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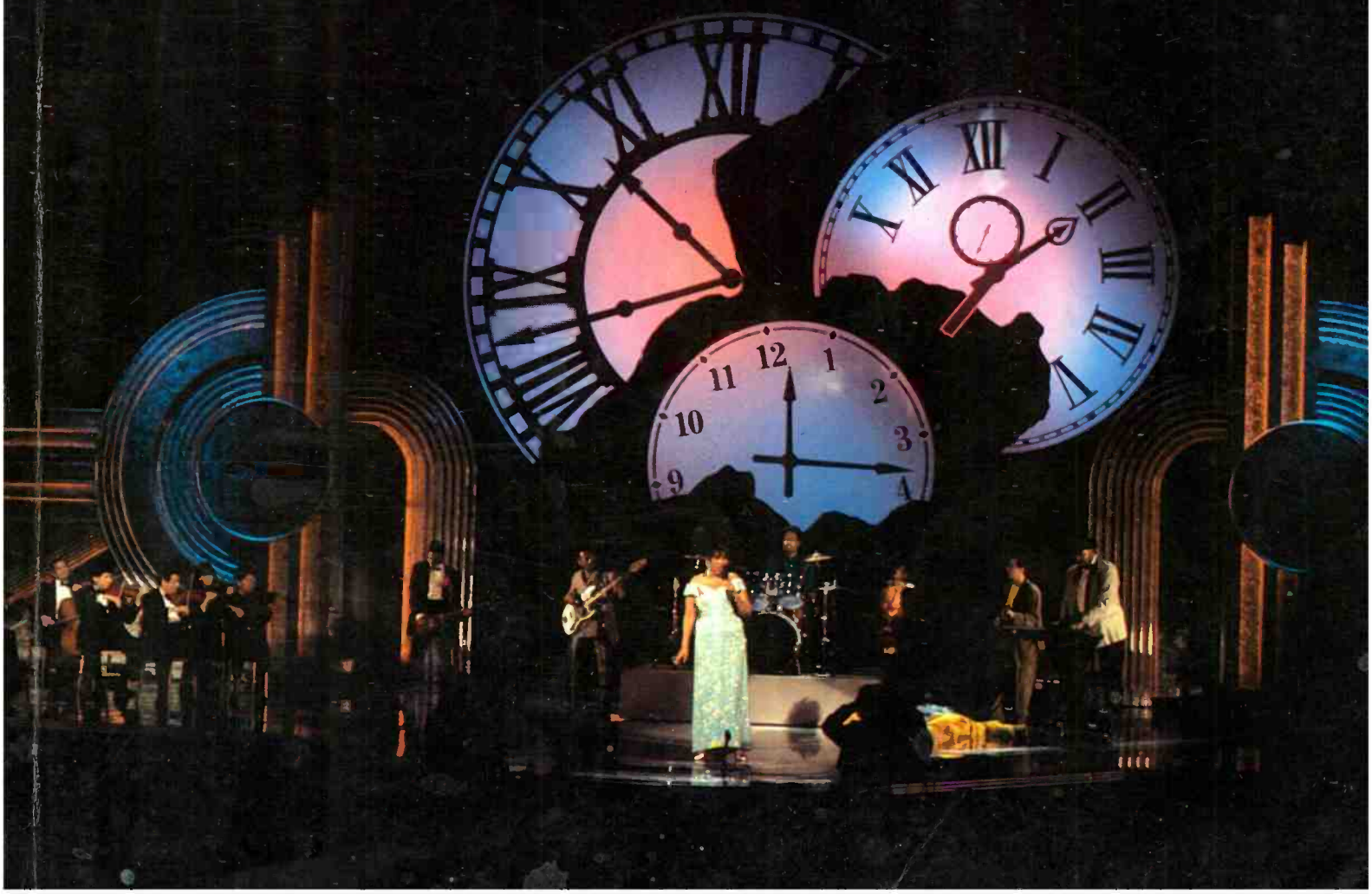
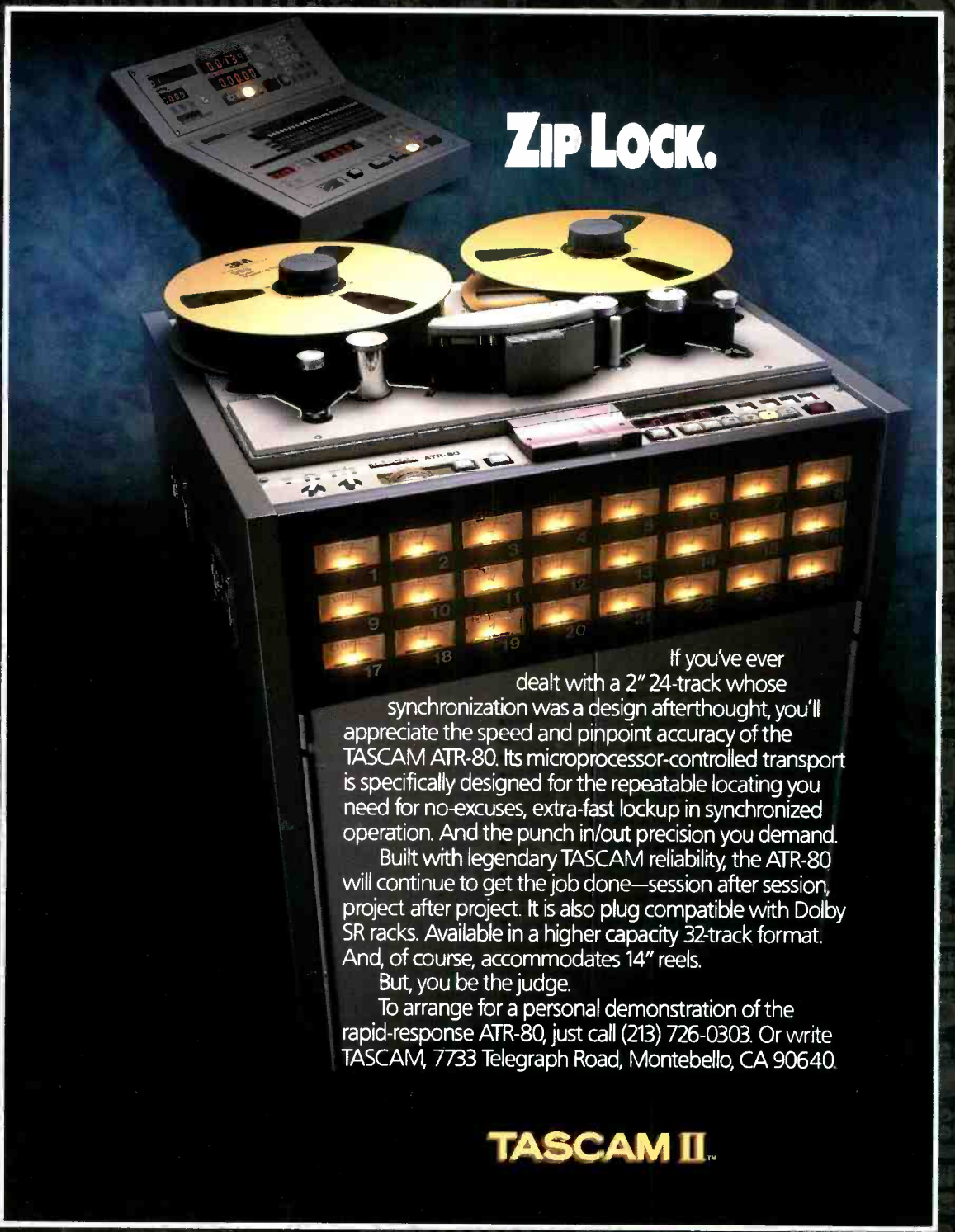
The Grammys

by Murray Allen

Sound Reinforcement for the Church





Circle 12 on Reader Service Card

May/June 1992 Vol. 26, No. 3

db MAGAZINE

serving: recording, broadcast and sound contracting fields

THE SOUND CONTRACTING ENGINEER

THE BROADCAST ENGINEER

THE RECORDING ENGINEER

THE ELECTRONIC COTTAGE

AUDIO FOR THE CHURCH

About the Cover

● This photo of Aretha Franklin was sent us by NARAS and was taken at the 34th Annual Grammy Awards. The live broadcast was an incredible combination of audio feeds and cues, all told in Murray Allen's article beginning on page 9.

DEPARTMENTS

Calendar

● **Patrick Watson**, Chairman of the Board of the Canadian Broadcasting Corp.(CBC), will deliver the keynote address at the **134th SMPTE Technical Conference and Equipment Exhibit** in Toronto, Ont., Canada, on November 10. The conference, "Images in Motion—The Second Century," will be held November 10 - 13, 1992, at the Metro Convention Centre.

A 35-year veteran of the broadcast industry, Watson is well versed in many facets of motion imaging. A distinguished Canadian television journalist, filmmaker, and writer, he is the author of several books.

The 134th SMPTE Technical Conference and Equipment Exhibit will explore new areas in image technology, including motion pictures and television. During the four-day event, participants will examine multimedia and the integration of computer technology via hands-on workshops, an equipment exhibition, and demonstration. In addition, approximately 100 authors will explore innovations in motion imaging and advances in established technologies during the technical papers program.

On November 9, the day before the conference opens, there will be two all-day tutorials, "Multimedia World," which will serve the needs of users and supplier of multimedia application and products, and "The Post Experience," which will focus on the creative as well as technical aspects of post-production. The Equipment Exhibit will run concurrently with the technical program.

Several tours will highlight the conference program. A tour of CBC's new broadcast center is planned, as well as a trip to the Skydome, where registrants can observe the largest indoor television screen currently in use. A visit to Cinisphere will allow registrants to view the largest film format in the world as well as hear

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several conference presentations that scheduled to take place there.

The traditional conference social events, including the Welcome Reception, Partner's Program, Honors & Awards Luncheon, Fellows Luncheon, and Annual Banquet will also be offered.

● **Synergetic Audio Concepts**(Syn-Aud-Con), in its 20th year of training audio professionals, have announced a 1992 schedule for their 3-day audio engineering seminars to be held at their farm in S. Indiana.

The 3-Day **Sound Engineering Seminars** cost $525.00 and will be held at the Farm—Norman, Indiana on May 21-23, June 18-20, July 16-18, August 20-22, September 17-19, October 15-17. An Assistant Instructor will be present at each of the seminars at the farm. Syn-Aud-Con will also host a 3-day "on-location" workshop on auralization and precision equalization on **May 15-17.** Dr. Wolfgang Ahnert of Berlin and Dr. Eugene Patronis of Georgia Tech will be the staff, along with Don & Carolyn Davis(hosts).

The research to be undertaken is Dr. Ahnert's new binaural head transfer function compensated auralization program for the Renkus-Heinz EASE program. This program enables the listener to hear what direction reflections are coming from in buildings that exist only on the drawing board and the computer's hard disk.

The second part of this two part workshop will be research into the new ACE technique of sound system equalization. ACE (Accurately Controlled Equalization) is a technique for precision matching equalizer sections designed by Dr. Patronis to detail anomalies measured before the performance by a new TEF technique and during the performance by Ariel SYSid used as a source dependent measurement- SDM system. That is, the measurement accuracy is restricted to the same frequency range as the program source.

For more information, contact: **Synergetic Audio Concepts, 12370 W. Co. Rd., 100 N., Norman, IN 47264; phone: 812-995-8212, FAX: 812-995-2110.**

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SHELLEY A. HERMAN

Behind The Screen at The Motion Picture Academy

Academy Awards! OSCAR™!

These words bring to mind the glory and glamour of Hollywood and the movies. At the heart of all this is the Academy of Motion Picture Arts and Sciences (AMPAS), the central organization of the movie industry.

IN THEIR HEADQUARTERS BUILDING on Beverly Hills' Wilshire Boulevard, are two world-class screening rooms. The first is the Samuel Goldwyn Theater, seating 1,028 people, with five screen channels, a sub-woofer system, and an extensive surround system. The second is the Academy Little Theater seating 67 people, with three screen channels. These rooms are the criterion for Academy members and organizations such as AES, SMPTE, and CAS to evaluate films, old and new, and the very latest technical advances in the art of film making.

As such, they are the world's standard theaters. This article rips away the screens to let you know just what makes these rooms sound so good.

In 1990, the existing sound systems were renovated and many new components were installed.

A committee of the industry's finest sound engineers designed the system: Claus Wiedemann from The Burbank Studios (TBS, now Warner Bros. Burbank); John Bonner and Don Rogers from Warner Hollywood Studios; Clay Davis from Glen Glenn/Todd AO; David Gray from Dolby Laboratories, Ed Anderson from Meridian Studios, and Mark Lindauer then from Paramount Pictures, now with Weddington Productions.

The amplifier-loudspeaker system selected for this renovation is based on the system developed for TBS by BGW Systems of Hawthorne, CA, using their Signal Processing Amplifier with a unique equalization characteristic to compensate for screen loss. The system worked so well for TBS that Warner Hollywood Studio soon purchased similar systems for their screening rooms. Word spread though the industry, finally resulting in specification of the system for the Academy theaters.

In addition to the screen loss compensation, the electronics unit supplies the necessary crossovers, time delays, high and low pass filtering, amplifiers, and other circuitry to process and power a

Figure 1. The main stage of the Goldwyn Theater. (Photo courtesy AMPAS.)

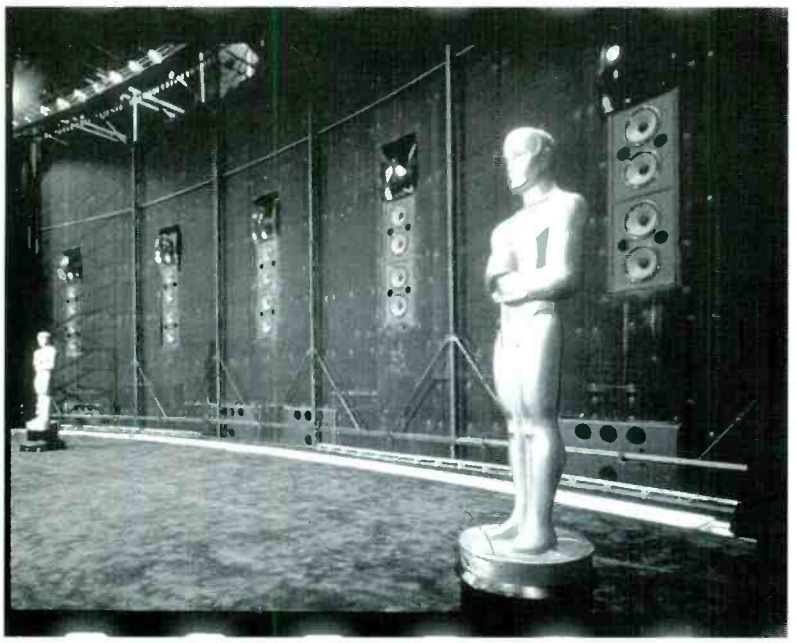


Figure 2. The curtain is open, the film screen is raised, revealing the speaker systems.

three-way loudspeaker system. (See *Figure 3.*)

Each Goldwyn Theater screen channel consists of a BGW SPA-3-2E-TBS amplifier driving a special JBL 4675 loudspeaker That consists of a 2360A/2450J horn/ driver combination and two 4648 woofer cabinets, each with two 2226H low frequency drivers.

An exceptional aspect of this combination is the use of two dual-woofer cabinets.

In the past, such a stack would create an inadvertent line array of nine to ten feet in length.

This would have the undesirable effect of severely narrowing the vertical distribution of the low frequencies, as a result making it difficult to achieve the proper equalizationanywhere throughout the auditorium.

To circumvent this problem, consultant John Eargle, of JME Consulting Corp., working with JBL, suggested driving one dual-woofer cabinet at the normal 500 Hz crossover frequency and driving the second dual-woofer cabinet at a lower crossover frequency. In empirical tests, the committee decided that 325 Hz is the optimum crossover frequency for the second cabinet. There is now plenty of low-frequency power below 300 Hz, where

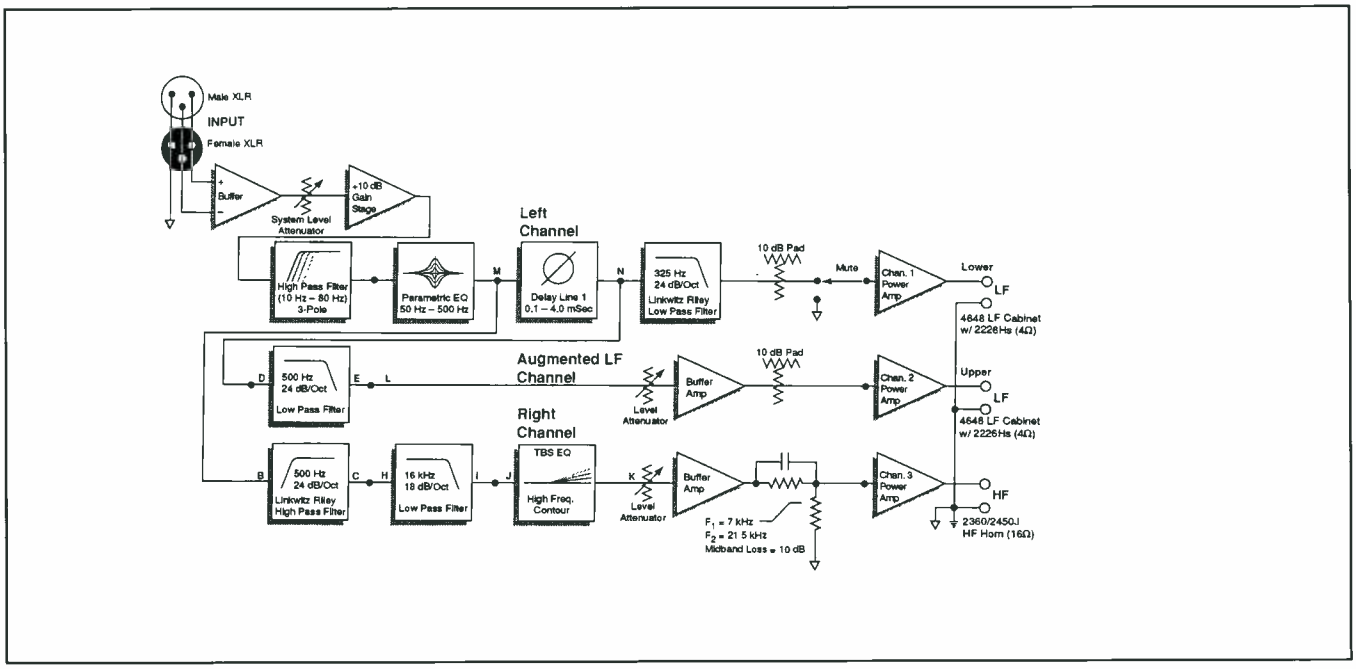


Figure 3. A block diagram of the overall system.

it is needed, while avoiding the unwanted vertical narrowing at frequencies approaching the mid-range. The three-channel signal processing amplifier made it easy to create such a system with two-way reproduction plus an additional low-frequency channel at a different crossover frequency. Additional sub-bass is supplied by JBL 18-inch woofer systems driven by BGW 750 series amplifiers.

The Academy Little Theater has three two-way systems identical to the larger room systems, without the second dual-woofer cabinet.

Using the same amplifiers as are used in the large room allows interchangability. The third channel has a mute switch for this purpose.

John Bonner, Co-chair of the Academy committee responsible for the new sound system, says that there is a substantial improvement in both rooms, with extended high-frequency response.

Mr. Bonner's subjective evaluation is that the systems' screen-loss compensation has improved the high frequencies perceived in the audience well beyond the 8 kHz typically possible using ⅓ octave equalization or broader shelving tone controls. With the excellent reception this system has received, watch for one coming soon to your neighborhood theater.

Thanks to Douglas W. Edwards of the Academy for ensuring that the facts were all correct. db

MURRAY ALLEN

Cover Story: A Marathon of Music—the 1992 Grammy Awards Show

Nine-hundred and twenty-seven microphones, six-hundred and fifteen console inputs, two-hundred and forty-four "live" musicians, singers and dancers, twenty-three performances, sixty cues and only forty-one hours to put it all together and make it sound great!

ON JANUARY 8, 1992, AT A press conference held at the Beverly Hilton Hotel in Los Angeles, the nominees for the 34th Annual Grammy Awards were announced. Following the press conference, the NARAS (National Academy of Recording Arts and Sciences) Television Committee, which is comprised of members representing the seven chapter cities and advisors such as myself, Phil Ramone, and Bill Ivey; officers of NARAS headed by Michael Greene (President) and members of the production company including Pierre Cossette (Executive Producer), John Cossette (executive in charge), Walter Miller (director) and the writers, Buz Kohan and Bruce Vilanch, have a lengthy meeting to decide who we should get to perform on the show. Once again the ball was rolling. In forty-eight days we would be broadcasting *live* The Grammy Awards Show from Radio City Music Hall in New York.

BACKGROUND

I mixed my first Grammy Show in 1973 in Nashville. In those days the show was only on the air for one and one-half hours. Our main truck was a sports truck with a sports mixer who handled the podium mics and tape playbacks. Next door we built a recording studio in a church. The live band played its cues live and I mixed

Figure 1. A view of the interior of the Effanel truck. See the text for details.

Murray R. Allen is president of Allen & Associates, Chicago and was the Sound Designer for the Grammy Awards Show.

and sent the signal · from the church to the sports truck. I always remember that I had built in over 40 dB of output gain. No matter how far the sports mixer pulled the music down, I could always push it up some more.

Nineteen years later, using true music trucks and having a feeling that the show might run close to four hours,(knowing what kinds of talent with which I will have to work), I began to hire the crew. The crew consisted of seven broadcast mixers, three in the Record Plant truck, two in the Greene/Crowe truck, and two in the Effanel truck. In addition, there were two monitor mixers, three P.A. mixers, one room-equalization operator and ten stage audio personnel. I also hired the trucks and began to make provisions for the rental of extra equipment.

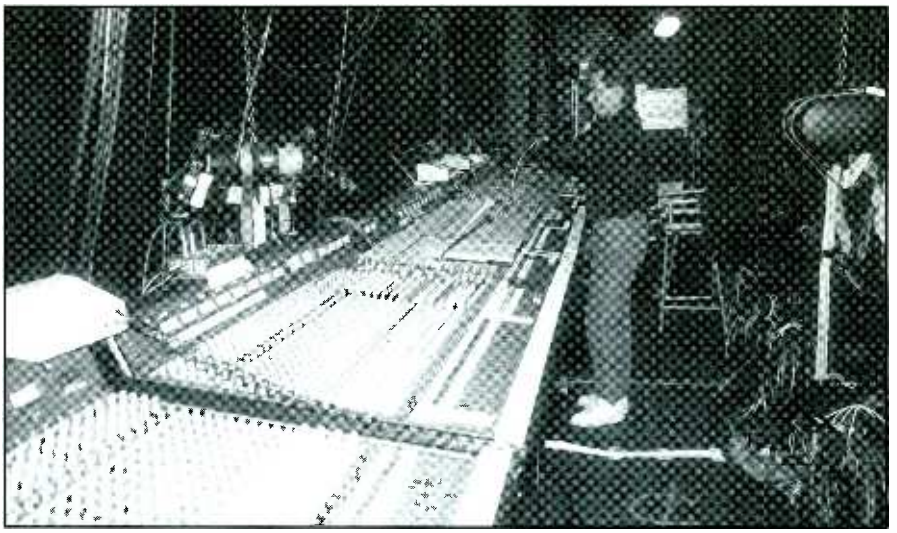


Figure 2. These four Ramsa WR-S-840 consoles handled sound reinforcement for the room and were on the specially-built platform in the theater. Burns Audio used engineer-mixer Mike Abbott who is seen during a rehearsal

Our next meeting took place in Los Angeles on February 10th. At this meeting all the department heads, mixers and key technicians were present. This was the day the valley was flooded...

On February 3rd, all the department heads including audio, lighting stage, design, electricians, carpentry and, of course, video, met in New York at Radio City Music Hall with John Cossette, Walter Miller, Tzvi Small, CBS and the Radio City Music Hall people. At this time, we decided where the trucks were going to park (they took up an entire city avenue block along 51st street between Fifth and Sixth Avenues), where P.A. would be located, when and where we will hang our sound clusters and where to place our stage monitor consoles. Stage monitors are always the most difficult group to find a place in which to set-up. We decided to build a 40 ft. by 10 ft. platform that would hang from the ceiling stage left.(See *Figure 2.*) This would be built while the Ice Follies were still performing at Radio City Music Hall, just prior to our move in.

Our next meeting took place in Los Angeles on February 10th. At this meeting all the department heads, mixers and key technicians were present. This was the day the valley was flooded because of excessive amounts of rain in California. It took some people over three hours to get to the meeting, while others just could not make it at all.

At this meeting all stage moves were discussed. All lighting and music cues were decided. If anyone felt a move was impossible, now was the time to say so, or forever hold their peace.

On February 19th we sent one audio man (Don Worsham) out to supervise the pre-cabling so that when the trucks parked at close to midnight, all they would have to do is plug in. By this day the monitor platform was finished, and all the speakers were hung.

PROBLEMS BEGIN

On its way from Los Angeles to New York, the Greene/Crowe truck (our main video and audio truck)

Figure 3. Alan Jackson performing ***Don't Rock the Jukebox*** *during the live show.*

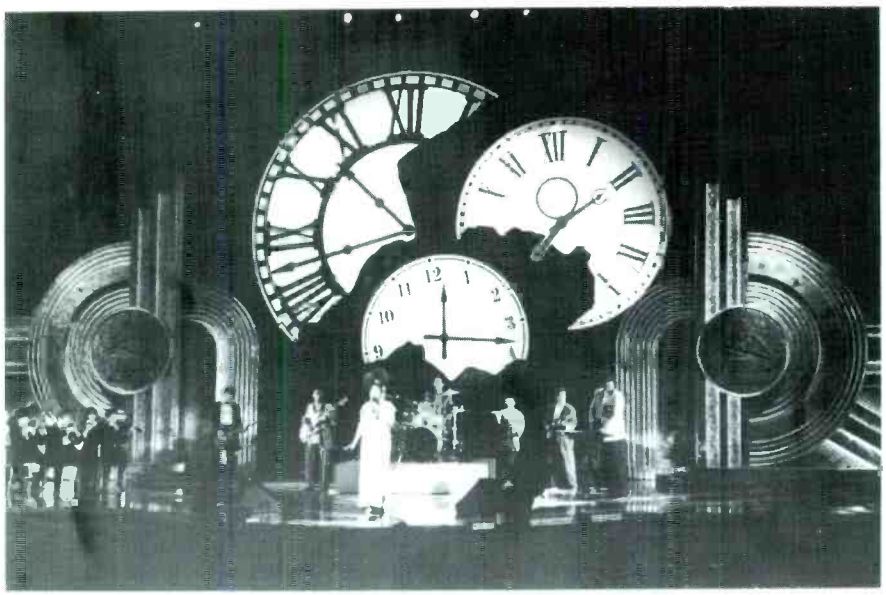


Figure 4. Aretha Franklin performs ***Ever Changing Times****. See our cover for a full-color view.*

turned over. We scrambled to get a different truck. Luckily, Unitel was able to rearrange their schedule and was able to furnish us with the Unitel Red Truck as a replacement. Because the two trucks have different space configurations, we had to move some of our audio mixing from the video truck to the rear of the Effanel truck. (See *Figure 1.*) This, and other configuration changes, added several hours to the interior truck set-up.

