	cone			2	horn comp	1.4k	46	$1898. pair	Same as above.
SGM-1000	40 25.5 18.5	walnut veneer	black cloth	8	46-20k 4	15	cone			1	horn comp	1k	128	$3698. pair	Same as above
FSM-U	35.75 31 22	black paint	black cloth	4/ 8	40-20k 3	15	cone			1	horn comp	500/ 1k	183	$5148. pair	Same as above
TRANSDUCER DEVELOPMENTS LIMITED															
Ref. Stnd TLS	20 22 48	black wood walnut	black brown cloth	8	16-35k 6.5	9.5	cone	4.5 (2)	cone	1 0.78	dome	200/ 3.5k/ 13k	154	$6995. pair	Transmission line design. Low freq. separately term.
Mon-itor TLS	18 12 47	black wood walnut	black brown cloth	8	18-35k 6.5	9.5	cone	4.5	cone	1	dome	300 13k	103	$4595. pair	Transmission line design. Low freq. separately term.
Stu-dio3 TLS	16 12 39	black wood walnut	black brown cloth	8	20-20k	8	cone (2)			1	dome fluid	3k	59	$1995. pair	Transmission line design, fea-turing magnesium alloy suspen-ded dome with separate chamber.
Stu-dio2 TLS	15 11 35	black wood walnut	black brown cloth	8	24-20k	8	cone			1	dome	3k	48	$1595. pair	Same design and high frequency component as the Studio-3.
Super Com-pact	14 11 20	black wood walnut	black brown cloth	8	28-20k	8	cone			1	dome	3k	26.5	$1095. pair	Reflex design.
Com-pact	12 9 18	black wood walnut	black brown cloth	8	30-20k	6	cone			1	dome	3k	22	$935.00 pair	Reflex design.

Model	Dimensions, H,W,D	Cabinet Finish	Front Screen Finish	Impedance, ohms	Frequency Response +/- dBs	Bass Speaker Size, in.	Bass Speaker Type	Midrange Speaker Size, in.	Midrange Speaker Type	High-Frequency Driver, Size	High-Frequency Driver, Type	Crssover(s)	Weight, lbs.	Price	Features
YAMAHA MUSIC CORPORATION See our ad on page 18															
NS 10M	8.5 15 7.8	black wood		8	60-20k	6.5	cone			1.4	dome	2k	13.2	$395.00 pair	High power, closefield ref.
NS 40M	11.4 23.4 12.1	black wood		8	50-20k	6.5	cone (2)	2.38	dome	1.13	dome	1.2k/ 5k	37.4	$445.00	High power, reference monitor.
S10X	6.1 9.5 6.5	black molded mesh	black metal	6	65-20k	4	cone					full range	6.2	$130.00	Carbon fiber cone, magnetically shielded for use with video monitors.
S20X	7.5 11.6 7.8	black molded mesh	black metal	6	65-20k	4	cone (2)					full range	10.1	$190.00	Dual carbon fiber cones, 150 watt power handling.