On the morning of the 20th, all the monitor and P.A. equipment was moved into their respective positions at Radio City Music Hall.

Figure 5. NARAS President Michael Greene during his presentation. He spoke of the ongoing and increased need of music education at primary and secondary school levels.

THE STAGE

The Radio City Music Hall stage contains three elevators that cover the width of the stage. This is how we bring up one act and get rid of another. These elevators are lowered 27 ft. to the basement where all the set-ups are stored. Early on the 20th, a Radio City electrician fell into one of these pits while the elevator was down. He almost died that night. At present, he is in a medically-induced coma to help with the healing. Last year one of our sound-crew members fell 6 ft. into a partially lowered elevator pit and he is still not back at work. This rightfully put the fear of God into our stage crew. I have never seen these men more nervous.

On the afternoon of the 20th, I transferred and edited instrumental tracks from nominated records in the Record Plant truck to be used as underscores to our premention packages. Prior to the live part of our Grammy Show, there is an opening show where all the awards in the categories not covered on the live broadcast are presented to the respective winners. During the live show these awards are mentioned along with pictures of the winners receiving their award.

The Record Plant truck has a Trident as its main console. During the show every other truck and broadcast console comes through this board. Don Worsham, who operates this console, is in charge of all the podium mics, all the video tape playbacks, audience reaction going into musical numbers and all the other feeds. This, in fact, is the final mix before going to air.

RECORD PLANT TRUCK'S EQUIPMENT

The Record Plant truck also has a cart playback station. Paul Sandweiss is in charge of this area. Paul uses a Soundcraft console. He has eleven cart machines. As each

nominee is mentioned, Paul plays the record for which they were nominated. When the winner is announced he will also play the winner's record again. Paul spends endless hours transferring these selections from CD's to carts making sure the quality is maintained. Paul will also play the bumpers going in and out of commercial.

Carroll Pratt, who is the sweetener for this show, is in the Record Plant truck. He adds applause and laughter to our live audience pick up. During musical numbers that have "board fades" it is important to have the audience begin their applause immediately with the start of the "fade". Since you cannot make a true "board fade" with a live act, it is important that applause cover up the final moments going to silence. If the audience reacts slowly, So, Carroll jumps in and saves the day.

Figure 6. Whoopi Goldberg who had to ad-lib cover for a 20 second delay of an audio cue.

IT BEGINS

At 7 PM on the evening of the 21st, we began our pre-record of bumpers, underscores, and the themes. We selected Clinton Recording and Ed Rak as mixer to help us with this chore. Since the house orchestra spends most of its time in the basement under the stage, it is impossible for them to play many of the cues. This necessitates a pre-record. This year we had 60 such cues. We finished mixing by 4 AM. I was back at Radio City by 9 AM on the 22nd to begin rehearsals.

On this day we rehearsed several of the acts including Mariah Carey, Vince Gill and Alan Jackson and Mary-Chapin Carpenter. We rehearsed until 8 PM, however I had to go back to the recording studio at 7 PM to finish the pre-records and rehearse with Dave Grusin. Once again, we finished mixing at about 4 AM; and, once again I was back at Radio City by 9 AM for rehearsals on the 23rd.

During rehearsals each act gets a sound check and four run-throughs. During the sound check and first run-through I will spend my time in the house checking on PA and room equalization. I listen to the next run-throughs in the broadcast trucks. At this time I make any suggestions I feel necessary to obtain better mix and/or better sound. In some cases I will even become one of the mixers.

THE EFFANEL TRUCK

In addition to the Record Plant truck, broadcast audio is also handled by the Effanel truck and the Unitel truck. The Effanel truck is owned and operated by Randy Ezrati. This truck has a SSL Series G 4000 console with Total Recall. In addition, the Effanel truck has many processing devices and tube equalizers. Randy will record each act that he is assigned on a Sony 48-track digital recorder pre-fader so after the act has finished their rehearsal, he may further refine his mix. Hank Neuberger helps with mixing in this truck.

THE UNITEL TRUCK

The Unitel truck has a large Auditronics console and four additional Soundcraft consoles. It also has several submixers and much processing gear. The house orchestra is mixed in this truck. The head mixer in this truck is Ed Greene.

We checkerboard the trucks as to which truck will get which act. For example, our first act (Paul Simon) was handled by the Effanel truck. The second act (Mariah Carey) was handled by the Unitel truck. The next act (Seal) was handled by the Effanel truck, and so on.

Because of the complexity of the show and the use of different trucks we did not get rid of all our hums and buzzes until mid-day of the 23rd. Also, because of the time it took to set up each act, we did not always get a good sound check, and in some cases we only had two run-throughs.

Rehearsal on the 23rd finished at 8 PM and I had a night off. We started rehearsal on the 24th at 9 AM and ran until 11 PM. We then had an audio meeting to go over all our stage moves and microphone placements. This finished at midnight.

On show day, the rehearsal began at 10 AM and lasted to 5:30 PM. During the dry run we did not make a single change on time. Anything that could have gone wrong, went wrong. I personally like a bad rehearsal because it makes everyone super sharp for the show. This turned out to be true.

ON THE AIR

At 8 PM (E.S.T.) we went on the air *live* to over 65 nations and 1.25 *billion* viewers in Stereo Surround Sound. The show was seamless. We made all the changes on time with only one exception which required Whoopi Goldberg (*Figure 6*) to stretch for 20 seconds.

When the show went off the air at midnight (running one-hour long for a total of four hours) we began planning for next year's show, which undoubtedly will be even more complex. db

BRAD LEIGH BENJAMIN

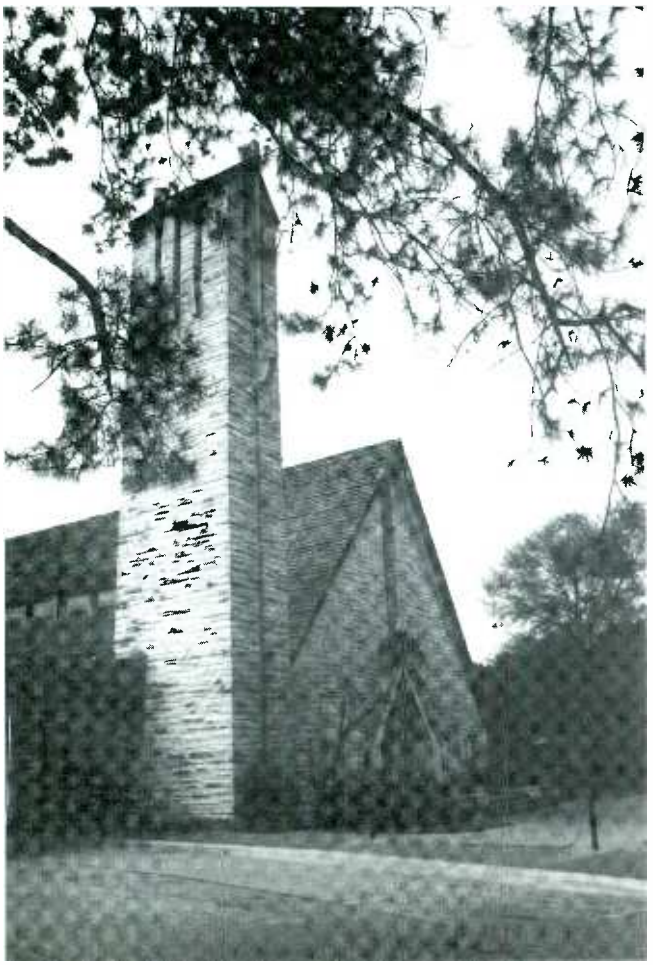
New Sound Reinforcement Systems At Saint John The Divine Episcopal Church

Saint John The Divine Episcopal Church in the River Oaks section of Houston, Texas, is the third largest Episcopal Church in the United States with a congregation of 4,400 and has a sanctuary seating capacity of 750 members.

DESIGNED BY THE ARCHITECTURAL FIRM OF Hiram, Salisbury, Mackie, and Shamrath, the church was built in 1953 in the style of Frank Lloyd Wright using plenty of native stone and solid oak.

The sanctuary, typical of a cathedral-type structure, is a very long, narrow building. From the back of the chancel to the rear of the balcony, it's 120 feet in length. The structure is 50 feet wide. The acoustics however, are extremely good and not as reverberant as one would expect from an edifice filled with such hard surfaces. The irregular, multi-surfaced, native stone, in conjunction with frequent use of random wood beams, and random-style windows in keeping

Figure 1. Saint John The Divine and its bell tower.



with genre of Frank Lloyd Wright, serve as diffusion for potential excess reflections.

The original sound system was basically a distributed system. There existed a couple of small chambers on two front walls and several flush mounted speakers in the ceiling. Saint John's had been wanting to do a complete refit of their sound system for some time and had a number of audio contractors come in and examine the possibilities. Nearly all of the contractors suggested a central cluster suspended front and center above the chancel area for a primary sound reinforcement system, but Saint John's was adamantly opposed. So proud are they of the sanctuary's architectural design that they have an aesthetics committee whose job it is to oversee any refurbishment or modifications proposed for the sanctuary. Their function is to guarantee that proposed construction or modifications don't compromise the aesthetics of the sanctuary.

There exists a large stained glass window in the rear of the chancel area, rising all the way to the peak of the ceiling which is some 50 feet high. There was no way Saint John's would accept a central cluster because no matter how it was suspended, it would obscure the view of the stained glass window. A central cluster was therefore, completely unacceptable.

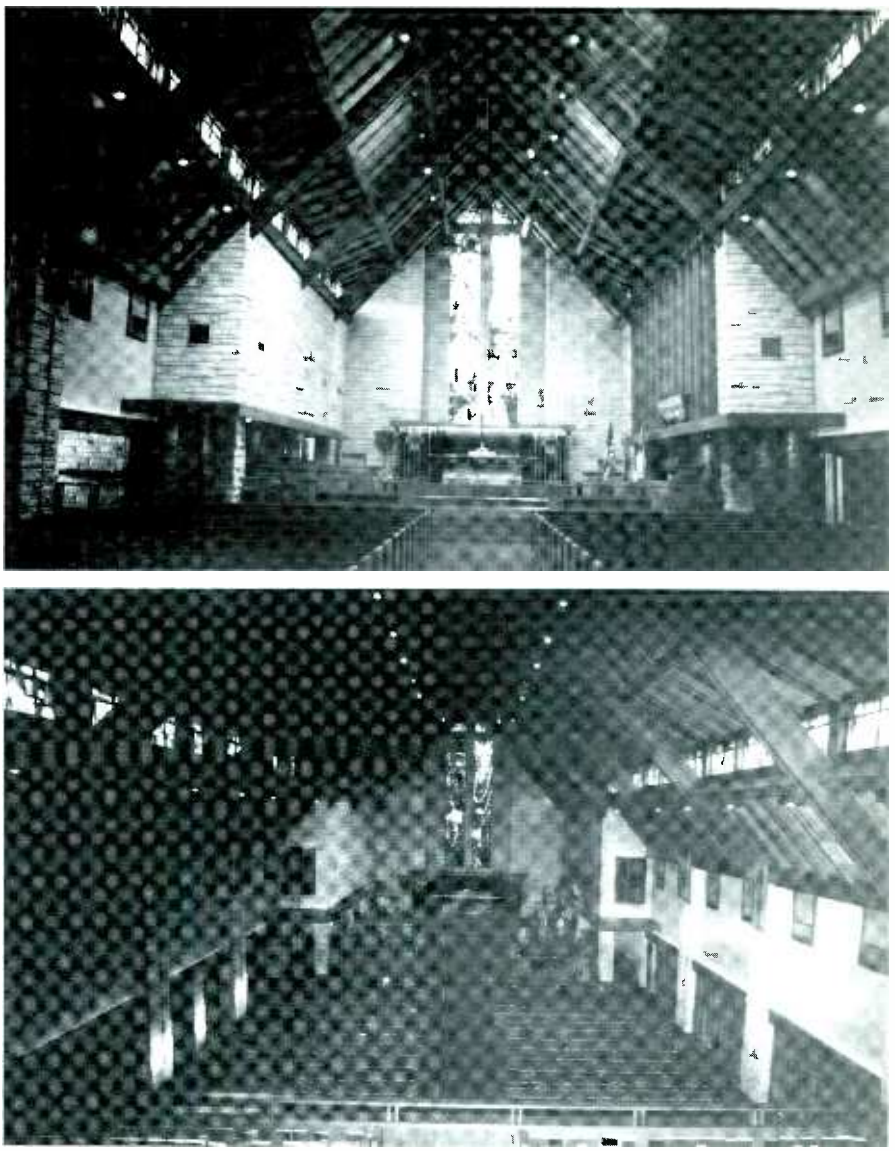


Figure 2. The main chancel seen before (top photo) and after (bottom photo) Crescendo's installation.

ENTER THE CONTRACTOR

Crescendo Sound Systems was the lone contracting firm offering an alternative to a central cluster. Founded in 1963, Crescendo Sound Systems has devoted its expertise exclusively to the design and installation of custom sound reinforcement systems for houses of worship. With over 1500 church installations to their credit, Crescendo Sound has consistently accommodated the most exacting of architectural nuances by virtue of their custom cabinet building division and skilled crafts people. Billy S. Hilbun, Founder, and John Spillyards, owner of Crescendo Sound Systems listened to the concerns of the Saint John's staff and considered the options.

"We approached the Saint John's staff with the concept of a side dispersion throw system in a mono configuration, utilizing enclosures on either side of the chancel. Although the enclosures would appear to be a stereo system, we preferred to run in mono for a variety of reasons. First and foremost, we surmised the space in the sanctuary vulnerable to comb filtering which would detract from the sound. Also, the church does not use the sound system for tape-based playback or elaborate music performance. It is used primarily for sound reinforcement of speech from mono sources, namely, the Rectors. A mono configuration would provide more than adequate intelligibility and audio recording quality for the purpose of archiving church services."

"Proposal of a side dispersion throw system and the fact that Crescendo has a custom cabinet shop were really the selling points to the church staff and aesthetics committee," continues Spillyards. "We could easily blend the enclosures into the architectural style of the sanctuary and that was of prime importance in their eyes.

They were almost more concerned with the aesthetics than the actual engineering so our goal from day one was to give them a system that was as invisible as possible while meshing seamlessly to the aesthetics of the room."

THE DESIGN

Saint John's sound system was designed by Crescendo's Billy Hilbun. The Chief Engineer on the installation was Floyd Arp. The first phase of the installation commenced during March of 1991. The staff

was so pleased with the results that Crescendo was asked to design and install a similar system in Saint John's Fellowship Hall during the month of September. The sanctuary install, however was far more elaborate and challenging in its many details.

"We built two large, trapezoidal-type cluster enclosures for placement on two side wing walls of native stone on either side of the chancel," comments John Spillyards. "The enclosures were matched to the random styles of the sanctuary's traditional Wright-type windows. We constructed the cabinets from oak and stained them to match the treatment of the windows."

Figure 3. This console desk matches the pews.

The clusters are approximately six feet high, four feet wide and three feet deep. Loudspeaker components include two E-V HP640 60 X 40 trans planar horns, each with an E-V DH1A compression driver, and one E-VTL606AX low frequency 15-inch woofer system per enclosure. The two horns were deployed in a long throw/short throw configuration. "The room is so long and narrow that it required very high directivity," says Spillyards. "The resultant coverage was extremely smooth."

"One of the job's unique challenges was the mounting of the enclosures on the irregular surface of the native stone walls," adds Spillyards. "When Floyd Arp tried to mount them on the wall and make them fit

Figure 4. A closeup of one of the speaker enclosures. Note how it matches the window styles.

flush with the wall, he ended up having to chisel the native stone flat with special grooves for the units to fit into.

The church wouldn't let him use a hammer drill because of the dust so he had to chisel it by hand. It took awhile —a long while but it worked just fine and the enclosures looked great. As a matter of fact, Rector, Laurens A. Hall said the room looked better with our enclosures than it had before without them."

The chancel area is almost 40 feet deep. Facing the chancel, one views the Pulpit to the far left, and a lectern to the far right, between which are two prayer desks facing one another. Directly behind the desks are two antiphonal choir lofts facing one another on either side of the chancel's center aisle. Behind the lofts at the rear of the chancel is the altar. To the left is the baptistry room and above that is a loft for the organ chamber. Custom built, E-V-loaded 8-inchcoaxial monitors with compression horn/drivers were designed and built for various locations on the chancel where they were mounted on the inside walls at various intervals. Measuring 15 X 12 X 8-inches, the woodwork on the enclosures was designed to match the areas of coverage including the altar and the baptistry room. A pair of wedge-style floor monitors were constructed to serve the orchestra.

Figure 5.Overview of console area.

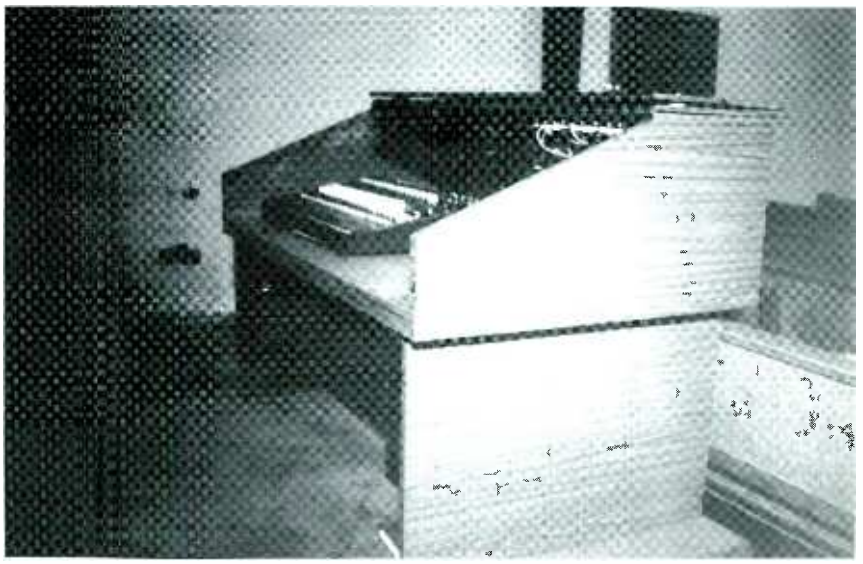


Figure 6.The console also has a tape desk patch panel.

A mixing desk made of light oak is located in the balcony and closely matches the wooden pews. The custom built desk is 6 feet wide x 42 inches high x 36 inches deep. Though the desk resembles a roll top, it employs a piano-hinge lid. Inside the desk is an Allen & Heath SR424 24-channel mixing board and patch bay for tape machines and auxiliary signal routing. An accompanying rack is stored in a service area off to the side of the balcony. The rack contains all of the power amps, and signal processing gear supporting the entire installation including a distributed monitor system fanning out to several remote locations. The rack is configured with a QSC MX 1500 power amplifier, three QSC MX 700 power amps, graphic equalizers including a DOD R231 and DOD R835 crossover for the mains, and a DOD R830 graphic equalizer for the monitors. The MX 1500 drives the lf units of the two main clusters in a dual mono configuration, while the MX 700s drive the horns and monitors. The equalizers are used to compensate for acoustic anomalies intrinsic to the sanctuary.

An interesting aspect of the installation is the distribution system fanning out to nurseries, a gift shop, the library, an office, the Fellowship Hall and the bell tower. The system utilizes eight ceiling speakers and two wall mount speakers for a total of ten enclosures powered by two existing TOA 80 watt amplifiers already owned by the church and interfaced into the system. The amps, located in the aforementioned rack, deliver 70-volt power throughout the immediate area and surrounding campus.

Saint John's is the proud owner of a one hundred-foot-high bell tower inside which resides a manual Carillon system. The operator rides an elevator to the top of the tower where he operates the tower bells from a manual keyboard. In many churches, Carillons are operated via remote digital playback systems located at the organ console, or via automated digital playback systems utilizing a timer or some variety of memory device. St. John's preferred to go the tractional root. "Actually," comments John Spillyards, "the traditional method was to have Quasi Moto climb the tower and pull the ropes by hand so this is more of a modern traditional approach requiring an actual person in the tower."

With this approach, a monitor was required for the operator in the tower in order to receive his cues. An enclosure had to be installed and fed from the distribution system, "and that meant one of our guys had to climb an emergency escape ladder 100 feet up into the tower, pulling the speaker cable up behind him," says Spillyards. "It was a sizeable job and required some bravery to make the climb."

"The wire runs were rather interesting throughout the entire job," continues Spillyards. "The runs were very long and we had to compensate for that in a lot of locations. The physical act of pulling the wires was quite extensive. The mic line runs averaged over three hundred feet apiece. Speaker lines ran two hundred feet. The distribution runs were phenomenal. One run alone was over five hundred fifty feet."

Figure 7. Choir mics, pulpit and two prayer desks.

"Inside the sanctuary, our technicians used a crawl space on top of an air conditioning chase which runs length of room to make the cable runs from the balcony/mix desk position to the chancel area," adds Spillyards. "There was no other conduit, and with a solid wood ceiling, there was no other way to get the wires from front to the back of the sanctuary but to crawl through the two foot crawl space up high in the sanctuary. We snaked the cables down through a bunch of equipment rooms to the basement and up underneath the stage with West Penn 291 mic cable, and 225, 226, and 273 speaker cables."

Routing the wires under the balcony to the mixing desk was somewhat of an acrobatic feat because there were four right angles in the chase. It was too small to crawl through so the technicians had to fish the wires through which took a lot of time and patience. They used fish tape—a rigid, flexible wire with a string attached. Once the wire was snaked through the maze, the cables were attached to the string and pulled through the tight quarters.

"The microphones on this installation were 100-percent Audio-Technica," says Spillyards. "Remember the big issue was aesthetics so we chose to use the Audio-Technica UniPoint Series for invisibility and because we're so impressed with the way UniPoint microphones perform in church applications. Of course the UniPoint microphone is almost a given for most any church installation at this point no matter who's doing the job and we're no exception. We used four AT1031 wireless diversity systems teamed with AT831 miniature condenser lapel microphones for the Rectors. At the pulpit and the lectern we installed AT857QML 19-inch gooseneck microphones. At the two prayer desks we put the AT857QM's—shorter versions of the pulpit and lectern mics. At the altar we used an AT871 boundary microphone. It serves the same function as a PZM—an invisible, flat surface pickup mic. The members of the congregation take communion at the altar. Most of the clergy have wireless systems. If there are any other clergy at the altar, they need to be mic_d in a way that's completely unobtrusive so we used the AT871."

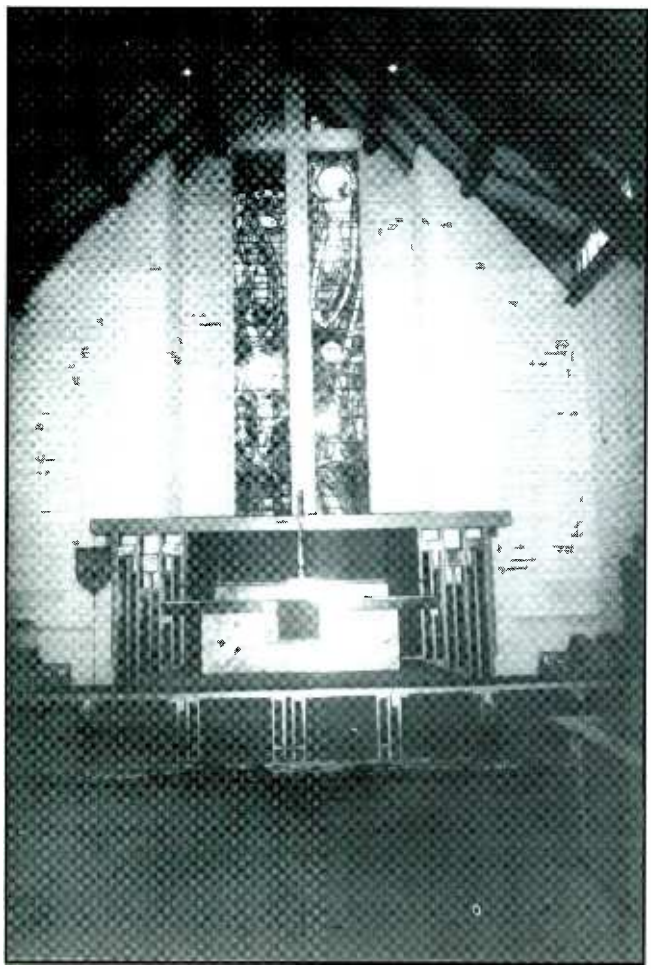
"Above the antiphonal choir split into two groups on either side of the chancel aisle, we hung four AT853 miniature condenser mics," continues Spillyards.

"We had to have special cables made because they were 50 foot drops from the ceiling. They don't impede anyone's view of the stained glass at all. That was never an issue because they're located far enough from the center aisle — outside the line of sight to the glass. They are so tiny and the cable is only 28 gauge. Against the backdrop of native stone, the AT853's are barely discernable and the cords look like black threads."

"We contracted with Crescendo Sound to install a sound system in our main sanctuary and we are quite pleased with the finished product,"

"Hanging those mics was a nerve-racking experience though," adds Splillyards. "The church owns a genie lift for changing light fixtures. Our guys had to ride that thing up 40 feet to hang those mics. One strong breeze and they'd have been history."

Figure 8. Main altar with the stained-glass windows behind. A choir mic is seen at right.



"We're using the Audio Technica Unipoints now for all of our installations," comments John Spillyards. "They're extremely sensitive and have the best diaphragm in the industry. To my knowledge, they're the first series of microphones designed specifically for church applications. They work so well and they're so attractive that we've used them again and again. In this case not only was quality of sound important, but aesthetics were given equal consideration so we went instantly to Audio-Technica Unipoints and it never even occurred to us to use anything else."

MORE WORK

"The church has just been thrilled with the system," adds Spillyards. They were so pleased, they had us come back and install a system in the fellowship hall. They already had a classic ceiling distribution system in place with a little mixer/amp used for speech and announcements. They wanted a music performance system as well."

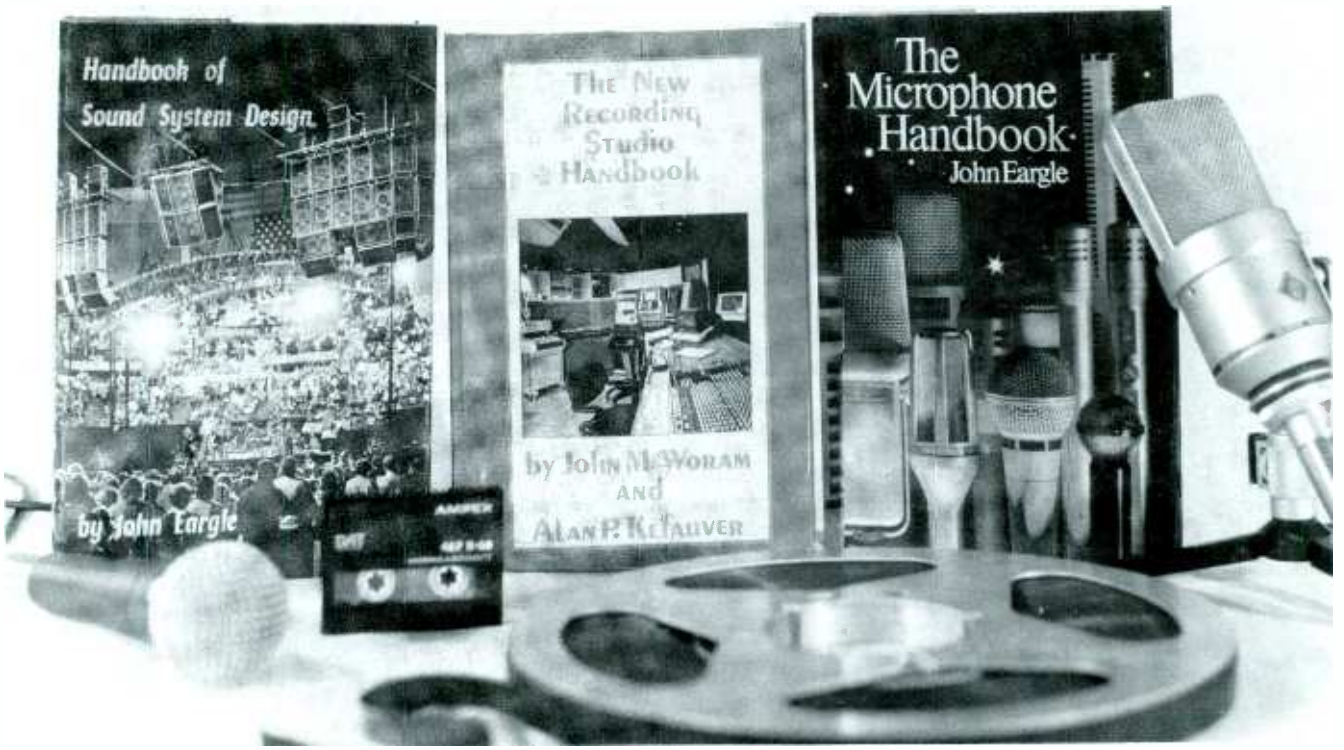
The Fellowship Hall is one hundred feet wide and fifty feet deep. The ceiling goes from twenty-five feet high at one point and cants down to ten foot high at the rear of the room. The ten-foot wall is all glass and it was necessary to control the reverberation in this type of environment so as to avoid unwanted reflections. "We actually cut into the twenty-five foot walls and recessed two chambers for speaker enclosures," says Spillyards. "Behind the wall where we made our cuts, there was an air handling room behind one cut and a return air plenum behind the other.

We assembled two enclosures utilizing E-V HP940 90 X 40 horns driven with E-V DH1A compression drivers, and an E-V TL606AX low-frequency unit. Mounting the enclosure in the air handling room was easier. Mounting the second enclosure above the return air plenum, however, took a little bit of gymnastics but it worked. The fronts of the enclosures appear flush with the wall of the fellowship hall where we covered them with grill cloth."

Crescendo built a five-foot wide rolling mix desk with a fifty-foot snake and terminated all signals to the wall. This system is for fellowship concerts or performances. The mobile desk rolls out from wall. The snake uncoils from inside the desk. A 16-channel TOA mixing board is powered with QSC amps, and processed through a DOD graphic equalizer and crossover. All power and signal processing gear is self-contained in the desk. It is a simple matter to roll the desk out to a central mix location in the hall, turn it on, and connect the snake to a custom junction box at the wall.

"We contracted with Crescendo Sound to install a sound system in our main sanctuary and we are quite pleased with the finished product," comments Business Administrator of Saint John The Divine Episcopal Church, Mollie DeVries. "At our request, they were able to blend the speakers they mounted on our walls with the sanctuary architecture and the aesthetic value is wonderful. The sound system itself adds wonderful presence to services and we were so pleased that we contracted with them to install a similar but smaller system in our fellowship hall, and we've worked with them on two different occasions. They're wonderful people to work with and we've enjoyed our business association tremendously." db

The ELAR Audio Library



The Books You Need To Be A Better Professional

• John Eargle's *Handbook of Sound System Design* has the answers to those needs you have for accurate technical information about sound reinforcement. It contains every thing from a small church to Madison Square Garden, from live sound for 60,000 to canned sound for 600. Chapters: High-Frequency Speaker Systems, Mid-Frequency Speaker Systems, Low-Frequency Speaker Systems, Dividing Networks, Central Loudspeaker Arrays, Distributed Systems, Paging Systems, Microphones, —All this and more.

• *The New Recording Studio Handbook* by John Woram and Alan P. Kefauver is for everyone involved in recording. It is already established as the "bible" for learning all the basics of the recording studio operation. This includes the latest in the many kinds of noise reduction, analog recording, digital recording from multi-track to R-DAT, what they are and how you use SMPTE and MIDI time codes, signal-processing equipment, microphones and loudspeakers (monitors), and all about the new automated consoles.

• If you are a professional in audio and use microphones in any aspect of your work, you need John Eargle's definitive *The Microphone Handbook*. Among the topics covered are: Using patterns effectively, directional characteristics, remote powering of condenser microphones, sensitivity ratings and what they mean, proximity and distance effects, multi-microphone interference problems, stereo microphone techniques, speech and music reinforcement, studio microphone techniques, and so much more.

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JOE CICCARELLO

The Brooklyn Tabernacle: Setting the Standard for Excellence

There was a time when the world's greatest music originated from the church. It employed or commissioned composers such as Johann Sebastian Bach and George Frederic Handel to fill its cathedrals with music that would glorify God.

THE CHURCH WAS COMMITED TO the biblical mandate to "Sing unto the Lord a new song. Play skillfully...." Psalm 33:3. It thereby set the standard for music and the arts.

Today, the church falls short of the stature it once held as the purveyor of the arts. But there is however, a resurgence especially among biblically-based churches to utilize music and the arts in expressive worship and outreach. The growth of the Christian music industry is one indication that the church is desiring to raise a standard of excellence that the world will take seriously.

One church which is doing just that is the Brooklyn Tabernacle in New York. With a membership in excess of 6,000, the Brooklyn Tabernacle places a strong emphasis on praise and worship and therefore, music plays a central role in the life of the church. Some of the top names in Christian music come to the Tabernacle every year to sing with the famed Brooklyn Tabernacle Choir. The choir has nine albums to its credit and yearly sells out Radio City Music Hall. With a music program of this caliber we decided to take a closer look at their approach to audio.

Joe Ciccarello is the Music Director for a 500-member church, the Christian Victory Center in Hempstead, NY. He has a Masters of Arts in Communication from Regent University.

The Brooklyn Tabernacle's present sound system was designed and installed by *The Top in Sound* located in Andersen, Indiana. With the aid of computers, system designer Bill Gillette, selected the components to create the sound for the 1,500-seat auditorium. At the center of this semi-circular converted theater, hangs a cluster of Electro-Voice speakers. (See *Figure 1.*) The four-Sub woofers are EV-TL3512's. Each cabinet contains an 18-inch driver. Mid range frequencies are handled by 2 EV-TL806 DX's. Each cabinet contains two—12-inch drivers. Four E-V horns loaded with DH 1-A drivers cover the high end and come in the long and short throw varieties. Three of the long throw E-V horns HP640's, fan out to cover the sides of the auditorium and middle balcony while the single short throw horn-HP-940, fills the middle and front floor. Finally, the left and right balconies are each reinforced by another E-V cabinet. Each contains a 15-inch driver and a horn. Due to the overhang of the balcony and the position of the center cluster, six Yamaha FX 20s were added to cover this dead spot (see *Figure 2*). Another area where fill was needed was directly in front of the stage. During their present renovation, four Bose 402s have replaced the Yamaha FX20s because of wider frequency response.

THE POWER

The power amps assigned to the center cluster, front fill and monitor system are located under the stage. The signal coming from the main house console is first sent directly through a White 27-band graphic EQ and then into a E-V EXQ3- 3 way crossover. From there, the high frequencies sent to the four horns are powered by a Crown Microtech 600 stereo amp—two horns per side. A Crown Microtech 1200 powers the two mid range cabinets and a second Crown Microtech 1200 drives the four sub woofers. The signals sent to the front fill is first routed through a Yamaha GQ 1031 BII graphic EQ and then powered by another Crown Microtech 600. The fill under the balcony is first sent through a Yamaha ⅓- octave graphic EQ and then a Yamaha SPX 90 delay under the stage before it is powered by a Microtech 600.

Finally, the signal sent to the satellite balcony speakers is treated identically to the center cluster, except that it is sent through a delay. It first goes through a White 27-

band EQ then to a Yamaha SPX 90 set at 0.53 second delay then into a E-V XEQ2 2-way crossover and then powered by a Crown Microtech 600.

LAYOUT AND MONITORING

Sometimes the best-designed churches are ones that were not originally designed as such. Many churches are finding that converted theaters provide the basics for a great sanctuary. Good acoustics, seating that provides easy viewing of the stage, and existing power to handle sound and lighting requirements, make theaters easily convertible to church use. Brooklyn Tabernacle takes good advantage of these assets. The natural ambient response is between 1.5-2 seconds giving it a live sound but with negligent echo, thanks to padded pews and carpeting (not to mention 1,500 bodies). Above the stage, hang fourteen acoustic clouds, which were added to help project the sound of the choir forward. The semi-circular design and shallow ground floor makes even the farthest balcony seats feel relatively close to the stage. The stage area is large enough to accommodate the 200 voice choir (standing only), a 6-8 piece band, soloists and special dramatic presentations. Two glass booths are located above and behind the choir. One serves as an isolated room for brass and reed players while the other houses the monitoring console (see *Figure 3*). I was particularly impressed with the rhythmic tightness of the band and especially the clarity and fullness of the drums. Upon closer examinations I discovered that they were all electronic MIDI pads, except for cymbals. The advantages of using MIDI drums in a close setup situation such as this are twofold:

1. With the choir and band literally surrounding the drums, an acoustic set would cause all kinds of leakage problems into the sensitive choir mics. Electronic midi drums (with the exception of cymbals) are virtually silent eliminating any bleeding.

2. The band and choir can play with greater precision because of their physical closeness.

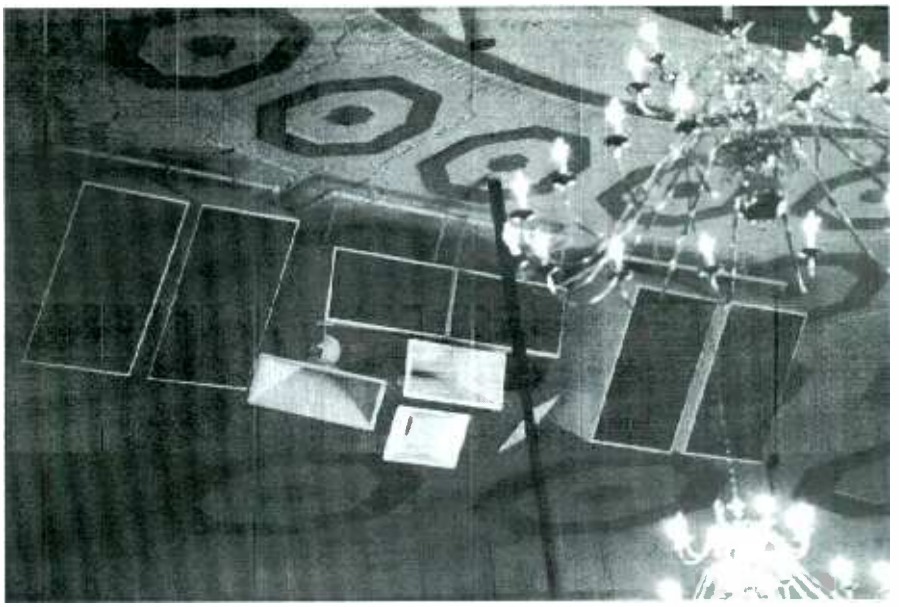


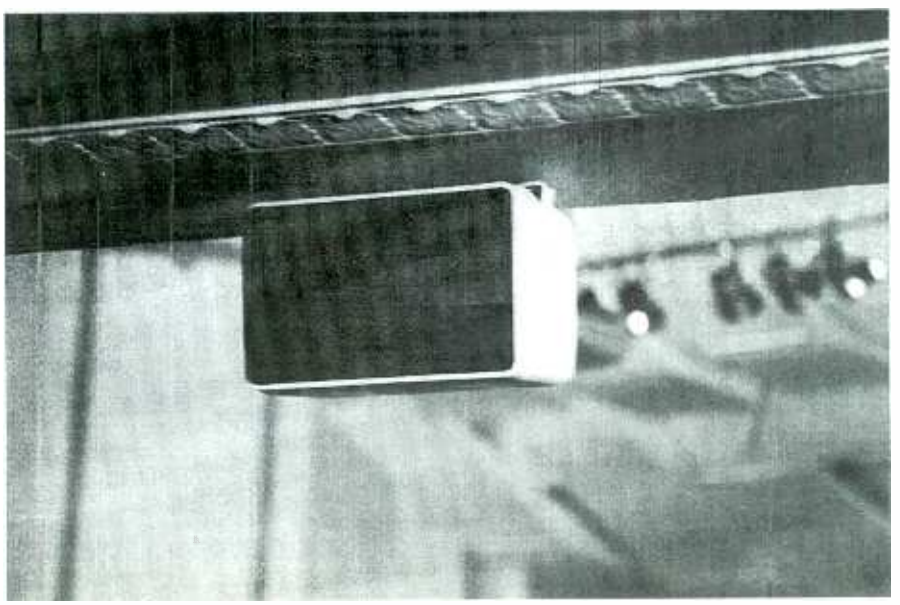
Figure 1. This cluster hangs in the center of the converted theater.

MONITORING SYSTEM

One of the unique features of Brooklyn Tabernacle's sound system, and another example of their commitment to excellence, is their monitoring system. Most churches would consider it a luxury to have four separate mixes on stage. This system features nine—with a capacity for ten—with effects! The monitoring console is a Soundtrac MCX series 32 X 10. This console is located in its own room above and behind the choir in full view of the head sound person in the balcony. *Figure 4* shows a simple diagram of the monitoring set up on stage. Four of the nine monitor feeds are sent as line-level outputs because the piano, keyboards, drums and organ have powered monitors on stage. A six-point intercom system is wired between two locations on stage, brass booth, monitor room, house console and security room.

There is nothing more frustrating for a musician or singer trying to communicate with a sound person (in sign language no less) when you're having a problem with your

Figure 2. These Yamaha FX20s cover the dead spot under the balcony.



monitor mix. An intercom system such as this might be an added expense, but is well worth it in the long run.

MICROPHONES

The church owns a varied selection of microphones. The following is a list of the types and their uses:

Ten Audio Technica AT 853. Used strictly for micing the choir.

Twelve Sennheiser ME-80. Original shotgun choir mics. More directional (than AT853) to get past cymbals and rhythm section. Also used for smaller choral groups.

Seven Shure SM 58. Widely used all-purpose vocal mics.

Six Electro-Voice PL 77-B. Used on percussion and horns because of added frequency response at high end.

One Samson Wireless Lavalier BT3. Used for dramatic presentations, Bible studies and preaching.

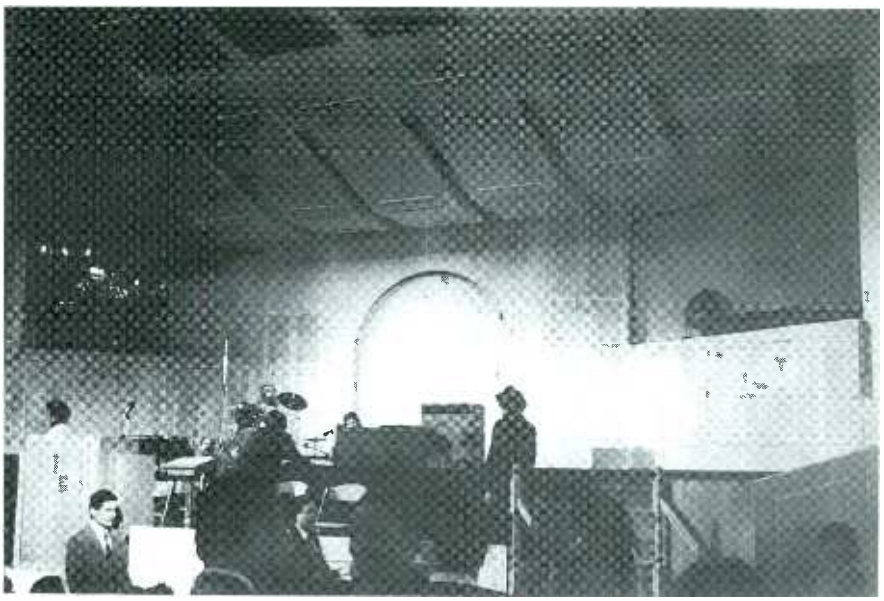
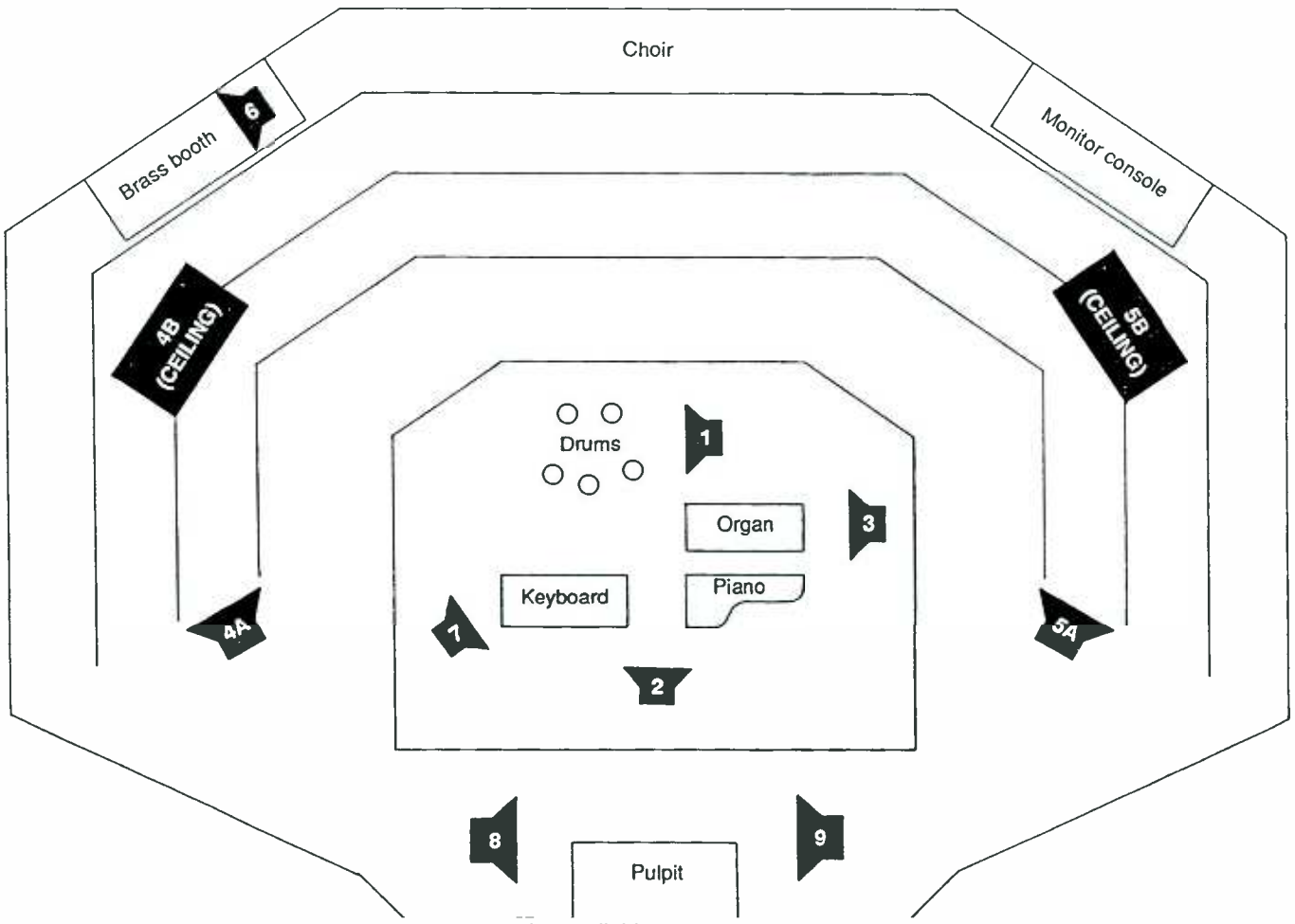


Figure 3. This isolated glass booth houses the monitoring console.

1 Samson Wireless Handhold (BT2). Vocal or speech (upon request).

Two Crown PCC160. Low profile floor mic for dramatic presentations and children's signing groups.

Figure 4. Legend: 1–drum monitor; 2–TOA powered monitor, piano; 3–TOA powered monitor, organ; 4A–JBL 4602B; 4B–E-V ceiling monitor; 5A–JBL 4602B; 5B–E-V ceiling monitor; 6–Peavey 112 HS; 7–Keyboard powered monitor; 8–Yamaha S2115H; 9–Yamaha S2115H; 19–spare.



One Audio Technic ATM 33R. Used for micing the hi-hat or the drums.

One Crown PZM (pressure zone microphone) used to mic the grand piano.

Two Meyer M-600. Used to mic the Leslie speaker cabinet.

The remainder of the instruments which are not miced on stage, go direct using Pro Co direct boxes. Fifty-four XLR input jacks are on stage (which include ten dedicated choir mics) and an additional 4 are available in the brass booth.

MAIN CONSOLE & EFFECTS

Located in the front middle balcony is the control center for the sound and lighting systems. It features 2 mixing consoles, a patch bay and a host of EQ's, effects and tape decks that would send most church sound people into raptures! The main console is a Soundcraft series 500 (see *Figure 5*). It features 32 inputs, 8 outputs, 6 auxiliary buses and 4 bands of EQ, 2 sweepable and 2 fixed. Immediately to its left is another smaller console, 1 Yamaha 1204 x 4 board singularly used to mix the 10-12 incoming choir mics. Gene Wooten, B.T.'s soundman likes to mix the choir mics down to 3 subs (soprano, alto & men). He then takes the single output from the Yamaha and routes it through a Rane SP15 notch filter to knock out any feedback. On occasion Gene will also patch in a Rane RE-27 EQ with spectrum analizer. With this device he can visually see, via multicolored LEDs which one of the 27 bands is causing the feedback and then drops it out. From there the choir signal is sent to the main board. With 6 auxiliary buses available at each of the 32 channels, various effects can be added. The following is a list of effect devices and their uses:

Roland SRV 2000. Used for reverb on main vocals.

ART DRT 24. Reverb for snare

Yamaha SPX-90. Reverb and delay

Alesis midiverb. Spare

The main vocal mix used for speaking and lead vocals is sent through a DBX 263X. This de-esser filters out the highly sibilant frequencies around 3200 Hz while maintaining clarity. According to Gene, his "most life saving piece of gear" is the Symetrix 522 dual channel compression/limiter. He uses the left channel for the main speaking and singing mic. Gene explains that no matter how fast you ride a slider the compressor/limiter will do it better. He sets the ratio at 2:1 with a quick attack time and a moderately fast release time. On the right channel Gene compresses the bass guitar. With the wide variety of styles played, this device guards against popping without killing the punch. He sets the ratio at 2:1 with semi-slow attack and fast release times. In the tape deck department the church is evolving to DAT (digital audio tape) but presently uses two machines—one for playback, one for recording. The playback machine which is used for vocal accompaniment tracks is a Nakamichi MR-2. The recording deck is an Akai GX-912. A separate room above the balcony (formerly a projection booth) serves as a recording and duplication room. Its sole function is to record and duplicate tapes of the pastors' sermons and make it available to the church.

Figure 5. This Soundcraft Series 500 is the main console with an auxiliary Yamaha 1204 X 4 at the left.

TRAINING

Gene Wooten serves as the head of sound at the Brooklyn Tabernacle. His main responsibilities include mixing the choir and main Sunday services and training a volunteer staff of twelve. Training a person, from beginning to end, takes about six months. Gene ideally prefers people with some formal training in music or electronics or both but will train anyone who is committed to serving the Lord and willing to learn.

The first three months are spent in studying the design of the system and learning how to properly set up and tear down. The trainee then begins shadowing the operator and observing for as long as needed. With Gene's approval he or she starts mixing the easier services and training is completed.

Most choose to specialize in either house or monitor mixing. A staff of twelve sound people may seem like a lot for a church but with two singing groups going out every weekend to prisons, half-way houses and outdoor rallies (in addition to regular weekly services), these twelve people get quite a workout. Gene's assistant Marilyn Moreno maintains a weekly schedule to ensure proper coverage at all meetings and events.

Most churches may never reach the size of the Brooklyn Tabernacle, or have the budget to buy all of their equipment, but if churches would commit to equip and train themselves properly, the tradition of excellence which characterized the church would continue. db

BRUCE BARTLETT with JENNY BARTLETT

Review: Digital Designs Nearfield Monitor Loudspeakers

The DD6a speaker, DD261a speaker and DDBP12 Subwoofer.

LOOKING FOR A GOOD NEARFIELD monitor speaker? Digital Designs has been producing professional nearfield monitors for several years now with periodic upgrades. Here's the scoop on their latest models.