ADDRESSES

Altec Lansing
10500 W. Reno
Oklahoma City, OK 73128

Apogee Sound Inc.
1150 Industrial Ave, Suite C
Petaluma, CA 94952

Bose Corporation
The Mountain
Framingham, MA 01701

Carvin Corporation
1155 Industrial Ave
Escondido, CA 92025

Cetec Gauss
9130 Glen Oaks Blvd
Sun Valley, CA 91352

Community Light and Sound
333 East Fifth St
Chester, PA 19013

Electro-Voice
600 Cecil St
Buchanan, MI 49107

Fostex
15431 Blackburn Ave
Norwalk, CA 90650

Galaxy Audio
625 East Pawnee
Wichita, KS 67211

JBL Professional
8500 Balboa Blvd
Northridge, CA 91329

Joe's Sound and Salami Co.
303 Clymer Ave
Morrisville, PA 19067

Klark-Teknik
30 B Banfi Plaza
Farmingdale, NY 11735

Klein and Hummel (Gotham)
1790 Broadway
New York, NY 10019-1412

Meyer Sound Labs
2832 San Pablo Ave
Berkeley, CA 94702

Peavey Electronics Corp
711 A St
Meridian, MS 39301

Pioneer Electronics USA Inc
2265 East 220th St
Long Beach, CA 90810

Ramsa Panasonic
6550 Katella Ave
Cypress, CA 90630

Renkus-Heinz
17191 Armstrong Ave
Irvine, CA 92714

Shure Brothers
222 Hartrey
Evanston, IL 60204

Studer Revox America
1425 Elm Hill Pike
Nashville, TN 37210

Tannoy North America, Inc
300 Gage Ave, Unit 1
Kitchener, Ontario
Canada N2M 2C8

Transducer Developments Ltd
(Connectronics)
652 Glenbrook Rd
Stamford, CT 06906

Yamaha Music Corporation
PO Box 6600
Buena Park, CA 90622

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Len Feldman—db magazine
September/October—1986

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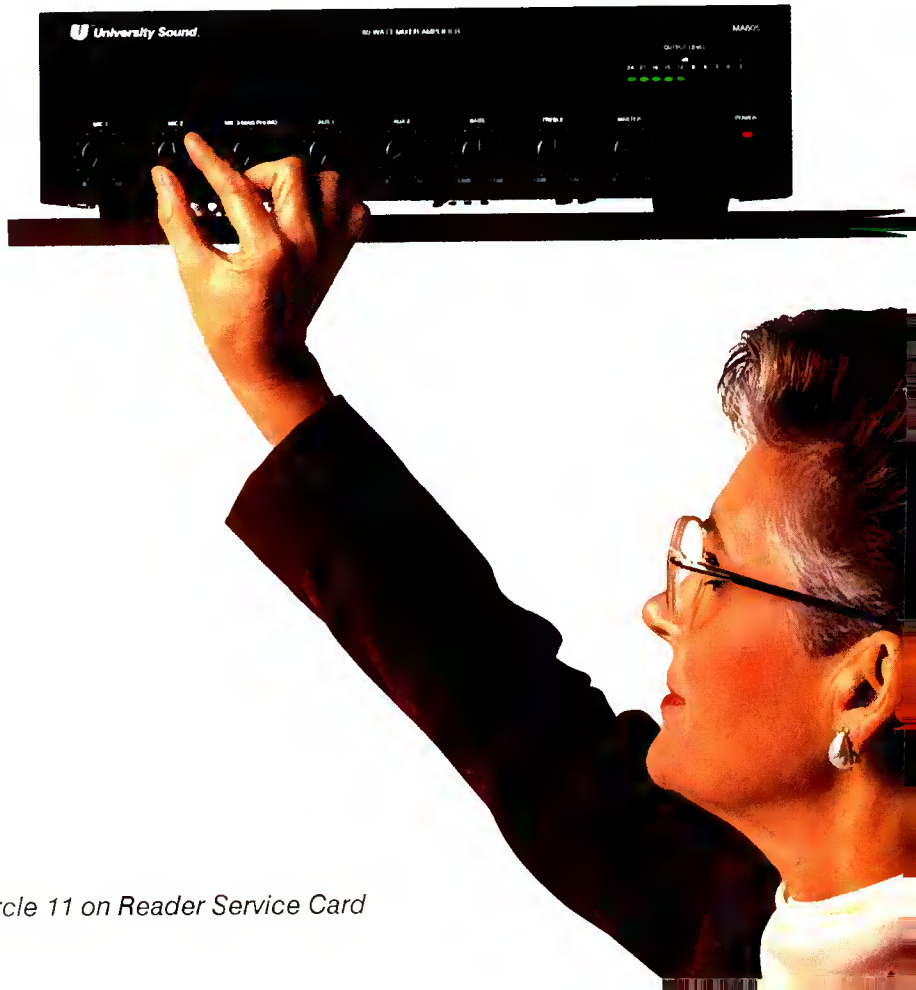

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