- The **DD6a** speaker uses a 6.5-in. woofer and a 20 mm tweeter in a small cabinet.
- The **DD161a** is the same but with a slightly larger cabinet for deeper bass.
- The **DD261a** is the same but with two woofers for still-deeper bass and higher output capability.
- The **DDBP12** bandpass 12-in. studio bass monitor is a subwoofer for use with the monitors listed above.

All the models are of sealed-box design with low-mass, high-strength cones. These features are claimed to give the tightest possible bass and excellent transient response. According to Digital Designs, the bass is accurate, not exaggerated.

The 6.5-in. woofer uses a mineral-filled polypropylene cone which is coupled to a compliant rubber suspension. The cone is extremely light for quick reaction to the incoming signal, and is internally damped to prevent ringing.

As for the motor structure of the drives, the design intent was to use a shorter coil length in a longer magnetic gap—an "underhung coil". According to the manufacturer, this provides more linear vibration with less distortion compared to conventional long-coil short-gap designs. The woofer voice coil can withstand high temperatures and the tweeter is ferrofluid cooled. Magnetically-shielded versions are available for use near video monitors.

The crossover design is minimal to prevent phase shift and non-uniform group delay. Around 3500 Hz, the woofer rolls off acoustically at 12 dB/octave, so no crossover components are used to roll off the woofer. A simple one-stage crossover keeps lows out of the tweeter. Internal solder connections are silver.

The woofer and tweeter are time-corrected or signal-aligned; this sharpens transients and smooths the response around the crossover frequency. On the back of the cabinet are gold-plated binding-post connectors. In the DD261a, connector polarity is indicated by small red and black rings at the base of the posts. Also on the back of the DD261a is a toggle switch labeled "accurate/mid-boost." The mid-boost position is meant to simulate a Yamaha NS10M nearfield monitor.

To improve the stereo imaging, the speakers are sold in mirror-image pairs with small front baffles. Several design features prevent diffraction and reflection effects which can color the tone quality and degrade transient response. For example, cabinet edges are rounded, tweeters are mounted off-center, and the grille is sonically invisible. The woofer and tweeter are mounted as close together as possible to simulate a true point source.

The monitors present a handsome, professional appearance. Cabinet finishes are available in black or oak.

PUBLISHED SPECIFICATIONS

Digital Designs supplied these specifications for the DD6a:

Frequency response: 68 Hz-20 kHz ±2 dB.
Impedance: 4 ohms.
Sensitivity: 88 dB SPL/watt/meter.
Power handling: 60 watts.
Dimensions (H,W,D, inches): 12 X 8.5 X 8.5.
Shipping weight (lbs): 28/pair.
Price: $365/pair.

Specs for the DD161a:

Frequency response: 52 Hz-20 kHz ±2 dB.
Impedance: 4 ohms.
Sensitivity: 88 dB SPL/watt/meter.
Power handling: 100 watts.
Dimensions (H,W,D, inches): 13.5 X 9 X 10.
Shipping weight (lbs): 33/pair.
Price: $520.00/pair.

Specs For The Dd261a:

Frequency response: 48 Hz-20 kHz ±2 dB.
Impedance: 8 ohms.
Sensitivity: 88 dB SPL/watt/meter.
Power handling: 200 watts.

Dimensions (H,W,D, inches): 18.5 X 10 X 13.5.
Shipping weight (lbs): 29/each.
Price: $698/pair.

Specs for the DDBP12:
Voice-coil diameter: 2.5-in.
Driver Fs: 19 Hz.
Power handling: 200 watts RMS.
Sensitivity: 92 dB SPL/ watt/meter.
Impedance: 4 ohms per channel.
Weight: 70 lbs.
Speaker weight: 16 lbs.
Frequency response: 5 dB down at 32 Hz; 10 dB down at 24 Hz.
Dimensions: 16 X 16 X 24.
Finish: Black textured paint.
Price: $770.00 to $900.00 depending on options.

DDBP12 SUBWOOFER

Using a 12-in. cone driver, the DDBP12 subwoofer was designed to provide extremely accurate, tight, and well-controlled bass; as well as high durability to cope with the demands of studio use.

Using the same short-coil, long-gap design as the nearfield monitors, the sub is intended to maintain control of the voice coil even with long excursions. According to Digital Designs, the voice coil never leaves the magnetic gap. You can EQ-in a bass boost without making the cone bottom out.

Digital Designs has taken special care to prevent voice-coil overheating. Overheating a voice coil causes several problems: As coil temperature goes up, coil resistance rises. This reduces the coil current, which reduces sound output. Then if you turn up the power amp to get more sound level, the coil heat rises again. To prevent this overheating, the metal structure around the voice coil is black-anodized to efficiently transfer heat from the coil to the motor structure. The motor structure is ventilated so that cool air pumps through the driver.

The enclosure design is innovative, using an acoustic bandpass rather than an electronic bandpass. That is, the enclosure itself acts as the crossover, hence the name "bandpass enclosure." There is no electronic crossover to cause phase shifts. The physical design of the woofer enclosure is a sealed back chamber and a vented front chamber. You can't see the cone; all you see is a port on the front baffle.

Constructed of high-density fiber board, the subwoofer cabinet is internally braced for solidity. Its surface is finished to resist water and marring. All mounting hardware uses threaded inserts for strength.

On the back of the cabinet are two subwoofer connectors per channel. They feed a single driver with dual voice coils. This clever design results in a combined mono signal for the deep bass, without any extra circuitry needed.

Other connectors include a pair of binding posts for each satellite speaker, 4 or 8 ohms.

The sub can be ordered without a crossover for electronic-crossover applications. Mono versions are available if you want to use one subwoofer per channel.

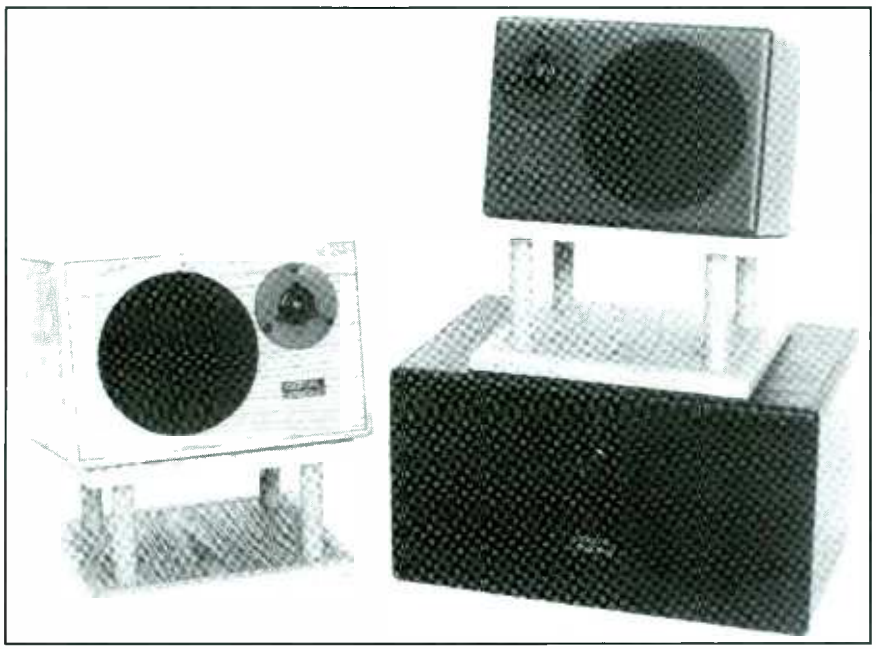


Figure 1. The DD161a is at left, theDD6a is at top right and the DD261a is at bottom right.

DD6a LISTENING TEST

Before making any measurements, I listened to the various models both with and without the subwoofer. I did not have the DD161 for testing. Speaker placement was in the middle of my control room, 3 feet apart and 3 feet from me, at ear height just over the mixing console. I played compact discs on a Magnavox/Phillips CDB610 CD player through a Crown PL-4 power amp (260 watts/channel into 4 ohms).

The first group of tests was of the DD6a, the small model with one woofer. When listening, I aimed each speaker straight ahead, rather than at me, because the sound on axis was too bright or sizzly. On the CD *The Nightfly* by Donald Fagen, the music is given a forward, bright sound. Cymbals are airy and sweet. All instruments are clearly defined. Although the bass does not go deep, it is usable, and very tight. The stereo stage is wide—slightly beyond the speakers— with very sharp imaging.

More bright, crisp sound is heard in the CD *Ivory Coast* by Bob James. Lots of clarity and presence here. Although there's not enough bass to balance the highs—the speaker seems to lack body or fullness—the kick drum sounds very tight.

On Telarc's recording of *The Firebird* by Stravinsky, the beginning bass-drum roll is absent. The woofer breaks up on loud bass-drum whacks, but this is a tiny speaker. It's very easy to follow individual instrumental lines. The overall tonality is clinical rather than warm. Imaging is palpable on most instruments, even with this spaced-microphone recording.

All the following recordings were auditioned with the subwoofer added. When I hook up the subwoofer, the deep throb of the bass-drum roll comes in, adding weight.

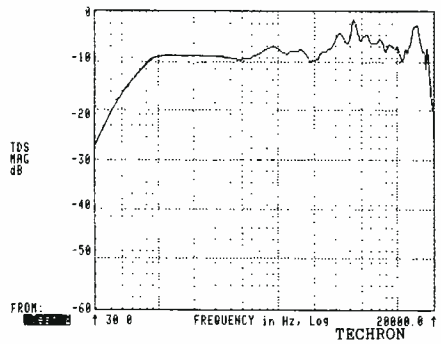


Figure 2. Full-space anechoic response of the DD6a.

Although the small satellites still break up on the bass-drum hits, the sound is more realistic. I feel that the sub is well integrated with the satellites. The tonal balance is improved—more of a whole, smoother, less top-heavy. You'll hear palpable, woody pizzicatos and breathy flutes.

With its deep bass and trombones, the recording *Chorus* by Eberhard Weber is difficult for most speakers to reproduce without tubbiness. But the DD6a/sub combination sounds very tight in the bass, never bloated. At high listening levels, however, the DD6a starts to blur or distort the trombones. The speaker is not meant for really loud monitoring. You can hear tiny gradation in the volume of the brushed snare, which is reproduced with great presence. In fact, you can almost see the wires in the brushes!

Unplugged, the new all-acoustic CD by Paul McCartney and friends, is reproduced with very sharp imaging. The tonality is bright or top-heavy, sometimes sizzly, with harsh sibilants in the vocals. However, the dobro is given a realistic twang. In this recording, an acoustic bass guitar was played rather than an upright bass, and you can easily hear the difference with the DD6a.

In *Appalachian Spring* with Leonard Bernstein conducting, you can hear detailed production noises, such as rustling in seats and breathy flutes. The strings have a sheen that verges on strident. This is a lively speaker, not a reticent one. It's easy to hear that the orchestra was close-mic'ed. At high volume, the speaker adds a little grunge.

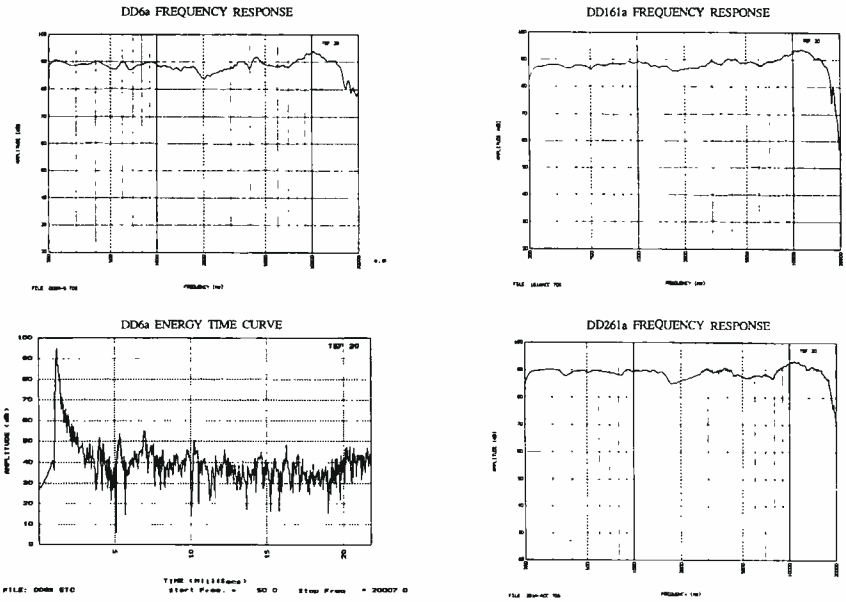


Figure 3. Digital Design's published response curves, 200-20 kHz (see text).

DD261a LISTENING TEST

The following recordings were played over the DD261a dual-woofer monitors with the DDBP-12 subwoofer. Since the DD261a sounded best when aiming at me, that's how I listened to them.

McCartney's CD *Unplugged* sounds clean, with less-harsh sibilants than in the DD6a. The center image is extremely sharp, and the speakers reproduce all the crispness of live guitars. Still, the DD261a does not sound harsh, twangy, or etched. When I change the "accurate/mid-boost" switch to mid-boost, the sound becomes slightly colored or honky but still is listenable.

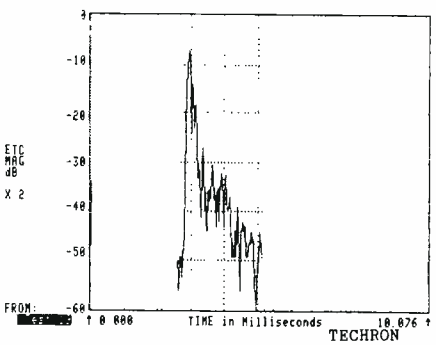
I performed several mixes using the DD261a/subwoofer combination as monitors. Listening fatigue was low, and the mixes translated well to other speaker systems.

The DD261a provides a very uniform bass response with the CD *Chorus* by Eberhard Weber. There's no evidence of "one-note-bass." The speaker reveals some modulation noise in the recording. The DD261a definitely handles the trombones better than the DD6a; there's less distortion or blurring. With the subwoofer disconnected, the deep bass notes lack weight or power, but still sound full.

On *The Firebird* by Stravinsky, there's a fuller, mellower tonal balance than you hear with the DD6a. Coloration is minimal. You can hear details such as key clicks in the woodwinds. When the bass drum hits some loud whacks, there's less distortion than with the DD6a.

Ivory Coast by Bob James sounds well balanced tonally. Compared to the DD6a, the DD261a sounds smoother, more listenable, and prettier. Any colorations are well controlled; there's no boxy effect. You can clearly separate the many instruments in this recording. Great job!

Figure 4. The energy time curve of the DD6a.



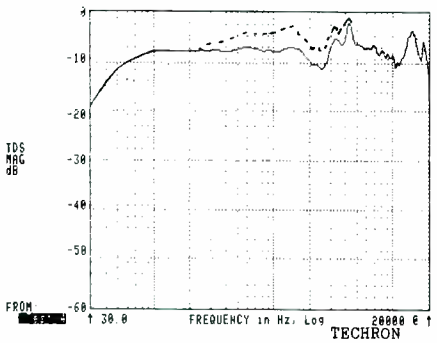


*Figure 5. Full-space anecoic frequency response of the DD261a. Solid line:**Accurate** response; dashed line: **Mid-Boost** response.*

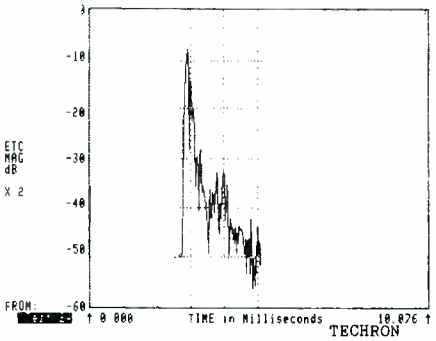


Figure 6. Energy time curve of the DD261a.

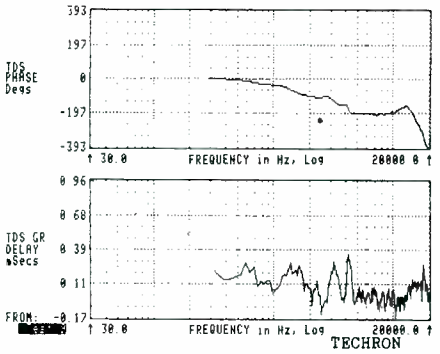


Figure 7. Phase response (top and group delay (bottom) of the DD261a.

Appalachian Spring also sounds better with the DD261a. The sound is fuller, less sizzly, more natural. Strings are still a bit strident.

Finally, I played the new Dire Straits CD, *On Any Street*, and was treated to an exciting experience. It's a full, rich, warm sound, with deep throbbing toms and bass. Cymbal taps sound airy and clean. You can easily hear each element in the mix. The dobro is striking in its detail. Overall, the effect is seductive and captivating.

I performed several mixes using the DD261a/subwoofer combination as monitors. Listening fatigue was low, and the mixes translated well to other speaker systems.

Mixing was relatively easy because the sound was so clear. Since the bass reproduction was not boomy, I could hear whether or not my recorded bass was boomy. In fact, some acoustic guitars I had recorded using different monitors sounded tubby with the DD261a.

This alerted me to roll off some lows on the guitars, and the result was a better mix. The tightly focused imaging made panning a breeze. I noticed that the sub could take a lot of low-frequency boost without audible distortion.

MEASUREMENTS

I measured the speakers with a Bruel & Kjaer 4156 lab-calibrated microphone and a Techron TEF System 12 analyzer. I placed the microphone 1 meter away, on-axis to the tweeter, and I measured from 333 Hz up to exclude any room reflections. To test the low-frequency response up to 333 Hz, I measured the woofer's near-field response ¼-in. away. This is the same as its half-space response in the far field. Then I subtracted 6 dB at low frequencies to yield the full-space response.

Figure 2 is the anechoic frequency response of the DD6a in full space. It measures 62 Hz to 18 kHz 5 dB. Peaks around 4 kHz and 13 kHz contribute to the bright, sizzly, sometimes strident sound heard in the listening tests. But they also add clarity and definition.

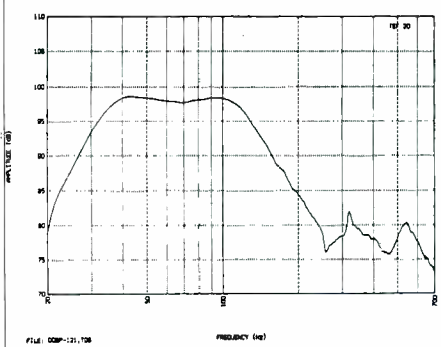


Figure 8. Anechoic frequency response of the DDBP12 subwoofer.

Designer Jesse Langford told me that the speaker's frequency response is flatter even at 10 degrees off axis.

He said that you can aim the speaker to tailor its high-frequency response (or to compensate for your degree of hearing loss!) *Figure 3* shows Digital Design's measurements of their new models, 15 degrees off-axis, with the microphone placed midway between the woofer and tweeter.

Shown in *Figure 4*, the Energy Time Curve of the DD6a is very good. The direct-sound spike is sharp, with minor cabinet reflections occurring 12 dB and 22 dB down.

Figure 5 shows the anechoic frequency response of the dual-woofer DD261a in full space. It measures 48 Hz to 20 kHz ±4 dB. The rise around 4 kHz adds some presence and definition.

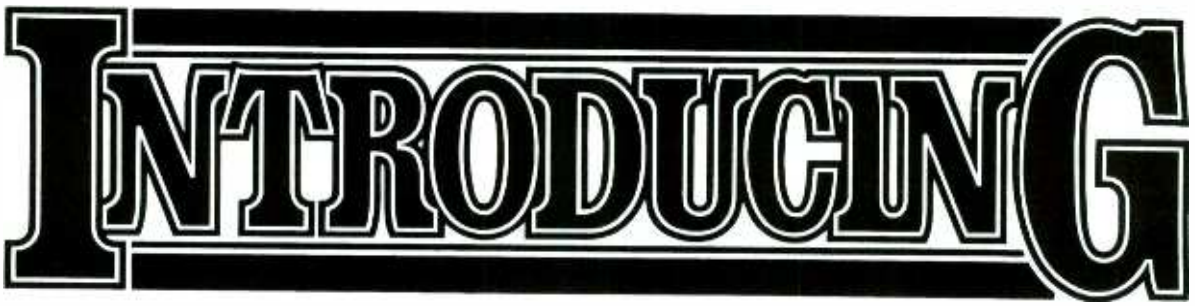
In *Figure 6* we see the Energy Time Curve of the DD261a. It's similar to that of the DD6a, with delayed reflections about 12 and 22 dB down from the direct-sound spike.

Figure 7 shows the phase response and group delay of the DD261a. This is the best group-delay performance I've seen: less than 0.2 msec over most of the audible range. This measurement verifies the excellent transient response of the speaker.

Finally, *Figure 8* is the subwoofer frequency response supplied by Digital Designs. It's essentially a well-damped bandpass from about 34 Hz to 110 Hz.

SUMMARY

The strong points of the Digital Designs DD6a and DD261 are their extraordinary clarity and detail, sharp imaging, well-controlled transient response, and tight bass. Since the speakers are necessarily small, some blurring or distortion becomes audible on loud peaks. Coloration is low but, to my ears, tends toward too bright in the DD6a. The DDBP-12 subwoofer blends well with the satellites, adding weight and power without any muddiness. Digital Designs continues to offer improved performance in their speaker line, a group of monitors with accurate and detailed reproduction. db



Your MIDI Recording Studio

by Bruce Bartlett

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BRUCE BARTLETT

Chapter 1
Your MIDI Recording Studio

The book will be available this year and will contain fifteen or more chapters, addenda, and a MIDI glossary, as well as a detailed index. Please also note that new photographs are being prepared but were not ready for this advanced chapter printing. They, of course, will be in the book.

MIDI STUDIO EQUIPMENT

In your own home, you can make professional-sounding records or sound tracks without any musicians but yourself, simply by playing a piano-style keyboard. The tools that help you do this comprise a home MIDI studio. This is a group of electronic musical instruments and devices used to compose, perform, and record music.

MIDI stands for Musical Instrument Digital Interface. It is a system for connecting electronic-music devices together so they can communicate with each other and stay synchronized.

The home MIDI studio is a wonderful system for composers or arrangers who want to hear how their songs might be performed by a group of musicians. If you're a musician who enjoys working alone, you can also use this system to create records, video sound tracks, music for commercials, or background music for spoken-word recordings.

At home you can record your performances on computer disk, take the disk to a professional studio, and have your disk play music on the studio's expensive MIDI equipment.

EQUIPMENT OVERVIEW

Every recording studio, whether conventional or MIDI, has these components:

- Musical instruments.
- Multi-track recorder—records each instrument's performance on a separate track.
- Mixer—combines the multiple tracks to 2-track stereo.
- 2-track recorder—records the stereo mix from the mixer.
- Monitor system—power amplifiers and speakers that let you hear what you're playing and recording.

Let's consider the musical instruments in a MIDI studio. Most of the instruments are electronic rather than acoustic. These might include:

- A synthesizer—a piano-style instrument that electronically simulates various musical instruments.
- A sample-playing keyboard—a piano-style instrument that plays digitally recorded notes of real instruments.
- A drum machine—an electronic device that simulates a drum set and other percussion.

Now let's look at the multi-track recorder. In a MIDI studio, you record the instruments mentioned above with a multi-track sequencer (Figure 1-1). This device records performance gestures, such as keypresses on a piano-style keyboard, into computer memory. Unlike a tape recorder, a sequencer does not record audio. Instead, it records which notes you pressed, when you pressed them, and so on. A tape recorder records the sounds you play; a sequencer records the actions you perform.

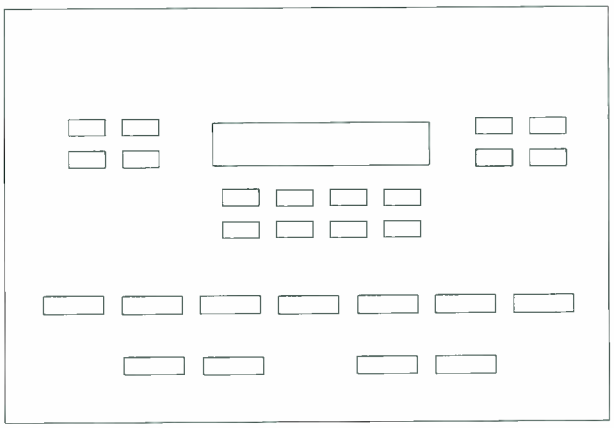


Figure 1-1. A sequencer.

A sequencer can record 8 or more tracks, with each track containing a performance of a different instrument. Three types of sequencers are available:

- A stand-alone sequencer
- A sequencer circuit built into a keyboard instrument
- A computer running a sequencer program.

The MIDI studio has a few more components. One is a *multi-track tape recorder* to record acoustic instruments and vocals. You also need a mixer, which combines the audio signals from all the tracks (both sequencer and tape) into a 2-channel stereo mix. You record this mix onto a *2-track recorder.* The recording made on that machine is the end product: your finished composition.

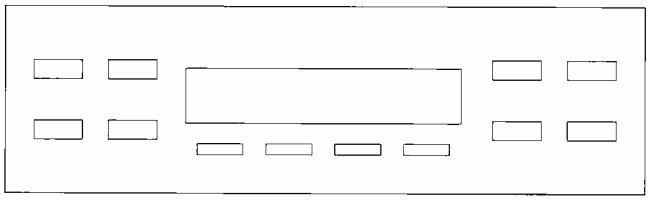


Figure 1-2. A sound generator.

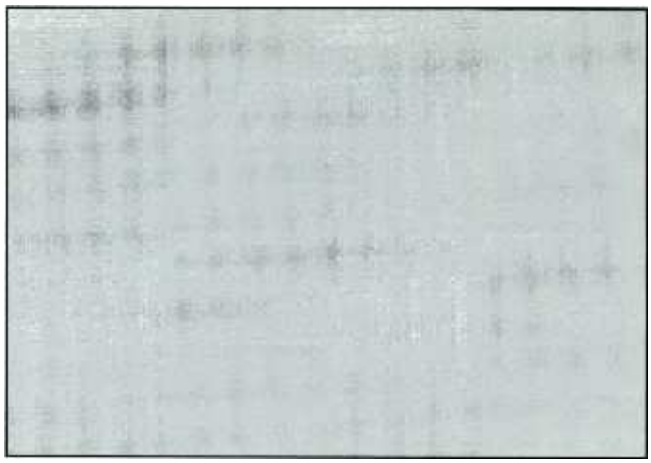


Figure 1-3. A synthesizer.

Figure 1-2 shows a simple MIDI studio made of the components just mentioned. The synth, drum machine and sequencer are connected by special cables that carry MIDI signals. These signals allow the devices to communicate with each other and play in sync. We'll cover MIDI in the next chapter.

RECORDING PROCEDURE

Here is the basic procedure for recording with a MIDI studio: 1. Play drum rhythms on a drum machine, and record them with the drum machine's built-in sequencer.

2. While listening to the drum machine playback, perform music on a synthesizer or sample-playing keyboard, and record your performance with a sequencer connected to the keyboard.

3. Check this sequencer recording by playing it back through your synthesizer. The sequencer activates the synthesizer to play the same notes you played, much like a player piano.

4. Play the synth and drum-machine parts together. While listening to them, record vocals or acoustic instruments on the multi-track tape recorder. A special sync tone on tape synchronizes the MIDI instruments with the tape parts.

5. After every part is recorded, play the multi-track tape. The sync tone activates the sequencer and drum machine so that everything plays together, in synchronization.

6. Use a mixer to blend the audio signals from the synthesizer, drum machine, and tape recorder. The resulting music sounds like a band playing.

The sequencer in this system lets you edit your music with extraordinary control. For example, you can fix wrong notes, change tempo without changing pitch, record a performance one note at a time, copy and rearrange song sections, and change synthesizer sounds after the performance is already recorded.

MUSICAL INSTRUMENTS

Let's look more closely at the electronic musical instruments used in a MIDI studio:

• **Synthesizer** (Figure 1-3): A keyboard instrument that creates sounds electronically with oscillators (tone generators). Synthesizers produce various sounds such as a synthesized piano, bass, snare drum, or choir. These sounds (timbres) are called *patches* or *programs*. A *multi-timbral synthesizer* can play two or more patches at once.

A synthesizer is limited in its number of *voices*—the total number of notes it can play simultaneously. For example, an 8-voice synth can play up to eight notes at the same time, whether with one patch or eight.

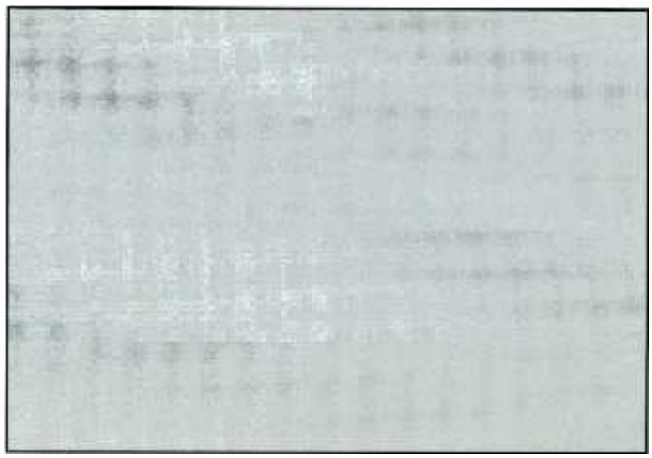
• **Sample-playing keyboard:** A keyboard instrument that plays pre-recorded notes of real instruments (Figure 1-3). Each note, called a sample, is digitally recorded in computer memory. A sample might be a flute note, a bass pluck, a drum hit, or a person yelling.

When you press a key on the keyboard, the sample plays. The higher the key you press, the higher the pitch of the reproduced sample. Thus you can select a sampled instrument and play chords and melodies with that instrument's sound.

Samples are recorded with a device called a sampler. Two examples are the Roland S-330 and Akai S1000. Often a sampler is built into a sampling keyboard, which both records and plays samples.

• **Sound module (sound generator or tone generator):** A device that generates a variety of sound timbres, either synthesized or from samples. Some examples of sound modules are the Yamaha TG77,

Figure 1-4. A drum machine.



TG33, and TG55; Kawai PHm MIDI Sound Module and the Roland Sound Canvas SC-55.

You play a sound module either from a sequencer or from a master keyboard. This master keyboard could be the one built into a synth or a sample-playing keyboard. Or it might be a *keyboard controller*, a piano-style keyboard without sound generators.

• **Drum machine** (Figure 1-4): a device that plays built-in samples of various percussion instruments, including a drum set. It also records and plays back drum patterns that you play or enter with built-in keys or drum pads. Some examples are the Alesis SR-16 and HR-16:B drum machines, the Korg S3 Rhythm Workstation, and the Roland Human Rhythm Composer. You may not need a drum machine if you have a sample-playing keyboard with drum sounds.

Having covered the electronic musical instruments, let's look at the other components in the MIDI studio.

• **Multi-track tape recorder:** a device used in a MIDI studio mainly for recording vocals and acoustic instruments. A 4-track recorder is sufficient for a budget studio; a more elaborate studio might use an 8-track recorder (either open-reel or cassette). Two 8-track cassette units are the Tascam 238 and the TOA MR-8T. Alesis makes an ADAT 8-track digital audio tape recorder selling under $4000.

A multi-track tape recorder does not have inputs for microphones, so it must be used with a mixer that has

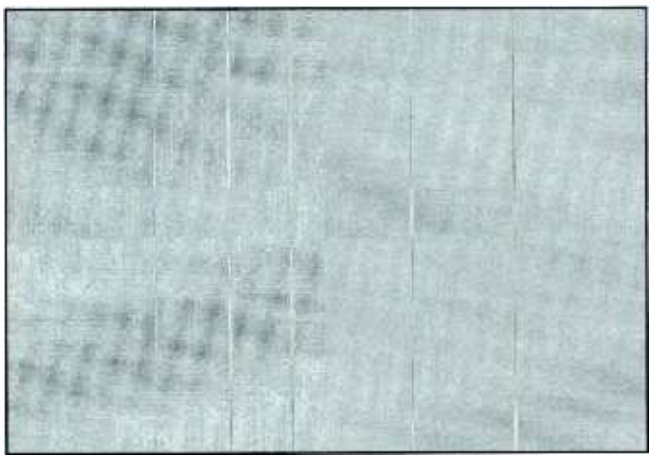


Figure 1-5. Sansui WS-X1 6-track recorder-mixer (courtesy Sansui c/o KDS Technologies).

microphone inputs. An alternative is a *recorder-mixer* (Figure 1-5), which combines a mixer and multi-track cassette recorder in a single portable package. Some recent examples are the Sansui WS-X1, Fostex 280, Yamaha MT3X, and Tascam 644 and 688 Midistudios.

• **Tape synchronizer:** You need this device if you want to use a multi-track tape recorder in your studio. A tape synchronizer forces the sequencer tracks to play in sync with the tape tracks, so that the music recorded on both devices plays together at the same tempo. The tape synchronizer also makes the sequencer start at the same place in the song that you start the tape. An example is the Tascam MTS-30 MIDI Tape Synchronizer. Sometimes a tape-sync unit

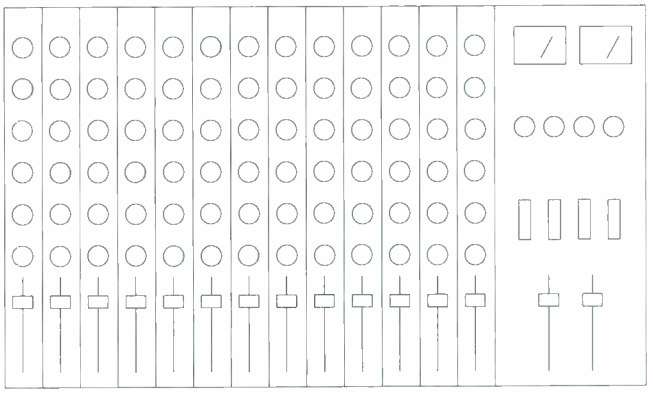


Figure 1-6. A mixer.

is built into a recorder, as in the Tascam 644 recorder-mixer.

• **Mixer** (Figure 1-6): a unit that blends several different audio signals into a single stereo signal. For example, you might mix the signals of a synthesizer, sound module, drum machine, and multi-track tape recorder.

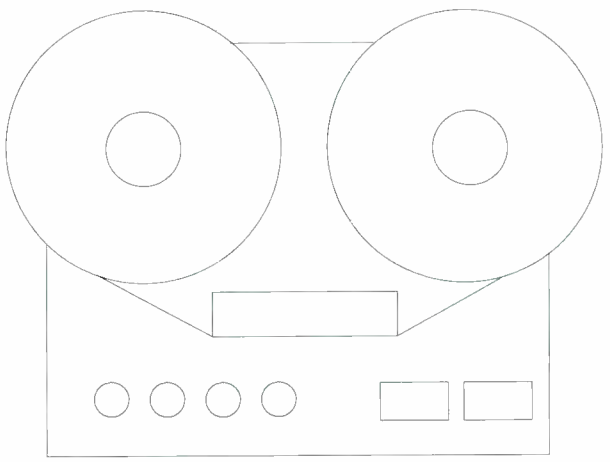
A MIDI studio requires one of three types of mixer:
1. A mixer with mic inputs
2. A line mixer without mic inputs
3. A recorder-mixer with extra line inputs.

Which should you choose?

• If you use a multi-track tape recorder in your studio (rather than a recorder-mixer), you need a mixer with mic inputs. That's because a multi-track recorder does not accept mic signals directly.

• If you use a recorder-mixer, you do not need a separate mixer with mic inputs because they are built into the recorder-mixer. In this case, a *line mixer* or *keyboard mixer* is adequate to mix the tape tracks and MIDI instruments. Some examples of line mixers are the Roland M-120, Yamaha KM802, Fostex 2016, Tascam MM1, and Korg KMX-122. They provide control of volume, panning, and effects (described later).

Figure 1-7. A 2-track recorder.



• If you use one of the new recorder-mixers with extra line inputs (such as the Tascam 644 and 688 Midistudios), you can do it all with the recorder-mixer.

• **2-track recorder** (Figure 1-7): a device that records the output of the mixer: the stereo mix of all your sound sources. The tape made on this recorder is the final product. The recorder can be open-reel, cassette, DAT (Digital Audio Tape cassette), a video cassette recorder (VCR) with VHS-Hi Fi, or a VCR with a digital audio adapter.

has built-in MIDI ports; the Yamaha is an IBM-compatible portable unit with MIDI and SMPTE connectors (explained later).

The computer can also be used with other music-related software:

A *voice-editor program* lets you manipulate the parameters that make up a MIDI instrument's patches or sounds.

A *sample editor* displays a sample's waveform (signal voltage vs. time) on your computer screen and lets

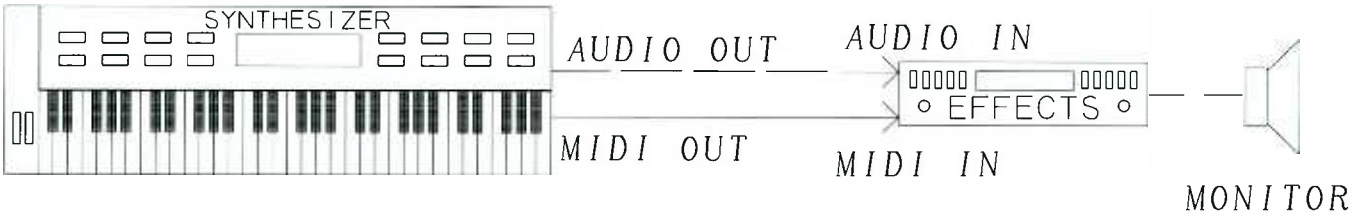


Figure 1-8. An effects unit.

• **Effects** (Figure 1-8): signal processors that modify sounds sent through them to add sonic interest or spaciousness. Some examples of effects are reverberation, echo, chorus, and compression. MIDI effects units can be controlled via MIDI commands (described later). Some recent effects units are the Alesis Microverb III and Yamaha FX1000.

• **Power amplifier and speakers, or powered speakers:** monitoring systems which let you hear what you're performing and recording. While you can use headphones or your home stereo system for monitoring, most MIDI studios use *close-field monitors*. These are small speakers placed about 3-feet from you and 3-feet apart. This arrangement places them far from the walls and floor, which generally results in weak bass. However, close-field monitors are designed to compensate for this effect, so they produce good bass from about 70 Hz up.

Some examples are the Ramsa WS-A10, Boss MA-12, JBL Control 1, Kawai KM-20, Yamaha MS202, and Fostex 6301B. They start at about $150 a pair.

OPTIONAL COMPUTER EQUIPMENT

• **Personal computer system:** a computer, disk drive, monitor screen, and perhaps a printer. Generally, the computer is used to run a sequencer program, which replaces a stand-alone sequencer device. Compared to a sequencer with its tiny LCD screen, the computer monitor screen displays much more information at a glance, making editing easier and more intuitive.

Some popular computers for music composing are the Commodore Amiga, 64 and 128; IBM and IBM compatibles; Apple Macintosh; Atari ST, Stacy and Mega, and Yamaha C1 Music Computer. The Atari

you modify it.

A *librarian* enables you to transfer patches between MIDI instruments and your computer, rename or rearrange the patches, and store them to disk.

A *notation program* converts your sequenced performance to standard musical notation and prints it.

Integrated Sequencer / Digital Audio Recording software lets you combine sequences with digital-audio recordings made on a computer hard disk.

• **MIDI computer interface:** an electronic device that plugs into a user port or slot in your computer, and converts MIDI signals into computer signals and vice versa. You need this only if you're using a computer in your system.

• **Hard disk drive:** This computer peripheral is for digital audio recording. It offers higher sound quality than a multi-track tape recorder, but costs more. The hard disk drive is used with digital-audio recording software.

MISCELLANEOUS EQUIPMENT

• **Audio cables:** cables that carry audio signals. They are used to connect the audio outputs of synthesizers, sound modules, sample-playing keyboards, a drum machine, and a tape recorder to your mixer line-input connectors. Synthesizer audio outputs are low-impedance unbalanced, and are used with cables having ¼-in. phone plugs.

• **MIDI cables:** cables that carry MIDI signals, connecting MIDI devices to each other with 5-pin DIN plugs. MIDI cables connect synths, sound modules, sample-playing keyboards, drum machines, and computers so that they can communicate with each other.

• **Power outlet strip:** a row of electrical outlets to power all your equipment. It's a good idea to have surge protection in the strip.

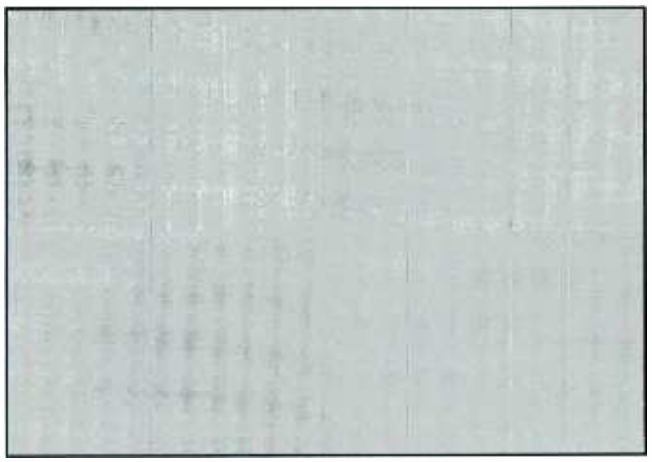


Figure 1-9. The Roland W-30 Workstation (Courtesy of Roland Corporation)

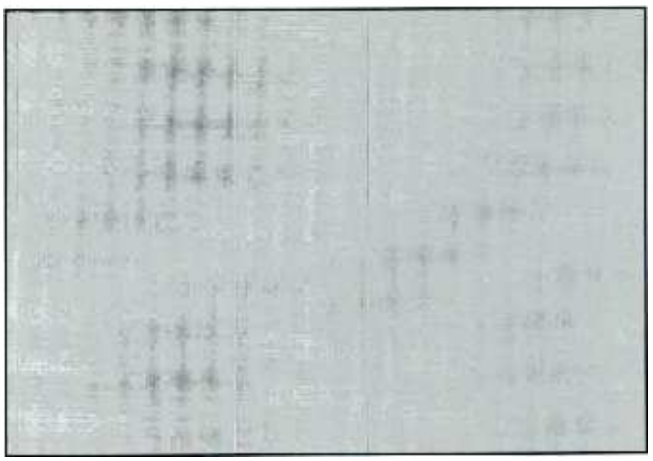


Figure 1-10. The Korg M-1 Digital Music Workstation (Courtesy of Korg Inc.)

- **Microphone (optional):** a device that converts sound into an electrical signal. You use a microphone for recording vocals and acoustic instruments on tape, or for recording your own samples.
- **Mic stand:** for positioning the microphone.
- **Equipment stand:** a system of tubes, rods, and platforms that supports all your equipment in a convenient arrangement. It provides user comfort, allows shorter cables, and saves floor area for other activities.

THE KEYBOARD WORKSTATION

A keyboard workstation combines several MIDI-studio devices in a single package. For example, a workstation might include a keyboard, drum machine, sample-player, synth, and sequencer in one portable chassis. Some keyboard workstations include a disk drive to store sounds and performances.

The all-in-one keyboard workstation is compact and simple because it omits wires, and costs less than a group of connected equipment. However, separate components are generally more flexible and powerful. Although a keyboard workstation seems complete, you also might need a multi-track tape recorder or recorder-mixer to record vocals and acoustic instruments.

Two examples of keyboard workstations are the Roland W-30 (Figure 1-9) and the Korg M-1 (Figure 1-10). Their features and functions are described in later chapters. Some other prominent models are the Roland D-20, Kurzweil K250, Ensoniq EPS and SQ-80, and E-mu Systems Emulator III.

The Roland Studio M combines in one box a 16-track sequencer, tone generators, mixer, tape-sync function, and automated mixing function. Add a keyboard controller and a multi-track tape recorder, and you have a complete MIDI studio.

All the MIDI equipment described here is sold at pro-audio dealers and music stores. Later chapters describe which features to look for when you're shopping for MIDI equipment.

This is the first chapter of the forthcoming ELAR Publishing Company's "Your MIDI Recording Studio" by Bruce Bartlett. See page 28 for information on how to advance-order this new book.

ELAR PUBLISHING CO. INC.
38 Pine Hill Lane
Dix Hills, NY 11746

HANDBOOK OF SOUND SYSTEM DESIGN *by John Eargle*

In one complete up-to-date book here are all the practical as well as theoretical aspects of sound reinforcement. The detailed chapters include information on electrical fundamentals, acoustical fundamentals and psycho- acoustical aspects; high-, low-, and mid-frequency systems; microphones in sound reinforcement and system architecture; central loudspeaker arrays, distributed systems, speech reinforcement and paging systems; system intelligibility; high-level sound reproduction, a theater sound overview, and sections on live music reinforcement, line arrays and sound columns.

347pp. Hardcover

$37.50 #12-991

INTRODUCTION TO PROFESSIONAL RECORDING TECHNIQUES *by Bruce Bartlett*

Geared primarily for the aspiring professional, this book provides a comprehesive discussion of recording, engineering and production techniques. Special coverage of microphones, microphone techniques, sampling, sequencing, and MIDI is also included.

416pp. Paper

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THE SONGWRITER'S WORKSHOP *edited by Harvey Rachlin*

This book and cassette meets the songwriter on the level that he practices his craft—through sound. Beginning with an idea for a song, it travels through inspiration and creativity, writing lyrics, making a demo, understanding MIDI and how to pitch songs to the industry. Each lesson is to be learned through reading and also hearing the lesson, and is taught by experts such as John Barilla.

96pp. and 2 cassettes, Paper

$24.95 #9-991

THE SOUND REINFORCEMENT HANDBOOK *by Gary Davis and Ralph Jones*

This second edition of a very popular book has an additional 40 pages and covers all basic aspects of sound reinforcement. The new topics include MIDI, synchronication, and an Appendix on Logarithms.

417pp.

Paper

$34.95 #17-791

SOUND REINFORCEMENT FOR CHURCHES *by Curt Taipale*

Tapes recorded during an actual seminar, you will hear Curt present on these tapes not only the basics of microphones, but how to get the most out of your console both in a live setting and in the studio; how to deal with feedback, how to recognize phase cancellations caused by poor speaker placement and much, much more. Helpful diagrams are enclosed where appropriate. This is your chance to learn from Curt's mistakes and his triumphs. His accomplishments and his failures are freely shared in an encouraging manner.

Four cassette tapes, nearly five hours!

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THE NEW RECORDING STUDIO HANDBOOK *by John M. Woram and Alan P. Kefauver*

This new edition has been accepted as the long-awaited replacement to the original book published in 1976. The new edition is not "old wine in a new bottle." The revision has been done by Professor Kefauver. He is the Coordinator of the Recording Arts and Sciences Department and Director of Recording at the prestigious Peabody Conservatory of Music. The book is used by most of the recording schools and universities here and abroad. This book contains all the basics for the recording studio engineer, as well as more advanced information covering MIDI, Automated Consoles, SMPTE Time Code and Digital Audio. This book has been and remains the "bible" of the audio industry.

525pp. Hardcover

$45.95 #13-991

LIVE SOUND! *by David Scheirman*

This excellent video is targeted at first-time users and musicians new to the field of sound reinforcement. However, the video contains insider tips and sophisticated approaches to using the equipment.

The video covers:

- Equipment selection
- Loudspeaker placement and setup
- Mic selection and placement
- Monitor systems
- Mixer Position
- Processing/effects
- Crossovers/Equalization
- How to Soundcheck
- System Assembly & Cables
- Power Amps
- Running the Mixer

This is a *must have* video!

75 minutes

$39.95 #16-791

SOUND SYSTEM ENGINEERING, SECOND EDITION *by Don and Carolyn Davis*

Like the first edition, this comprehensive text provides readers with useful information for the day-to-day work of designing sound systems. This updated version contains in-depth coverage that carefully examines acoustic gain, clarity of sound, and required electrical power.

688pp. Hardcover

$49.94 #2-991

CONCERT SOUND AND LIGHTING SYSTEMS *by John Vasey*

This book shows how to set up, maintain, and operate sound and lighting equipment for the performance of amplified music or any kind of touring production. An excellent reference and/or guide to procedure, the book provides descriptions of all the components that make up a system, explanations of how they all work together, and photographs and illustrations that show specific equipment and proper stage setup.

178pp. Hardcover

$27.95 #4-991

HANDBOOK FOR SOUND ENGINEERS: THE NEW AUDIO CYCLOPEDIA *by Glen Ballou*

This brand-new second edition has been updated to include the latest in MIDI, cinema sound, tranformers and compact discs. Readers learn the new developments in audio electronics, circuits, and equipment. There is also an in-depth examination of disc, magnetic, and digital recording and playback.

1,400pp. Hardcover

$99.95 #5-991

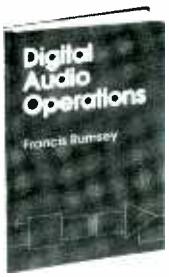
BROADCAST SOUND TECHNOLOGY *by Michael Talbot-Smith*

This is an introduction to the technical aspects of sound in radio and television. It examines in detail the main items in the broadcast chain: studio acoustics, microphones, loudspeakers, mixing consoles, recording and replay (analog and digital), and the principles of stereo. It offers a easy technical treatment of audio principles and broadcast hardare.

224pp. Hardcover

$42.95 #7-991

DIGITAL AUDIO OPERATIONS *by Francis Rumsey*



Leaving the higher levels of theory to other digital audio texts, this handbook emphasizes principles for the studio and those aspects of digital audio appropriate for day-to-day sound engineering operations. It describes the sampling process, error correction, editing systems and different recording options. This book is written to help producers and engineers in the studio get the best possible results from the high quality standard equipment in use today.

256pp. Hardcover

$39.95 #6-991

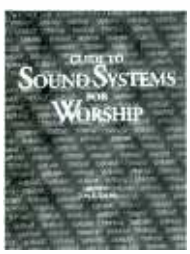
STEREO MICROPHONE TECHNIQUES *by Bruce Bartlett*

This book is extremely timely for sound engineers and video or audio producers. Also, as Digital Audio Tape (DAT) production becomes less costly to use in the field, all electronic media will be trying to achieve the highest level sound production possible. This book tells how to position the correct microphones in the proper locations in order to record optimal quality stereo sound. The many illustrations and clear organization easily explain the theory behind stereo mic'ing methods, and describe specific techniques, including comparative evaluations. In addition, it offers suggestions on session procedures and stereo troubleshooting as well as recent developments in binaural and transaural stereo and stereo boundary arrays.

192pp. Paper

$24.95 #3-991

GUIDE TO SOUND SYSTEMS FOR WORSHIP *by Jon F. Eiche*



This book is written to assist in the design, purchase, and operation of a sound system. It provides the basic information on sound systems that is most needed by ministers, members of Boards of Trustees and worship and music committees, interested members of congregations, and even employees of musical instrument dealers that sell sound systems. To be of greatest value to all, it is written to be both nondenominational and "non-brand-name."

183pp. Paper

$24.95 #1-991

LIVE SOUND MIXING

by Duncan R. Fry

Live Sound Mixing is the first book that shows you how to pull a great sound from a PA system. Author Duncan Fry is a survivor of many years on the live sound trail. People used to say "Ah, you can't learn how to mix from a book!" With this book, you can! This is an easy-to-read and understand "hands on" book that every live-sound engineer should have. From the basic principles of how a system works, through troubleshooting when it doesn't, the book is packed with useful information, many clear diagrams, helpful hints and detailed explanations. There are examples of every type of equipment you're likely to come across.

164pp. Paper

$26.95 #11-392

THE RECORDING SERIES BASIC MULTITRACK RECORDING TIPS *with Rick Shaw*

Using a "hands on" approach, this video gives you an overview of the basics in setting up a personal studio. Among items covered are: hooking up instruments, connecting equipment, setting levels, working with the console, doing a recording, overdubs and mixdown. This is a very important video for all persons planning on setting up a studio.

Approximately one hour long

$34.95 #18-791

THE STUDIO BUSINESS HANDBOOK: A GUIDE TO PROFESSIONAL RECORDING STUDIO BUSINESS AND MANAGEMENT

by Jim Mandell

Here is a comprehensive survey on the state of recording studio business and management in the nineties that includes startup and equipment cost comparisons from low budget to world class operations; equipment purchasing strategies; rate-setting factors; actual examples of pre-session contracts; how different studios handle billing, credit applications, payment guarantees, conflicts and collections; how to write publicity releases that will get into print; what to avoid in advertising;

336pp. Paper

$29.95 #10-991

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JOHN BARILLA

THE ELECTRONIC COTTAGE

HOT TIPS: ON PRODUCING CUSTOM ALBUMS

● It used to be that making a "custom album" was almost a dirty word in this business. You know an artist wasn't professional enough to land a recording contract, so he or she (with the financial help of a few compassionate friends) sought a studio where they could have an album recorded, duplicated and packaged—and then of course, sell it out of their cars at gigs. The product was usually expected to sound like a demo—replete with noise, cheesy sounds and the vagueness of tracks that had been bounced too many times. It had something of the stigma associated with struggling poets who pay to be published by some fly-by-night vanity press.

But thankfully, things have changed in recent years. Doing a custom album is no longer synonymous with second best, and many artists have found it to be a legitimate vehicle for propelling their careers into a wider arena.

Case in point: A couple of years ago I created a neat sounding demo of a song I had written, which ended up catching the ear of a young, relatively unknown artist in Nashville. The artist was not signed by any record company at that time, but he had enough sense to recognize a good song when he heard it. He found himself some financial backers, and went into the studio and cut my song—along with nine others, and released it as a custom cassette album on his proprietary label.

For several months, the album went nowhere, but it did come to the attention of a major record company who bought up the multitrack master, remixed it and re-released it. My song was the single—and it ended up charting at #11 nationally. So you see, a well-produced custom project can, at very least, be a stepping stone to a higher career track. It can open doors that have previously been closed to the artist.

WHY IS THAT SO?

To answer that question we have to consider the fundamental role of economics in the music business. The custom project—a full-blown quasi-master production—simply eliminates the record company's need to invest money in an unknown quantity. Over the past 15 or so years, talent development budgets have gotten scarcer than hen's teeth for several reasons:

For one, the record companies themselves made lots of bad investments, in the early days of "talent scouting" they signed everybody they could—just to see what would fly in the market place. But those halcyon days seem to be gone. Rising manufacturing costs, audiences with little discretionary money and a far less ingenious talent base have led all the major companies to tighten their belts and invest predominantly in time-tested mega-stars, rather than dubious new talent. A wise move for the record companies, but bad news for budding new artists.

The A&R departments at record companies probably ought to share some of the blame for this economic decline, for they have often squandered their own money. Another case in point comes from an associate of mine who operates a management company for musical artists. The management company represented an artist who was known not for his songwriting, but for his magnificent associations as a sideman with several well-known musical acts. On the strength of this, he was signed to a major label and received a rather hefty recording budget. But two years and $250,000 later, the record company found that they had not one single usable track worthy of release. Needless to say, they dropped the artist from their roster, but it cost them a quarter of a million dollars to find out how shallow his talent really was.

In light of this, it is easy to see how custom projects have become much more interesting to record labels. After all, it allows them to see an artist in a fully-developed fashion: no guesswork, no economic risks. A person who puts out a quality custom album is likely to be more than a "two-song wonder", a nice voice or a pretty face.

Instead that person has demonstrated artistic depth, perseverance, and the ability to attract a certain amount of investment capital. That person is worthy of a closer look.

Of course, selling out to a major label is not the only purpose in putting together a custom release. Setting up an independent label is the course that many clients choose; and for some, it can be a profitable one. It's easy to get lost in the gloss of wanting a "hit" to validate oneself as an artist, but many people have found a viable income from custom releases that never hit the charts or get much airplay.

Case in point: One independent company in the Pacific northwest has become known for the synthesized instrumental music made by its owner and a small group of his friends. His main sales avenue is direct mail marketing to a slowly increasing group of loyal fans. A woman from Long Island has garnered for herself a sizeable audience for her children's music—all without major record company involvement. Both are making a decent living doing original music, without needing a day gig. It's far from stardom, but some people feel they can live without the adulation. I believe this decentralized, populist style of record making is catching on and people who can offer efficient, economical and comprehensive production services to independent artists will also be able to profit from this trend.

ENTER, THE ELECTRONIC COTTAGE

Who is in a better position to offer quick reasonable custom album recording than the local electronic cottager? With only a moderate investment in facility and equipment, your overhead is low enough to offer these enterprising artists a deal they can afford. And if your profile is typical, you are probably part musician, part producer and part engineer, and patient enough to offer a personalized service—helping the client at every stage of the process:—from choosing songs down to deciding on a layout for a cassette label. Remember, for many of your clients, it will be the first time they are doing such an extensive project. Your willingness to involve yourself from start to finish may be the decisive factor in landing the project. Even if you aren't expert at every stage of the process, simply holding your client's hand and walking them through every stage will enhance your value in their eyes.

You will have to be a bit of a "renaissance person" to do this job, but the knowledge you need can be learned as you go. Granted, you'll make a few mistakes along the path, but if you never promise more than you can deliver, you won't make an enemy. After a few times through the process, you will become adept at all facets of custom album production and your services will become all the more comprehensive and valuable. Now let's do a thumbnail sketch of the process, highlighting some important things that you should be aware of.

THINGS TO REMEMBER

In other articles, I have pointed up the importance of mastering the final production dub that leaves your studio. It is not expedient to expound on that again here, except to say that it is an important service that will save your budget-conscious clients money. It will assure that the only service required of the company you choose to do your duplication is a simple machine-to-machine transfer: no EQ, no level matching, etc. On-line time (where aesthetic decisions must be made) is expensive and may be prohibitive when working with a modest budget. Your client will appreciate having a production master that does not need modification.

While cassette duplication is straightforward, the process for compact discs is a little different: it always requires an intermediary stage. This process, known as "glass mastering" is where the production master—in whatever format you present it—is first transferred to a Sony 1630 formatted U-Matic master (the industry standard) where certain necessary timing and indexing codes are added. Then the information on the 1630 tape is burned-in (with a laser) to the actual glass master, from which metal stampers are made to mold the actual CDs. Most of this process is transparent to you—in other words, you needn't be concerned about it—if the master you present is suitable for transfer as is. If however, you are using a consumer DAT recorder (as opposed to a professional DAT), you may find that the sampling rates are incompatible for a direct digital-to-digital transfer. The CD preparation facility can provide you with sample-rate conversion (from the 48 k rate down to the conventional 44.1 k of CDs); but this is quite expensive. I know the purists will balk at this, but the simple and economical solution is to borrow or rent a professional DAT machine and transfer the album using the analog output of your consumer deck into the analog input of the pro deck. While it's understood that a direct digital transfer obviates the extra stage of digital to analog conversion, the practical reality is that even an audiophile would be hard put to tell the difference—so long as the machines were short-wired to each other and not run through a console or any additional processors. For cassettes (which is your most common medium for custom albums) no such wrangling is usually required; most cassette duping facilities are willing to run both 48 k and 44.1 k DAT masters, as well as analog recordings.

Another angle that you can serve your clients is helping them organize the graphics layout for the custom album cover. For an extra fee, most duping facilities will handle the actual finished mechanical layout and printing; but it will simplify things immensely if they are given a rough layout indicating the size and arrangement of headlines, notes, photos, logos, etc. Duping houses can usually supply you with templates of both cassette and CD inserts, so that you can quickly and easily indicate placement.

CONCLUSION

Finally, the artist will probably need a promotional package to go along with the custom album. Items included may be a bio, an itinerary of recent performances and a photo, all housed in a conventional pocket binder.

If you are a decent writer or photographer you might want to try providing these services to the client yourself. The intimacy and convenience of having all their needs catered to under one roof will ensure that your clients see you as a truly valuable resource. db

Introduction to the Charts

We've tried to make the charts of amplifiers as self-explanatory as possible, with slanting headlines on each column that explain what we wanted to show you.

These charts represent entirely what each of the respective manufacturers have sent us in response to our (sometime repeated) requests. You will also see that there are numbers of blank sections within the charts. If they don't have a specification available, we can't list it. But note that many do not have anything under the Features column. This column is where we have invited each manufacturer to state, in as few words as possible, what is special about the product. You can safely assume, then, that when this column is blank, it is because the manufacturers told us nothing.

Note also that we ask for amplifier continuous power not only at the traditional 8 and 4 ohm resistive loads, but also at 2 ohms. As you know, when you parallel speakers, the load is halved. Accordingly, in the real worlds of studio monitors and headphone lines, and the even more real world of performance and stadium systems, effective loads back to an amplifier can well be 2 or 3 ohms. Since modern solid-state amplifiers can handle such loads successfully, we ask each manufacturer for this specification. Note that not all give it. It's, therefore, safe to assume that if it is missing, the amplifier may not be reliable at low loads.

Distortion at normal and full power ratings is also specified. While many amplifiers today can boast of almost vanishing distortion, remember that if you will be pushing an amplifier hard up against its rated power and beyond, distortion will then be rising rapidly. No audio product is really made to be abused, and amplifiers are no exception.

One group of important specifications deals with dimensions and weights. Amplifiers, particularly high-power ones, are not lightweights. A few racks can have weights adding up rapidly.

Finally, the price. What we have asked each manufacturer for is the suggested retail price. Different retail dealers establish their own.

On to the charts...

Model	Number of Channels	Cont. power/channel at 8 ohms, all channels driven	Cont. power/channel at 4 ohms, all channels driven	Cont. power/channel at 2 ohms, all channels driven	Power Bandwidth Hz-kHz	IM at 1 watt, %	IM at full power, %	THD at 1 watt, %	THD at full power, %	Frequency Response at 1W +/- dB	Sensitivity for full output, V	Dimensions, H/W/D, in.	Weight, lbs.	Price, $	Features
AB INTERNATIONAL ELECT. INC.															
1200	2	800	1350	1950	20-20k	0.05	0.05	0.25	0.25	20-20k +-0.25	1.9	5.25	68 19 15	$2,699.00	Fully modular, soft clipping, led display
1100	2	525	850	1100	20-20k	0.05	0.05	.025	0.25	20-20k +-0.25	1.5	5.25	39 19 13	$1,249.00	Signal/clip indicators, led display option
900	2	350	590	775	20-20k	0.05	0.05	0.25	0.25	20-20k +-0.25	1.5	5.25	34 19 13	$1,039.00	As 1100 model above
600	2	270	425		20-20k	0,05	0.05	0.1	0.1	20-20k +0.25	1.5	5.25	33 19 12	$829.00	Signal/clip indicators
ALESIS CORPORATION															
RA100	2	75	100		20-20k			.05	0.19	20-20k 1	0.5	3.5	15 19 8.5	$349.00	UL and UA listed requires no fan, Short circuit protected.
ALTEC LANSING CORPORATION															
9441A	2	75	100		10-50k	0.1	0.1	0.1	0.1	10-50k +0,-1	0.75	1.75	18 19 12.8		100 watts per channel/4 ohms at 0.1% thd.
9444B	2	200	300		20-20k	0.05	0.05	0.1	0.1	10-90k 0,-3	0.78	5.25	34 19 12.75		Balanced XLR/barrier strip inputs, level controls on back panel, 300W bridged into 8 ohms.
9442A	2	100	150		10-50k	0.1	0.1	0.1	0.1	10-50k +0,-3	.775	5.25	32 19 11		Balanced XLR/barrier strip inputs. level controls on back panel. powered accessory sockets.
9446A	2	600	650		20-20k	0.05	0.05	0.01	0.1	10-90k +0,-3	.790	5.25	52 19		Balanced XLR/barrier strip inputs. level controls on back panel,
ARX SYSTEMS See ouir ad on page 2															
SS1200	2	425	625		20-20k			0.02	0.04	20-20k +-0.4	0.775 or 1.6	33		$1,342.00	Balanced inputs, 2 fans,phase reverse, switchable bridge, all mosfet.
SS600	2	250	350		20-20k			0.02	0.04	20-20k +-0.4	0.775 or 1.6	26		$999.00	As above.
SS300	2	100	150		20-20k			0.02	0.04	20-20k +-0.4	0.0775	15		$679.00	Jack input, XLR output, fan cooled.
BGW SYSTEMS															
GTA	2	360	625	1000	20-20k	less than 0.05	0.03	less than 0.1	less than 0.1	3-85k +0,-3	1.73	5.25	78 17.5 16.3	$2,199.00	Twin power supplies, balanced inputs w/looping XLRs and 1/4 in. TRS.
GTB	2	300	450	425	20-20k	less than 0.05	0.03	less than 0.1	less than 0.1	3-85k +0,-3	1.54	5.25	50 19 14.3	$1,539.00	Balanced inputs w/looping XLRs and 1/4 in. TRS, fan cooled, large LED status indicators.
750F/G	2	300	450	425	20-20k	less than 0.05	0.01	less than 0.1	less than 0.1	3-85k +0,-3	1.5	7	55 19 15	$1,699.00(F) $1,849.00(G)	LED status indicators, thermostat fan control, 850 w/2 ohm single channel, (G) stereo 50 dB range metering.
350/350A	2	200	325		20-20k	less than 0.05	0.03	less than 0.1	less than 0.1	3-85k +0,-3	1.18	5.25	34 19 11.8	$1,199.00 $1,349(.00A)	LED status indicators, convection cooled, balanced inputs w/looping XLRs and 1/4 in. TRS.
200	2	100			20-20k	less than 0.05	less than 0.03	less than 0.1	less than 0.1	1-85k +0,-3	0.92	1.75	14 19 11.9	$999.00	100W/Channel in one rack space, balanced XLR and 1/4 in. TRS inputs, LED status indicators.
6500T	2	100	150		20-20k	less than 0.1	less than 0.05	less than 0.05	less than 0.05	3-100k +0,-3	0.9	3.5	28 19 12.9	$599.00	Barrier strip inputs/outputs w/ 1/4 in. TRS, optional XLR balanced inputs, rearmounted level controls
7500T	2	200	300		20-20k	less than 0.1	less than 0.05	less than 0.1	less than 0.1	3-85k +0,-3	1.18	5.25	36 19 12.4	$849.00	Barrier strip inputs/outputs w/ 1/4 in. TRS, optional XLR balanced input. rear mounted level controls.
8500T	2	300	450	425	20-20k	less than 0.1	less than 0.05	less than 0.1	less than 0.1	20-20k +0,-2	1.6	5.25	50 19 13	$1,299.00	Same, with 850 watts 2 ohm single channel.

Model	Number of Channels	Cont.power/channel at 8 ohms,all channels driven	Cont.power/channel at 4 ohms,all channels driven	Cont.power/channel at 2 ohms,all channels driven	Power Bandwidth Hz-kHz	IM at 1 watt, %	IM at full power, %	THD at 1 watt, %	THD at full power, %	Frequency Response at 1W +/- dB	Sensitivity for full output, V	Dimensions, H/W/D, In.	Weight, lbs.	Price, $	Features
BIAMP SYSTEMS (ADVANTAGE DIVISION)															
Advantage CPA-130	2	40	65			0.05		00.08	0.5	20-20k +0,-0.5	1	3.5 22 19 10			Stereo/mono bridge, front or rear controls peak indicators,passive cooling.
Advantage CPA-650	2	200	325			0.3			1	20-20k +0,-0.5	1	5.25 33 19 11			650W-bridged mono,front/rear controls, peak indicators,passively cooled.
Advantage D-60	1	60	60			0.05		0.08		20-20k +0,-0.5	1	3.5 15 10.2 11			Available as D60EQ with a 9-band eqalizer; with 9-band eq and 2-chan mixer. f
BRYSTON/BRYSTON VERMONT															
2BLP	2	50	100		1-100k	less than 0.01	less than 0.01	less than 0.01	0.01	1-100k	0.75	1.75 18 19 10		$775.00	Full twenty year warranty on .all units
3B	2	100	200		1-100k	less than 0.01	less than 0.01	less than 0.01	0.01 20-20k	1-100k	1.0	2.25 30 19 9		$1,3.75.00	Modular construction.
4B	2	250	400		1-100k	less than .01	0.01	less than .01	0.01 20-20k	1-100k	1.25	2.25 45 19 13.5		$2,095.00	All triple good plater contacts.
7B	1	500	800		1-100k	less than 0.01	0.01	less than .01	0.01 20-20k	1-100k	1.0	2.25 45 19 13.5		$2,195.00	All discrete.
CARVER CORPORATION															
P1200	2	450	600		5-80k		0.1		0.5	20-20k +0,-.5	1.5	3.5 21 19 12.75		$1,250.00	Bridged mono operation—70V direct drive operation, remote/sequential power on—LED power meters—XLR.
PT1250	2	465	625		5-80k		0.1		0.5	20-20k +0,-.5	3.5	11 19 10.75		$1,500.00	Has 70V direct drive operation, LED power meters, XLR, TRS inputs clipping eliminator circuit.
PT1800	2	600	900	1100			0.1		0.5	1.5	5.20	46 19 12.75			Bridged mono operation, 70V direct drive, operation-dual detachable power cords, fully modular.
PT2400	2	750	1200	1500			0.1		0.5	5	1.5	5.20 52 19 12.75			Same
M120	2	40	60		2-120k		0.1		0.5	20-20k +0,-.5	1	10 19 12		$560.00	Bridged mono operation, headphone jack—XLR, TRS, barrier strip in-inputs—clip indicators.
M300	2	110	150		4-70k		0.1		0.5	20-20k +0,-.5		11 19 12		$680.00	Bridged mono operation, headphone jack—XLR, TRS. barrier strip in-puts—LED power indicators.
M600	2	200	300		5-80k		0.1		0.5	20-20k +0,-.5		23 19 11.56		$820.00	Remote/sequential power on/off circuit—convection cooling—bridged mono operation XLR.
M900	2	350	450		5-80k		0.1		0.5	20-20k +0,-.5	3.5	24 19 11.56		$995.00	Same. with fan cooling.
CARVIN															
FET 1000(W)	1	300	500		20-20k			.05	.05	20-20k	37	19 10		$679.00	Mosfet circuitry, speaker guard protection. short circuit current limiting thermal shut off switch.
FET 450	2	125	450		20-20k			.05	.05	20-20k		32 19 10		$499.00	Same
FET 401(W)		150	300	400	20-20k			less than 0.1	less than 0.1	1	20-20k	19 10		$399.00	Has 9 band graphic equalizer, thermostatic protection.
CREST AUDIO, INC.															
Fcv220	2			110		60-18k	0.015	0.015	0.025	0.025	60-18k +0,-3	0.775 3.5 42 19 14		$880.00	Isolated X-former-coupled (bypassable),fan.
Fcv440	2		220			60-18k	0.015	0.015	0.025	0.025	60-18k	0.775 3.5 50		$1,188.00	Same as above.

Model	Number of Channels	Cont.power/channel at 8 ohms,all channels driven	Cont.power/channel at 4 ohms,all channels driven	Cont.power/channel at 2 ohms,all channels driven	Power Bandwidth Hz-kHz	IM at 1 watt, %	IM at full power, %	THD at 1 watt, %	THD at full power, %	Frequency Response at 1W +/- dB	Sensitivity for full output, V	Dimensions, H/W/D, in.	Weight, lbs.	Price, $	Features
ul601	2	120			20-20k	0.015	0.015	0.025	0.025	20-20k +0,-0.5	0.775	3.5	19 14 33	$768.00	UL listed, fan cooled.
ul901	2	225	300	400	20-20k	0.015	0.025	0.025	0.025	20-20k +0,-0.5	0.775	3.5	19 11.5 40	$966.00	UL listed, fan colled.
ul1201	2	280	450		20-20k	0.015	0.0.015	0.025	0.025	20-20k +0,-0.5	0.775	3.5	19 14 42	$1,398.00	As directly above.
ul2401	2	330	580		20-20k	0.015	0.015	0.025	0.025	20-20k +0,-0.5	0.775	3.5	19 14 61	$1,674.00	As above.
4601	2	300	425		20-20k	0.015	0.015	0.012	0.02	20-20k +0,-0.3	1.03	3.5	19 16.5 52	$1.750.00	Tailored for mid and high freq. applications.
3301	2	220	330	400	20-20k	0.015	0.015	0.0.25	0.025	20-20k	0.9 +0,-0.3	3.5	19 16 49	$1,390.00	As directly above.
CROWN INTERNATIONAL, INC.															
MA600	2	235	340	410	20-20k	.05	.05	.05	.05	20-20k 0.01	.725	3.5	19 16 39	$1,295.00	P.I.P ,Q compatible, ODEP, IOC, balanced XLR input, front panel level, SPI indicators, air coolIng ground isolation switch.
MA1200	2	320	495	200	20-20k	.05	.05	.05	.05	20-20k 0.01	0.775 +-0.1	3.5	19 16 44	$1,595.00	As above
MA2400	2	520	820	1100	20-20k	.05	.05	.05	.05	20-20k 0.01	0.775 +-0.1	3.5	19 16 51	$1,995.00	As above.
MA3600	2	1165	1655	1800	20-20k	0.05	0.05	0.1	0.1	20-20k	0.775 +-0.1	3.5	19 16 56	$2,895.00	As above.
CT200	2	100	155		20-20k	.05	.05	.05	.05	20-20k 0.1	0.775	3.5	19 16 21	$790.00	P.I.P and IQ compatible, grounded bridge , 70-V direct mode,bridged mono, ODEP, IOC,balanced Input barrier block connector.
CT400	2	210	230		20-20k	.05	.05	.05	.05	20-20k 0.1	0.775	3.5	19 16 31	$1,050.00	As directly above.
CT800	2	305	410		20-20k	.05	.05	.05	.05	20-20k 0.1	0.775	5.25	19 16 46	$1,550.00	As above
CT1600	2	540	850		20-20k	.05	.05	.05	.05	20-20k 0.1	.775	7	19 16 57	$1,990.00	As above.
ELECTRO-VOICE															
AP2300A	2	100	150		10-50k	less than 0.1	less than 0.1	less than 0.1	less than 0.1	20-20k than 0.1	.775 1	5.25	19 11 32	$ 810.00	Available with precision stepped attenuators. Has rear mounted level controls and octal crossover sockets.
AP2600A	2	200	300		7-85k	less than .03	less than .03	less than .05	less than .01	20-20k 1	.775	5.25	19 12.75 39	$1,040.00	Same
AP3200	2	400	600		10-90k	less than .05	less than .05	less than .02	less than .01	20-20k 1	.775	5	19 15.75 .25 52	$1,890.00	
7300A	2	250	425	500	7-85k	0.03	.03	.05	.01	20-20k 1	.775	5.25	19 12.75 39	$1,040.00	Each amp individually measured and certified for power and distortion.
7600	2	400	600	850	10-90k	less than .05	less than .05	less than .02	less than .10	20-20k 1	.775 1	5.25	19 15.75 52	$1,830.00	Same
HAFLER PROFESSIONAL/DIVISION OF ROCKFORD CORPORATION															
P1200	1 or 2	60	85		10-40k		.005		.01	10-40k -.5	1.1V	3.25	18 19 9.5	$500.00	Has 60 watts per channel, balanced 1/4 In. and XLR inputs. lateral mosfet outputs, level controls.
P2400	1 or	120	200		4-40k		.005		.025	4-40k -.5	1.2	5.25	27 19	$630.00	Has 120 watts per channel, balanced 1/4 in. and XLR inputs,

Model	Number of Channels	Cont.power/channel at 8 ohms,all channels driven	Cont.power/channel at 4 ohms,all channels driven	Cont.power/channel at 2 ohms,all channels driven	Power Bandwidth Hz-kHz	IM at 1 watt, %	IM at full power, %	THD at 1 watt, %	THD at full power, %	Frequency Response at 1W +/- dB	Sensitivity for full output, V	Dimensions, H/W/D, In.	Weight, lbs.	Price, $	Features
P5000	2 1 or 2	325	450		10-40k		.01		.025	10-40k -.5	1.5	3.5	10.5 40 19 14	$1,200.00	lateral mosfet outputs. I Yields 325 watts per channel, balanced inputs, lateral mos-fet outputs, front panel level controls.
JBL PROFESSIONAL															
6290	2	300	600		20-20k	less	less than 0.1	less than 0.1	less than 0.1	20-20k than 0.1	1.1 +0,-1	7	63 19 14	$1,650.00	Balanced bridging input circuitry, full complementary driver and output circuitry.
SR6615	2	75	150	250	20-20k	less	less than 0.1	less than 0.1	less than 0.1	+0,-1 than 0.1	1.1	3.5	32 19 17.5	$645.00	Has 2 rack space unit, variable speed fan. rear to front coling system,.
SR6630	2	150	300	500	20-20k	less	less than 0.1	less than 0.1	less than 0.1	+0,-1 than 0.1	1.1	3.5	34 19 17.5	$895.00	Has 2 rack space unit, modular power supply and amp channels, balanced XLR and 1/4 in. phone input.
SR6650	2	300	500	650	20-20k	less	less than 0.1	less than 0.1	less than 0.1	+0,-1 than 0.1	1.1	3.5	42 19 17.5	$1,195.00	Has 2 rack space unit, bridgeable to 1000 watts into 8 ohms,.
PANASONIC PROFESSIONAL AUDIO SYSTEMS															
WP-9055	2	50			10-85k	less	less than 0.05	less than 0.05	less than 0.05	20-20k than 0.05	+4 1.75 dBv		19 18.9 13.13	$620.00	U.L. listed and carries five year limited parts and labor warranty.
WP-9110	2	100	150		10-85k	less	less than 0.05	less than 0.05	less than 0.05	20-20k than 0.05	+4 3.5 dBv		28.6 18.9 15.06	$699.00	Same
WP-9220	2	200	300		10-85k	less	less than 0.05	less than 0.05	less than 0.05	20-20k than 0.05	+4 5.25 dBv		38.6 18.9 15.06	$899.00	Same
WP-9440	2	350			10-60k	less	less than 0.06	less than 0.06	less than 0.06	20-20k than 0.06	+4 5.25 dBv		75 18.9 19.13	$1,810.00	Same
PEAVEY ELECTRONICS CORPORATION															
IPA 70 PLUS	2	30			20-20k				0.01	20-20k	0.775 +-1	7	10 5.25 8.25	$99.99	half-rack width, rear-mounted level controls, 1.4 jack inputs.
IPA 250	2	70	125		20-20k				0,01	20-20k +-1	1	5.25	26 19 11.5	$499.99	Distortion Detection Circuitry (DDT).leds indicate DDT, separate channel level controls.
IPA150T	1	150	150		20-20k				0.5	20-20k +1,-2	1	19	26 15.50 4.5	$498.75	Level control, selectible subsonic filter, balanced XLR.
IPA300T	1	300	300	300	40-20k				0.19	40—20k +-1	1	13,4	40 19 5.75	$749.75	As above plus 70V line output.
IPS 400	2	120	200		10-50k				0.05	5-50k +0,-1	1	5.25	40 19 12.4	$874.99	Barrier-strip in/out, bridgeable. level controls.
IPS 800	2	240	400		10-50k				0.05	5-50k +0,-1	1.4	5.25	45 19 14.4	$1,049.99	As above.
QSC AUDIO PRODUCTS INC.															
MX 700	2	150	225	350	5-65k	.01	.025	0.1	0.1	20-20k	1.0 0.25	3.5	25 19 12	$598.00	Has 1/4 in and barrier strip inputs, fan cooled, compact package.
1100	2	50	70	90	5-100k	.01	0.01	0.1	0.1	20-20k	1.0 +0,-1	1.75	12 19	$568.00	Has 1/4 in., XLR, and barrier strip input—headphone jacks, front.
1200	2	100	150	250	5-60k	.01	.025	0.1	0.1	20-20k	1 1	5.25	24 19 9.5	$598.00	Has 1/4 in. XLR, and barrier strip inputs, optional fan cooling, rear gain controls.
1400	2	200	300	450	5-65k	.01	.025	0.1	0.1	20-20k	1 1	5.25	34 19 9.5	$798.	Has 1/4 in. XLR and barrier strip inputs, fan cooled, rear gain controls.

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MX 1500	2	330	500	750	8-300k	.01	0.02	0.1	0.1	20-20k	1 1	3.5	47 19 17.9	$1,098.00	Dual mono design, fan cooled, 1/4 in. barrier strip inputs.
3500	2	300	450	700	8-300k	.01	0.02	0.1	0.1	20-20k	1 1	3.5	50 19 15.9	$1,488.00	Dual mono, front removable channel modules, convection cooled.
3800	2	375	600	850	8-300k	.01	.025	0.1	0.1	20-20k	1 1	5.25	75 19 15.9	$1,958.00	Same
EX 4000	2	720	1100	1400	8-100k	.01	0.05	0.1	0.1	20-20k	1.0	5.25	64 19 17.9	$2,298.00	Open input architecture, speaker connectors, advanced thermal mgmt. system..
RANE CORPORATION															
MA6	6	100	150	150	20-20k	0.1	0.1	0.07	0.07	5-50k +0,-3	0.775	5.25 19	44 11	$99.00	Built-in limiter on each channel, level controls, auto bridging.
RENKUS-HEINZ, INC.															
P-2500	2	400	600	700	20-20k		0.05		0.025	20-20k +0,-5	1.2	3.5	48.5 19 16	$2,092.50	Chip-Guard protection,servo-controlled variable-speed fan.
P-2000	2	300	500	600	20-20k		0.015		0.025	20-20k +0,-5	1.1	3.5	45.5 19 16	$1,530.00	As above.
SHURE BROTHERS, INC. See Our Ad On The Back Cover															
210	1	6	10			100-15k		1	3	100-15k	40mV	2.75	2.13 9.5 5.63	$130.00	Balanced mic input, unbalanced line in-put, ext. 12V power.
SOUNDCRAFTSMEN															
A100	2	60	60		10-100k	0.05	0.05	0.05	0.05	20-20k +-0.1	1.25	1.75	17 17 10.87	$49.95	Gold RCAinputs, semi-torroidal power supply, MOSFET amp.
A200	2	125	190		10-100k	0.05	0.05	0.05	0.05	20-20k +-0.1	1.25	5.25	27 17 10.87	$469.95	As above, linear power supply.
A400	2	205	300	450	10-100k	0.05	0.05	0.05	0.05	20-20k +-0.1	1.25	5.25	30 17 10.87	$759.95	As above, phase control regulated power supply.
PM860	2	210	315	450	20-20k	.05	.05	.008	.05	20-20k			5 20 8.5 14	$599.00	Has high current design to allow stability with 2 ohm loads.
450X2	2	210	315	450	20-20k	.05	.05	.008	.05	20-20k	1.2	5.25	28 19 11.75	$849.00	High current MOSFET amp with balanced or unbalanced inputs.
900X2	2	375	675	900	20-20k	.05	.05	.008	.05	20-20k	1.22	5.25	59 19 16.5	$1,599.00	Same
300X4	2, 3 4	600 205	900 300	450	20-20k	.05	.05	.008	.05	20-20k	1.0	5.25	60 19 14	$1,399.00	Multi-channel MOSFET, 2, 3 or 4 channel mode indicators, front panel-mounted circuit breakers.
SOUNDTECH															
PL150	2	55	75		15-30k			.007			1.23	1.75	17 19 8.5	$419.90	Single rack space, clip, protect, power and bridge/mono LED indicators, protection circuit.
PL250M	1	113	200	300	18-31k			.007			1.23	3.5	30.8 19 16	$449.90	Built-in 9 band graphic EQ, clip, protect, power and temp. LED indicators protection circuitry.
PL500	2	165	250		20-20k			.007			1.23	3.5	39 19 16	$599.90	Clip, protect, power, temp. and bridge/mono LED indicators, protection circuitry,
PL1000MP	4	165	210		20-20k			.007			1.23	3.5	59 19 16	$1,099.90	Four channels, clip protect, power temp. and bridge/mono LED indicators. Protection circuitry.
PA50B	2	25	50	50	5-100k		0.04		0.03	20-20k	1	1.7	3.5	$279.00	Same, and balanced version also

Model	Number of Channels	Cont.power/channel at 8 ohms,all channels driven	Cont.power/channel at 4 ohms,all channels driven	Cont.power/channel at 2 ohms,all channels driven	Power Bandwidth Hz-kHz	IM at 1 watt, %	IM at full power, %	THD at 1 watt, %	THD at full power, %	Frequency Response at 1W +/- dB	Sensitivity for full output, V	Dimensions, H/W/D, in.	Weight, lbs.	Price, $	Features
												8.5			features level controls and clip-
												6.2			ping indicators.
PA100U	2	50	90	100	5-100k		0.08		0.04	20-20k	1	1.7	5.5	$324.00	Switch mode power supply design
												8.5			reduces size and weight. Set up
												10.2			for unbalanced signals.
PA100B	2	50	90	100			0.07		0.04	20-20k	1	1.7	5.5	$359.00	Same, and setup for balanced or
												8.5			unbalanced; balanced version features
												10.2			level control and clipping indicators..
PA-1200	2	250	400	600	3-180k		less		0.06	20-20k	750	3.5	15	$999.00	Fully dual-monaural design uti-
								than			1		19		lizing switch mode power supply.
								0.1					12.53		
PA-1600	2	350	500	800	15-45k			0.01	0.1	20-20k	0.775	3.5	17	$1,499.00	
													19		
													16		
STUDER REVOX AMERICA, INC.															
B242	2	200	300		20-20k		0.01		0.01	20-20k	1.55	18.4	40	$2,900.00	MOSFET drive and special bipolar
										+0,-0.3			6		power transistors, two power
													14.2		transformers, mono bridgeable.
A68	2	150	250		30-15k		0.1			30-15k		19.5	46	$995.00	Fully complementary from input to
					+0,-0.5					+0,-0.5			5.5		to output, mono bridgeable.
													13.5		
SUNN															
SPL7450	2	275	450		10-50k	less	1	0.03	1	5-50k	+4	5.25	38	$899.00	Two speed fan, compressor, male
							than			+0,,-3			19		and female XLR input connectors
							0.05						15		and balanced 1/4 in.
2150	1	150	250		10-50k		0.1			5-40k	0.625	14	25	$599.99	
										+0,-3			19		
													3.5		
SPL6000	2	175	300		10-50k		0.05			5-50k	0.625	3.5	25	$699.00	
											+0,-3		19		
													25		
SYMETRIX															
220	2	20	20		20-20k			.02	.03	20-20k	.5	1.75	9	$349.00	Stereo, 2-channel or mono-bridged
													19		operation. Balanced XLR/balanced
													12		and unbalanced 1/4 in. inputs.
P-1030D	2	100	150			0.02	0.05	0.03	0.01	20-20k	+4dB	5.25	39.8		
										+0,-2			19		
													13.75		
P-1060D	2	200	300			0.02	0.05	0.03	0.01	20-20k	+4dB	5.25	44.2		
										+0,-2			19		
													13.75		
P-1090D	2	300	450			0.02	0.05	0.03	0.01	20-20k	+4dB	5.25	48.5		
										+0,-2			19		
													13.75		
YAMAHA CORPORATION OF AMERICA															
P2700	2	350	500		10-50k	less	less		less	10-50k		1.23	5.25	$995.00	High-power stereo operation with
							than	than		than			18.88		500W/channel, or 1,000W in bridged
							0.03	0.05		0.05			17.25		mono operation-forced air cooling.
P2350	2	175	250		10-50k	less	less		less	10-50k	1	.23	5.25	$795.00	XLR and 1/4 in. input jacks, bind-
							than	than		than			18.88		ing post and 1/4 in. output jacks-
							0.03	0.05		0.05			11.25		forced air cooling.
P2075	2	50	75		10-50k		less		less	10-50k		1.23	3.878	$395.00	XLR and 1/4 in. input jacks, bind-
								than		than			18.88		ing post and 1/4 in. output jacks-
								0.05		0.003			14.38		compact and lightweight.
P2160	2	80	125		10-40k	less	less		less	10-50k		1.23	3.44 23	$595.00	Same
							than	than		than			18.88		
							0.03	0.05		0.05			14		
PC4002M2	4	30	700		10-100k	less	less		less	10-50k		1.23	7.95	$2,795.00	High power "audiophile" monitor
							than	than		than			18.88		amp with calibrated meters.
							.005	0.01		0.01			18		

Addresses

AB International Electronics, Inc.
1830-6 Vernon Street
Roseville, CA 95678

Alesis Corporation
3630 Holdrege Avenue
Los Angeles, CA 90016-4304

Altec Lansing Corporation
P.O. Box 26105
Oklahoma City, OK 73126

ARX Systems
P.O. Box 0842
Silverado, CA 92676-0842

BGW Systems
Box 5042
Hawthorne, CA 90251-5042

Biamp Systems(Advantage Division)
14270 NW Science Park Drive
Portland, OR 97229

Bryston/Bryston Vermont
979 Franklin Lane
Maple Glen, PA 19002

Carver Corporation
20121 48th Avenue West
Lynnwood, WA 98046

Carvin
1155 Industrial Avenue
Escondido, CA 92025

Crest Audio, Inc.
150 Florence Avenue
Hawthorne, NJ 07506

Crown International, Inc.
P.O. Box 1000
Elkhart, IN 46515-1000

Electro-Voice
600 Cecil Street
Buchanan, MI 49107

Hafler Professional/Division
of Rockford Corporation
5910 Crescent Boulevard
Pennsauken, NJ 08109

JBL Professional
P.O. Box 2200
8500 Balboa Boulevard
Northridge, CA 91329

Panasonic Pro Audio Systems
6550 Katella Avenue, 17A-7
Cypress, CA 90630

Peavey Electonics Corporation
711 A Street
Meridian, MS 39301

QSC Audio Products Inc.
1926 Placentia Avenue
Costa Mesa, CA 92627

Rane Corporation
10802 47th Avenue West
Mukilteo, WA 98275

Renkus-Heinz, Inc.
17191 Armstrong Avenue
Irvine, CA 92714

Shure Brothers, Inc.
222 Hartrey Avenue
Evanston, IL 60202-3696

SoundCraftsmen
2200 South Ritchey Street
Anaheim, CA 92705

SoundTech
255 Corporate Woods Parkway
Vernon Hills, IL 60061

Studer Revox America, Inc.
1425 Elm Hill Pike
Nashville, TN 37210

SUNN
7975 N. Hayden Rd.
Scottsdale, AZ 85258

Symetrix
4211 24th Avenue West
Seattle, WA 98199

Yamaha Corporation of America
P.O. Box 6600
Buena Park, CA 90622

NEW PRODUCTS

NEARFIELD MONITOR

● The N-Series FB "Fatboy" loudspeaker utilizes a 3-way Wavefront Coherent design incorporating a long-excursion subwoofer unit. This nearfield system was built expressly for A/V contractors, nightclubs, entertainment systems and any application requiring a strong bass from a single enclosure. The Fatboy is operable between 45 Hz and 18 kHz, has an impedance of 8 ohms and produces 124 dB of maximum continuous SPL at 1 meter. The speaker has a proprietary 12-in. long-excursion woofer at the cabinet's bottom end. Ferro-fluid cooled and supported by a triple-spider and cast frame, the woofer receives frequencies up to 200 Hz. Above this level, signals are directed to dual 6 ½-in. horn-loaded midrange drivers until 1800 Hz, at which point a single high-frequency driver with a 1-in. exit and a titanium diaphragm takes over. It is electronically controlled and protected by the FB System Controller and it can be either bi-amped by using the sub-output of the controller, or can be operated as a passive 3-way system. In the latter configuration it can be operated with other subwoofers. The speaker is housed in a black-carpeted trapezoidal enclosure measuring 26 ½-in. tall, by 18 ¼-in. wide and 14-½-in. deep with a 22 ½ degree cabinet pitch. The loudspeaker features steel edges with integral rigging points and a built-in stand adaptor. It weighs 75 lbs and is optionally offered with a hand-laminated glass fiber exterior or an "invisible" gray finish.

Manufacturer: Community Light & Sound, Inc.
Price: $1,340.00
Circle 50 on Reader Service Card

TAPE SYNCHRONIZER

● The ATS-500 has been added to broaden the line of synchronizers. The unit supports all the necessary functions of the professional environment. They include: built-in time code generator with external reference capability, offset function, wide-band reader (ideal for code-only master set-ups) and Jam Sync. The unit is user friendly with Auto-Calibrating and does not require the mastering of hidden screens or functions. It will synchronize any two of Tascam's serial interface transports and with the addition of an IF-500 serial-to-parallel interface, also work with any common parallel interface VTR or ATR. The built-in time code generator is capable of all common frame rates and may be referenced to an external composite video signal. The offset function has an Auto mode or allows manual entry of offset values. The three synchronizer modes are Chase, Phase and Chase & Phase, thus providing the user with flexibility necessary when working with outside source material.

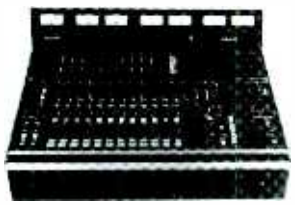
Manufacturer: Tascam
Price: ATS-500 is $799.00; IF-500 is $550.00
Circle 51 on Reader Service Card

WIRELESS MIC SYSYTEM

● The 551 VR Two Channel Wireless Video Microphone System features two user switchable VHF operating frequencies, surface mount technology (SMT), the companding noise-reduction circuitry makes possible a dynamic range of 120 dB. The system includes the HT-10 a wireless, handheld mic featuring a tapered balanced design and rugged all metal case; the ultra compact SX/LT-30 lavalier bodypack transmitter which features two user selectable channels plus SMT, a mini XLR connector to accept any electret condenser lavalier mic and a road ready, all metal case. Both the mic and transmitter feature a Transmitter ON/OFF switch, Audio ON/OFF switch, level trim and low battery LED. This system provides an operating range of more than 200 feet and up to 1,500 feet, line of sight. Besides allowing the videographer the ability to place the mic where the action is, the system eliminates camcorder noises, ambient sound and unwanted environmental sounds such as wind or

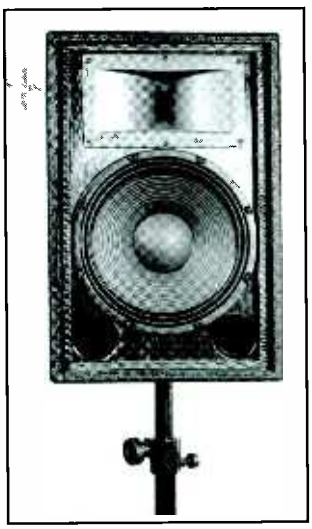
background noise. The system is ultra compact, in an all metal case, included belt clip, as well as a balanced audio output jack and headset output, removeable rubber duck antenna and it is compatible with virtually all camcorders and video cameras.
Manufacturer: Nady Systems, Inc.
Price: Under $500.00 with bodypack transmitter and mini XLR connector for lavalier mic.
Circle 52 on Reader Service Card

BROADCAST CONSOLE



● The 850 series broadcast console was designed to serve as a sweetening console for Workstations or as an on-air console. This unit evolved from the 800 series, introduced in 1991, but as a primarily on-air board. This console has as part of its capability includes either signal processing or input pre-selection physically above and electrically in-line with each input module. As with all the other consoles, this console is configured to the customer's individual needs.
Manufacturer: Auditronics, Inc.
Price: depending on configuration.
Circle 54 on Reader Service Card

FULL-RANGE SPEAKER

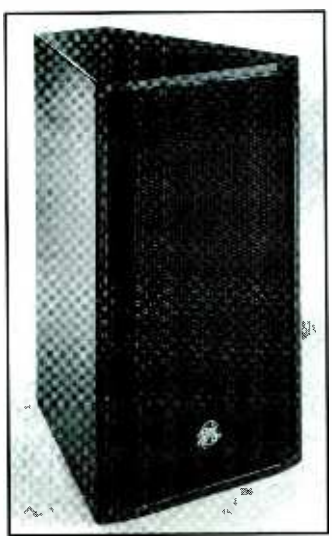


● The PowerMax 1 full range loudspeaker features the HPB12 high excursion low frequency driver and the EXF16 high frequency compression driver. It also utilizes an all new Linkwitz Riley 24 dB passive crossover to ensure phase coherence through the crossover region. It is available in two versions, as the standard PowerMax 1 and the 1F for flown applications.
Manufacturer: ARX Systems
Price:
Circle 55 on Reader Service Card

MINI SUPERCARDIOD

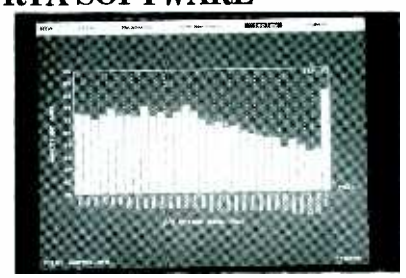
● The M 424 series microphone is a miniature supercardioid dynamic mic incorporating TG-X technology via the use of rare earth neodymium magnets. Although physically small, 1 ½-in. long and ⅝ of an inch in diameter, it provides high sensitivity, tight polar pattern, fast transient response plus the ability to withstand exposure to high SPL sound sources. This mic is also available in a pre-mounted slim profile gooseneck version as the SHM 424.
Manufacturer: Beyerdynamic
Price: $139.95
Circle 56 on Reader Service Card

TRAPEZOIDAL SPEAKER



● This is an arrayable speaker system designed for applications requiring high performance and intelligibility from a small full-range package.Extremely efficient low-end coupling when arrayed with another system, the R-2T and its 12-inch cone transducer provides solid low-end response to 50 Hz. The high-end driver is a 2-inch compression unit with a 60 by 40 degree horn. The dispersion is suitable for near-field and medium-throw applications. The horn is also rotatable, facilitating horizontal or vertical placement. Available with or without handles and infrastructure rigging, the R-2T is ideal for theaters, worship centers and music sound reinforcement.
Manufacturer: Clair Brothers Audio Systems, Inc.
Price:
Circle 57 on Reader Service Card

RTA SOFTWARE



● Designed to provide audio professionals with the power to perform Real Time Analysis (RTA) with either the TEF 20 or TEF 20HI, the new Sound Lab RTA software greatly expands the working role of the latest generation of TEF products. With Sound Lab RTA, measurements can be made at 1, ½, ⅓, ⅙, and even 1/12 octave bands, while collected data can be viewed in 3, 6, or 12 dB per division increments. For storage purposes, six sets of non-volatile memory are provided. Once data is stored, it can be manipulated by the user to obtain overlays, or it can be compared to a standard with the use of a difference mode. An independent module of Sound Lab, RTA works in conjunction with other TEF 20 capabilities to supply wide-ranging sound analysis tools in a single, easy-to-use package. As an example of the synergistic capabilities available, imagine being able to set a delay line, check coverage, measure intelligibility, and then switch to RTA to do equalization.

Compatible with IBM PC host computers, Sound Lab RTA meets all ANSI band requirements for an extended ⅓ octave real-time analyzer. Its graph-style display can be adjusted to show dashes or bars, while measurements can be frozen on the screen as well. Additionally outfitted with a peak hold which holds the highest peak instantaneously, it has a response time averaging from 171 milliseconds in the fast mode to 10 seconds in the long mode.

Manufacturer: Techron

Price: $300.00

Circle 58 on Reader Service Card

NEW DIVERSITY AND NON-DIVERSITY

WIRELESS

● Suited for professional audio applications ranging from gymnasiums and houses of worship to classrooms, boardrooms, auditoriums, and live theatre, the new diversity WT-870 and non-diversity WT-770 wireless microphone systems are VHF high-band units operable between 168 MHz and 216 MHz. Featuring a rack-mountable design, each system's receiver is outfitted with removable front panel covers which conceal two tuner ports. These ports readily accept frequency specific tuner modules which can be installed or removed according to setup requirements. To prevent RF interference and virtually eliminate ambient RF noise, the WT-870 and WT-770 systems are equipped with a proprietary double squelch circuitry, which consists of a tone- key circuit and a noise squelch. The tone-key circuitry reduces external RF interference by enabling the microphone to simultaneously transmit both the audio signal and a high frequency side-band (or tone-key) signal. In turn, the receiver will not accept any audio signal unless the tone-key signal is present, thereby insuring controlled operation. A complement to the tone-key circuitry, the noise squelch automatically mutes noise which exceeds a predetermined level to further ensure that the audio signal remains as clean and transparent as possible. Another feature shared by the WT-870 and the WT-770 systems is a specially-designed compander circuit which compresses audio signals within the transmitter to a specific ratio, and then expands them back to their original state at the receiver. By routing the signal in this fashion, the compander circuit boosts dynamic range and the signal-to-noise ratio to levels normally obtained only by hard-wired systems. Located on the front panel, controls and indicators for both systems consist of a power switch, on/off indicator, volume knob, and LED indicators for signal presence and line level. Standard balanced XLR connectors are provided for each output channel, while a ¼-inch phone jack is supplied at a mixed output. An additional DC input jack is also available on both receivers to facilitate an alternate power supply of 12 V at 250 mA (minimum). Each receiver comes with a single tuning panel installed. Additional tuning panels are offered optionally, along with a dipole antenna, whip antenna, stand-mount antenna, rack mounting accessories, and more. Measuring 8.3 inches wide by 1.9 inches high and 11.02 inches deep overall, both receivers can be mounted side-by-side to supply 4-channel capabilities in a single rack space.

Manufacturer: TOA Electronics, Inc.,

Price: WT-870—$1,142.00; WT-770—$884.00

Circle 59 on Reader Service Card

BROADCAST R-DAT

● Conceptually the D780 is designed for broadcasting requirements. As a front loader with optional rack mounting brackets, this recorder can be integrated in the studio as free-standing or in a rack. For searching, high spooling speeds up to 400 times play speed are available. A locator with nine user-definable addresses and a tenth address that is always the most recent start command are provided. There is also an auto-cue function for automatically placing the tape at the start of modulation. Absolute time is recorded. A special quick-start option is achieved by reading into special memory approximately 7 seconds of the recording around the start point. Four different fader start points are also available.

Manufacturer: Studer

Cost: $7,400.00

Circle 60 on Reader Service Card

New Products are edited from information supplied by the respective manufacturers.

If you want your new product listed in this section, send the release, include the suggested list price and there **must** be a photograph or diagram included.

Send them to New Products department, **db Magazine**, 203 Commack Road, Suite 1010, Commack NY 11725.

HAROLD LINDSAY

These pages, reproduced from our 1977 December and 1978 January issues are reprinted because of their historical importance, in this our 25th year of publication.

Magnetic Recording Part I

A tantalizing proposition—reproduce a machine with no information regarding its electronics.

THE YEAR 1977 marks one hundred years since the invention of the first demonstrable sound recording devices, and thirty years since an event that profoundly influenced the development and acceptance of magnetic sound recording—the first radio show to be aired in the United States from a magnetic recording of acceptable professional quality. This event was to revolutionize broadcasting transcription practice.

Early in the evening of May 16, 1946 my wife Margery and I drove the 35 miles north from Redwood City, California to San Francisco to attend an Institute of Radio Engineers (now known as I.E.E.E.) meeting to be held in Studio A of the NBC/ABC complex. Little did we realize as we set out that this event would serve to change the whole course of our lives and many others as well.

The speaker of the evening was John T. (Jack) Mullin and his subject the "Magnetophon." This was to be the first public presentation in the United States of this remarkable recording device, which had been first demonstrated in August 1935 at the Radio Exhibition in Berlin, Germany. The device, developed by Germany's A.E.G., in conjunction with I.G. Farben, used tape consisting of carbonyl iron powder coated on cellulose acetate. In January, 1938 the German Reichs-Rundfunk-Gesellschaft had adopted the Magnetophon and magnetic tape as the future standard for radio broadcast recording in Germany.

Further refinements in machines as well as tape continued throughout the war and somewhat beyond its end. In all, three different types of tape were produced along with at least six different models of the Magnetophon.

It is nothing short of astonishing that while researchers here were still struggling with steel tape and wire recorders, our wartime enemies were fully a decade ahead of us—and we didn't even know it. People engaged in the audio professions in this country were not even aware of the advancements that had taken place overseas until after the war's end. Only then did military intelligence and communications personnel take an interest in this "new" technology and recognize its potential.

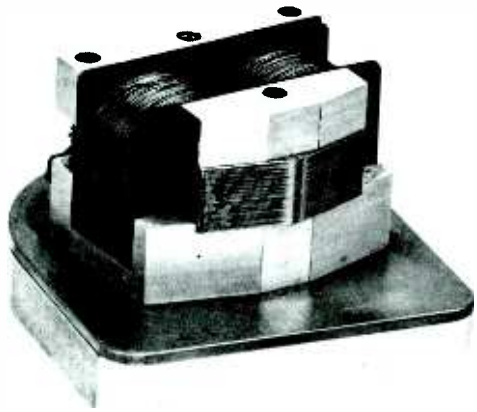
By that time, Germany's industrial capacity was in a state of near collapse. At least two of the "Magnetophone Union" factories had been bombed out, and production of recorders and tape was at a virtual standstill. One of the last operating factories to produce type "L" tape used in the machines was confiscated and shut down by Russian occupation forces.

Therefore, the machines on which Jack Mullin demonstrated the use of magnetic tape were exceedingly rare, representative of what had become an extinct species. And the tape on which they depended was rarer still; there was no possible way of getting more. The fact that Jack Mullins later shared some of his precious tape with the people from Ampex will always be remembered with gratitude.

MULLIN'S DEMONSTRATION

The studio in San Francisco was packed to the foyer. We could sense the feelings of anticipation and excitement

Harold W. Lindsay, a distinguished audio pioneer and internationally recognized authority on magnetic recording, helped lead Ampex Corporation to success and growth and is currently special consultant to that company's magnetic tape division.



Original prototype Ampex playback head (enlarged 3.5X). This is the actual head that was proportioned to allow mounting in Mullin's Magnetophon head housing for proof of performance.

as the crowd viewed the puzzling array of sound equipment crowding the stage. Jack Mullin opened his presentation with a slide-illustrated technical description of the Magnetophon. Then came the demonstration.

Previously recorded musical numbers were played back while, intermittently, live music from a small jazz combo in an adjacent studio was switched with an A/B switch back and forth from live to tape. No one, but no one, in that audience of critical ears was able to detect a difference between live and tape. This brought forth a standing ovation from the spellbound listeners. Equally amazing was the demonstration of the fascinating capabilities of tape editing, including a one-minute stretch of program containing twelve splices, none of which was detected by the listeners.

A deluge of questions followed the formal presentation, and Jack fielded the queries in fine academic fashion. Adjournment brought a crush and jam of the technically inclined to the lecture platform for a close look at the fantastic Magnetophon.

Margery and I waited until the crush had thinned out before inspecting the equipment. Quite overcome with excitement, I burst out to Jack, "I've got the feeling this development is going to change the lives of millions of people. That's what I'd like to do someday—work with magnetic recording."

Jack smiled as he shook my hand. "I hope you do. If I can be of any help, look me up." As we parted, little did I realize that this offer, so lightly made, would be taken up in earnest only six months later.

My first contact with the Ampex Company came in September, 1946 while I was working in the engineering department of the Dalmo Victor Company in San Carlos, on the San Francisco Peninsula. Forrest Smith, general manager of Ampex, frequently visited Dalmo Victor in connection with the precision permanent magnet motors and generators Ampex had been supplying to Dalmo for assembly in the APS-6 airborne radar for Sperry Gyroscope and the U.S. Navy.

Mr. Smith and I became quite friendly. Then one day he surprised me with a message from his employer, Alexander M. Poniatoff, asking to meet with me at my earliest convenience for a technical discussion. The meeting arranged for the following week became another turning point in my life. Mr. Poniatoff explained that with the end of their war-time contracts in view, he and the people at Ampex were anxious to find a post-war product to help them stay in business They were considering studio-type turntables, but felt they should have some consulting expertise to assist in the final decision. Mr. Poniatoff proposed that I serve in a part time consulting capacity to Ampex in this matter of new product selection. I accepted, and a series of meetings ensued.

AMPEX CONTACTS MULLINS

After many weeks of discussion and review I finally conjured up enough nerve to suggest to Mr. Poniatoff that he consider looking into the German Magnetophon with the idea that the design be upgraded where possible and adapted to suit radio broadcast practice in the United States. His response was immediate and favorable, which was typical of Mr. Poniatoff when presented with a new and intriguing idea. I described the May 16th I.R.E. meeting to him and when I related Jack Mullin's parting comment, Mr. Poniatoff was fast to interrupt: "Let's phone him!"

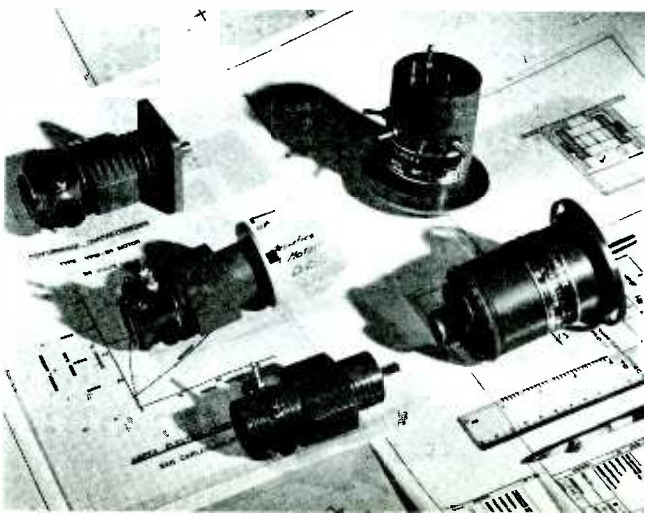
Jack was cordial but apologetic. He was all packed and ready to depart for Los Angeles to attend the annual convention of the Society of Motion Picture Engineers (SMPE—there was no "T" for television then). He suggested that Mr. Poniatoff try to make plans to come down to this affair where he could meet Jack and see the equipment demonstrated. After hasty arrangements, Mr. Poniatoff was on his way.

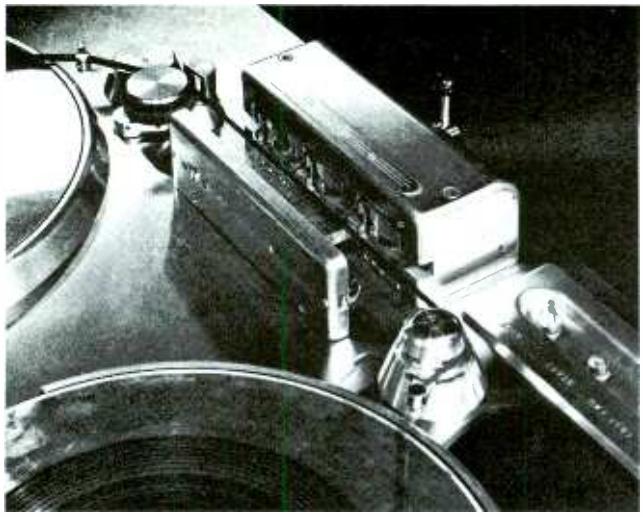
He returned with a display of enthusiasm for the tape recorder, which unmistakably meant Ampex was about to enter a new field. His first comment, directed to me, was, "I want you to become a full-time member of Ampex and assume responsibility for the development of our first magnetic recorder." How could I refuse? My wish had become a reality.

THE DEVELOPMENT PROJECT

On the 10th of December, 1946, not quite eight months after that memorable I.R.E. meeting we were on our way toward the development of a magnetic tape recorder. None of us in our wildest dreams could have visualized the full

Ampex's first products. Precision permanent magnet motors (left) and generators (1944-1946).





Partial view of top-plate showing cast Meehanite head housing with gate forcibly extended beyond its regular open position permitting view of magnetic heads. Note alloy inner shield cans. Far left head is play-back with laminated shield can. Also shows straight-line threading path of tape.

View illustrating plug-in feature of magnetic head assembly. Slotted cap screw at left of head gate covers hole for editing pencil insertion over playback gap.

impact of what lay ahead, but I remember saying to Mr. Poniatoff, "If we succeed, one day people will be beating on our door to get these products."

At the outset of the development project, the immediate challenge was where to start and how to divide the work load. In fact, the division of labor was quite simple. There was Myron Stolaroff, the electrical engineer who had done much of the design work on the radar motors and generator, and myself. That was the entire engineering team at my disposal as project leader!

A good suggestion as to the best starting place came from Jack Mullin, whom we had phoned for advice. Based on his experience with the Magnetophons he had found there was no question that the most critical part of the entire recorder rested in the design and construction of the magnetic heads, especially the play-back head. With this in mind, he urged us to attempt a play-back head design and to construct a model for performance tests. Success with this should give encouragement to continue the whole project; but should we fail we would be better off dropping the idea of ever producing a magnetic recorder!

In proposing these early head tests, Jack of course realized that we would be in no position to perform them without the availability of an already operable recorder, so he kindly extended an invitation to test our head design, when ready, on one of his two Magnetophons. By designing our play-back head so that at least its mounting requirements would be adaptable to the Magnetophon's head housing, we would be able to make performance tests using the German erase and record heads.

THE MOMENT OF TRUTH

In the spring of 1947, after several months involving construction of lamination dies, a hydrogen annealing furnace, core stacking and lapping fixtures, and many tedious hours of stamping, stacking, hand lapping and winding, we were at the point of final assembly and static testing. We believed we had gone as far as we could without tape—we were ready for that long sought, but now almost frightening moment of truth, the final test. I phoned Jack and set a date. The following evening found an excited but nervous Ampex group on its way to the W. A. Palmer Studios in San Francisco, where Jack Mullin and Bill Palmer had been using the Magnetophons for over a year in their commercial film production.

The first tests were to be subjective listening tests using the best master taped material in the Palmer studio. We listened critically to this as it was played back with the normal Magnetophone head, using their best monitoring equipment. After replacing the German reproduce head with the Ampex prototype and rewinding the test material, we were ready.

I have always remembered that next moment, just before pressing the start button, as one of the most anxious

Author Lindsay checking out Model 200 (January 1948).

times in my entire life—so much hung in the balance: a dismal failure or the beginning of an exciting future.

The tape whipped up to speed; we were stunned, entranced, suspended in an eternity of mere seconds. Then cheers and hand shakes and clapping—the sounds of a wild celebration. Our ears had just told us what measurements later confirmed—we had outperformed the Magnetophon head. We were destined not to failure, but to fame.

We followed the playback head with a successful record head and finally one for erase. These head successes and Alexander Poniatoff's unbending courage and confidence served to carry us through the very difficult months ahead, months when finances would dwindle to the near vanishing point, plus loss of credit, inability to get supplies when needed, weeks without pay checks and experimental and developmental reverses. Nevertheless, in the face of all these obstacles we continued, stubbornly unwilling to give up.

During these rough months Jack Mullin was helpful in many ways and on many occasions, allowing us to examine the mechanical portions of the Magnetophon, but never the electronics. This puzzling situation was later explained when we were told of his previous commitment and contract with Col. Richard Ranger who was also hoping to produce a domestic version of the German recorder. Jack had made certain improvements in the electronic circuitry which were to be exclusively used in the Rangertone equipment.

While unable because of these commitments to show us any of the electronic assembly beyond the front panel, Jack did, however, help us in many ways. His moral support, encouragement when going was rough, loan of a number of reels of German "L" type tape when he had precious little on hand, design suggestions, and last but certainly not least, his promotional efforts in Hollywood on behalf of our forthcoming product were vital to us.

THE TAPE CRISIS

As development of the prototype model of the Ampex 200 reached the tape pulling stage, we began to get very uneasy feelings. Up to now, Jack Mullins had been sharing his slender stock of type "L" tape with us. But the sources of the tape were no longer in existence. If we didn't develop a tape to go in our machine, we'd be all ready for production with no place to go.

But fate was moving along with us. One day a gentleman came into our office, introducing himself as a representative of Audio Devices, an eastern manufacturer of disc recording blanks. They'd heard through the grapevine about our project and wondered whether we would cooperate with them in using our new machine to test some new tape they were developing. Needless to say, we were more than happy to oblige.

It seems almost incredible, but a few weeks after the Audio Devices arrangement had been made, we again had an unannounced visitor. This man seemed to be in a great rush, somewhat nervous. In a hurried manner, he explained that his firm in the middle west believed that there was a great future for magnetic recording. They'd embarked on an intensive project to develop an acceptable tape product. However, like Audio Devices, they were stymied because they didn't have suitable recording equipment on which to test their tape. They also wanted to use our new equipment.

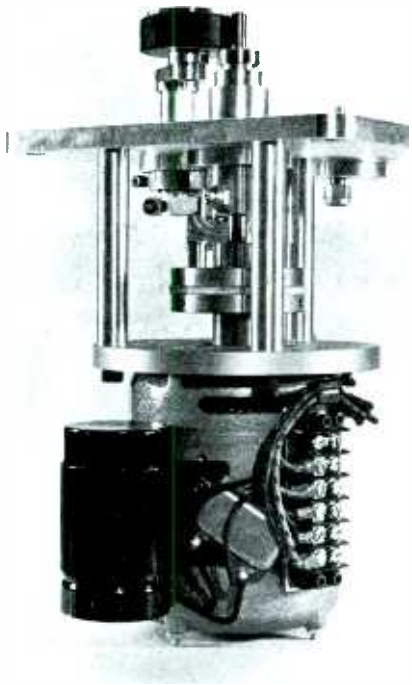
Without identifying the other company, we told him about our previous arrangement.

He was not shaken. "Why not help us both? The results can easily be kept confidential. Furthermore, if you have

Threading the 14"-diameter open-faced "reel." Reel held 5400 ft. 0.002" thick tape. Torque/threading pin mounting circle dimensions have carried over to present day N.A.B. Standard Hubs as inside (hub bore) driving slots.

Recessed push-button control center. Buttons of Lucite were illuminated, recessed to reduce chances of mis-cueing.

Front view with cabinet doors opened. Note modular electronic assembly on vibration-isolated base. Removable modules are (left to right) power supply, control logic assembly, record module, and playback module.



Capstan drive sub-assembly removed from top-plate.

two tape sources, this will double your chances of arriving at the marketplace in time with tape."

This aspect of the proposal was too tempting; we couldn't turn it down. As he rushed to leave I called after him, "Pardon me sir, may we have the name and address of your company for our records?"

He replied, "I come from Minneapolis, and my company makes pressure sensitive tape products labeled 3M."

MODEL 200 STEAMROLLERS

As mid-summer 1947 arrived, the Model 200 project was accelerating. Six- and seven-day work weeks, as well as many around-the-clock sessions were stepping up progress, but not without their toll on the participants. By this time (July) trials of Mr. Mullin's reworked Magnetophons were also accelerating at ABC/NBC's Radio Center in Hollywood. We had heard of the misfortune Col. Ranger suffered when the "Rangertone" failed in its comparative demonstration with the Magnetophon (held in the NBC recording department).

However, Jack Mullin's successful demonstrations for NBC and ABC as well as for the Bing Crosby/Philco radio show people had served to stir up great interest in the potential use of professional quality magnetic tape recording equipment for broadcast applications.

The next step would be an actual trial on the air, and the Crosby people were in a position to benefit handsomely from its successful use. They were willing to go ahead but had two principal concerns. With the failure of the Rangertone unit, who would supply the needed equipment for back-up should the German machine wear out, and where would be the source of new magnetic tape when the German "L" tape was eventually consumed by splicing operations?

Jack Mullin called us long distance and explained that since the Rangertone fell by the wayside the Crosby and Philco people were anxious for Ampex to succeed. It seemed we were being put on the spot to quickly produce an acceptable unit, but it was also a fantastic opportunity for recognition and the establishment of credibility. There was an ominous mandate: we must not fail.

The Crosby people visited us at Ampex and, satisfied with what they saw in a partially completed machine, encouraged us to notify them when it was finished and to bring it to Hollywood to Crosby's "listening room" at ABC/NBC Radio Center for demonstration.

THE CROSBY CONNECTION

After conferring with Jack Mullin, the Crosby/ABC people decided to go ahead with the Magnetophon taping of the Philco show. That decision was based on Mullin's assurance that he felt Ampex would produce an acceptable recorder within a reasonable period. The decision called for initially recording on tape, editing, and performing a single-generation dub to a Scully cut disc from which the program would be broadcast. It was hoped that when the additional recorders were available, the operation might be ultimately expanded to the use of tape playback directly to the network.

In August Jack Mullin set up his two Magnetophons in a small studio in the NBC building and started recording and editing an average of one show a week.

In the meantime, there was rapid progress on tape development. Audio Devices and 3M were moving along on somewhat parallel paths. Both concerns were supplying test samples at frequent intervals to Ampex for evalution. 3M also supplied samples to Jack Mullin with the assurance that they were most anxious to cooperate in any way possible to help make the application of magnetic tape practical. Both firms arrived at the marketplace with acceptable tapes in time for use on the first Ampex machines.

Toward the end of August, our prototype Model 200 had reached the stage of final testing. We phoned Jack and a date was set for early in September for the Crosby demonstration. During the course of final testing and adjustment, a decision was made for a slight alteration in the record and bias circuits. To our dismay we experienced severe degradation of signal quality in the record mode. We feverishly worked night and day in an effort to restore the original circuits and performance, but to no avail. Our date at Radio Center was less than a week away and it appeared that we would have to cancel out. We needed more time to rectify our error.

In desperation we phoned Jack Mullin and explained our situation. His first question was, "Will it play back?" On being assured that the playback performance was excellent he implored us not to cancel the appointment. This was one of those rare opportunities which might never come again.

TAPE SPEED

It was now that a decision made some eight months previously was to pay off. In our early discussions with Jack with respect to transport design direction, the question of tape speed was considered. It was thought that in the interest of interchangeability of recorded tapes between the Magnetophons, with their 76.2 cm/sec tape velocity, and the Model 200, that we should adopt the same speed. A simple conversion from the metric provided an answer of 30.0 inches per second. This speed was adopted in our design and it has continued as a reference base for tape speeds throughout the industry's expansion.

This simple decision made it possible to demonstrate our prototype on a playback-only basis in Hollywood, using excerpts from the Crosby show tapes as source material. The Ampex 200 was set up in Crosby's listening room at Radio Center, and to our surprise the event turned out

MAGNETIC RECORDING: HIGHLIGHT SUMMARY

1898 The Danish physicist Valdemar Poulsen introduced the "Telegraphone," first of the early magnetic recording and reproducing devices of practical design. Danish Patent No. 1260, British Patent No. 8961.

1900 U.S. Patent 661,619 issued to V. Poulsen covering the "Telegraphone."

1907 U.S. Patent 873,033 issued to V. Poulsen and P.O. Pedersen covering the principle of d.c. bias.

1912 Dr. Lee De Forest's invention of the vacuum tube.

1918 Leonard F. Fuller was issued a patent covering the use of high frequency current for erasure of magnetic recordings.

1920 Dr. Kurt Stille of Germany recognized the real value of magnetic recording as applied to a variety of uses.

1921 U.S. Patent application by W. L. Carlson and Glen W. Carpenter for the use of d.c. bias on a wire telegraphone. This was finally issued as Patent No. 1,640,881 in 1927.

1927 J. A. O'Neill granted U.S. Patent No. 1,653,467 covering powdered recording media. December 20, 1927.

1928 Dr. Fritz Pfleumer, German Patent No. 500,900, January 31, 1928, British Patent No. 333,154, August 5, 1930, covering application of magnetic powders to paper or plastic backing media. Seeking technical help for the development of his idea he approached the German electrical company Allgemeine Elektrizitats Gesellschaft (A.E.G.) of Berlin. A.E.G. in turn interested I.E. Farbenindustrie Aktiengellschaft of Ludwigshaven in the project. Concurrently with the tape development at I.G. Farbenindustrie the A.E.G. carried on a project resulting in a product to be known as the "Magnetophon."

1931 Ludwig Blattner, a German, exploited Dr. Kurt Stille's ideas and introduced the steel tape "Blattnerphone" to the British Broadcasting Co. where it was used for radio transcription purposes.

1935 The A.E.G. developed the Magnetophon using tape consisting of carbonyl iron powder coated on cellulose acetate. It was publicly demonstrated in August 1935 at the Radio Exhibition in Berlin. The eight models displayed were sold during the show.

1938 In January, German Reich-Rundfunk-Gasellschaft adopted the Magnetophon and magnetic tape as the future standard for radio broadcast recording in Germany.
His "Telegraphic Patent Syndikat" obtained rights to various magnetic recording patents. along with some of its own, and issued licenses for commercial exploration.

1938 Dr. Hans-Joachim von Braunmuhl re-discovered a.c. bias and patented it.

1946 May 16, 1946, Institute of Radio Engineers (now I.E.E.E.) San Francisco Chapter local meeting featuring John T. (Jack) Mullin as speaker of the evening. Subject: "The German Magnetophon Magnetic Tape Recorder."

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British Patent	333,154	Fritz Pfleumer	1930
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*(Published in U.S., U.S. Property Custodian Ser. No. 413,380) 1934			
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to be much more demanding than we had been led to believe in the planning discussion. Early in the day playbacks were made for the Crosby principals and crew, and while they were in progress a waiting line began to form outside. It was composed of engineers and technical people from all over the area—from the networks, disc recording studios, and the motion picture industry, as well as others. The word had gotten around and they were not about to miss what they were inadvertently helping to shape into an informal first showing of an exciting new product. The demonstration room was small, with room enough for only 12-15 guests per playing, and the demos went on all day!

As the last of the admiring visitors left, we of the Ampex crew were left in a state of amazement. We had fully anticipated that among that continuous stream of tech-

Our first advertisement.

nical experts, at least one engineer would have said, "The playback is beautiful, but how about a demonstration of recording!"

A few days after our return to Redwood City, some representatives of Crosby Enterprises called on us. Their comment, "We assume that you know you have taken Hollywood by storm," served to open the subject they had in mind: "Now, what are your plans for marketing it?"

MARKETING

In a somewhat naive manner, we had to admit that we had been so preoccupied with development that there had been no discussion of such plans; as a matter of fact, I think most of us believed that the marketing might in some mysterious way take care of itself.

This seemed to be just the sort of answer they were expecting. They had a proposal: would we be interested in their representing us in the eleven western states as our distributors?

After a short discussion we agreed and signed the contract they had brought along. And then another document appeared from a hidden pocket—a signed order for twenty recorders! These (and ultimately four others) were to be for the American Broadcasting Co. Some were to be installed at each of three locations—New York, Chicago, and Hollywood, and all were to be ready in their respective installations by April 25, 1948.

A few days passed before we re ered from the euphoria induced by this event and were able to start in earnest on the task of planning for our first production run of Model 200s, which of course included parts and material ordering. It was at this point that we became abruptly aware of a serious shortcoming.

Ampex was almost completely devoid of working capital! There were not sufficient funds to purchase the materials and parts necessary to go into production, and the local banks were not ready to make loans for such a wild enterprise.

But good fortune was with us again. Quite unexpectedly an envelope with a Hollywood postmark brought us a check for $50,000—with no strings attached or collateral requirements. The signature it carried: Bing Crosby. ■

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HAROLD LINDSAY

Magnetic Recording: Part II

From Todd-AO to digital recording; one thing led to another.

PART ONE, published last month detailed the beginnings of the fledgling Ampex Company and how its ailing finances during the development of the first American tape recorder were solved by a check bearing the signature of Bing Crosby. . . .

The first two Model 200 machines assembled went to Jack Mullin to help relieve the much overworked Magnetophons. The twenty machines for the A.B.C. installations were operated in their key locations for time-delayed broadcasting of network shows across the country. Their performance in this first application is best related in the following letter which was sent to Mr. Poniatoff at the close of the season:

. . . commencing April 25, 1948, and continuing through September 25, 1948 (a total of twenty-two weeks), the American Broadcasting Company in Chicago recorded on the Ampex, approximately seventeen hours per day. For thse 2618 hours of playback time the air time lost was less than three minutes, a truly remarkable record. We believe that a large share of this successful operation was due to the use of the Ampex tape recorder manufactured by your company.

We wish to thank you for your splendid cooperation in supplying us with this fine piece of equipment capable of withstanding the severe conditions imposed during our delayed daylight saving time program.

Very truly yours,
Frank Marx. V.P. in charge of engineering
American Broadcasting Company

In all, 112 Model 200's were manufactured. At about the halfway point in their production (the fall of 1948), we had acquired enough experience and knowledge, as well as input from our customers, to realize that we should consider the design of a new model. The Model 200 had served to demonstrate conclusively that magnetic recording had a lasting place, not only in radio broadcasting, but as a more convenient and flexible means of mastering recordings for phonograph record manufacturers.

In creating this first product in a field new to us, the key premise in our design philosophy was "uncompromising quality and unsurpassed reliability." In our intense desire to assure that these elements were not jeopardized we found ourselves with a product that was somewhat over-designed.

With our newly developed knowledge and skills, especially in the matter of magnetic head design, we were in a

Harold W. Lindsay, a distinguished audio pioneer and internationally recognized authority on magnetic recording, helped lead Ampex Corporation to success and growth and is currently special consultant to that company's magnetic tape division.

position to produce a recorder to follow the 200 at half the price; it could also be substantially smaller in size and operate at half the tape speed (15 in./sec.). It was thought that the lower operating cost of 15 in./sec. and the reduced physical size would appeal also to users with smaller monitoring and control rooms.

MODEL 300

In November, 1948, we set to work on a new project, the result of which was to be our Model 300. Tape speed would be halved and the dimensions reduced, but performance and reliability kept as close to the 200 standards as possible. By halving the tape speed, we could reduce the reel size and tape length and still maintain the playing time of the Model 200. This new 10½-inch reel, with later modifications, eventually became the NAB standard. This challenging assignment was pursued on an all-out basis and the first production run was conducted in July of 1949 when fifty units were manufactured. The first machine off the line went to our good friend Jack Mullin.

The response in the market place was beyond our most hopeful expectations. As a result, we were now faced with a new set of problems—how to supply an unending rush of orders. The "300" was an immediate success, and within the first few years of the design's long lifetime in the market place it was to be found in all of the major radio networks as well as widely used in the smaller nets and individual stations. The big name phonograph label record manufacturers were all using the "300" for mastering and editing.

The basic design of the "300" remained virtually unchanged throughout its lifetime until the late '60s; its solid state version was introduced in 1966. In all, somewhere around 20,000 Model 300s were manufactured during this time.

The Model 300 received recognition in October 1950 when the publication *Electrical Manufacturing* presented to Ampex a Certificate of Award for "outstanding achievement in product development, design and engineering."

As noted earlier it had been decided in embarking on the "300" development project to lessen the over-design of the "200." Our goal was reduced size, weight and cost.

An Ampex alignment tape circa 1948. This is probably the first professional alignment tape made in this country. Ampex made these tapes available to purchasers of Model 200 machines. Photo from Jack Mullin's product museum, as shown at a recent AES Convention.

The Ampex 300 appeared in early 1949, running at 15 in./sec. speed (also 7.5) and at both reduced size and price from the 200. This was the first ad. Note the specs.

while retaining reliability and outstanding performance. Fortunately, the Model 300 retained a certain amount of over-design, which some two years later, in 1950, proved to our great advantage.

MODIFICATIONS

By 1950, after the first year of "300" production, Ampex started to receive requests to supply special modifications of the basic "300" to be used, not for normal audio purposes, but for data recording in industrial, military and scientific research. These highly specialized applications were so tempting to us that we succumbed and entered headlong into a development program which spurred us into the new field of instrumentation data recording.

This is where the "excess" capability of the original "300" design paid off. We were able to modify the transport to handle tape speeds from 1⅞ in./sec. to well over 120 in./sec. By this time our skills in magnetic head design and fabrication had advanced sufficiently to enable us to produce narrower gap reproduce heads and multi-channel heads with acceptable crosstalk.

MODEL 3200 DUPLICATOR

These developments enabled us to introduce the Model 3200 tape duplicator system (based on Model 300 modifications), consisting of a high speed tape master playback machine feeding banks of slave recorders. Thus it became possible as well as practical to duplicate master tapes at reasonable cost for retail sales of prerecorded high fidelity tapes.

For instrumentation applications we also introduced frequency modulation recording, as well as pulse code modulation systems. We were then in a position to supply

The author (left) with Alexander M. Poniatoff at the introduction of the Ampex ATR-100.

record/reproduce equipment covering a wide range of data requirements from direct current levels and digital coded information, to high frequency signals well above the audio range. This capability resulted in Models 301, 302, 303/311, and others. Instrumentation magnetic tape recording was here to stay and Ampex was to remain as an important influence on the growth of this new technology.

Entrance into the instrumentation field did not de-emphasize our efforts in the audio field. New audio models were forthcoming. The 400 series, which had been first manufactured late in 1949, was upgraded to become the 401 but turned out to be the least successful of the early introductions, having a relatively short life in the audio market place. In 1952, Model 350/351 was first introduced and became a very popular professional recorder, evolving through the years and a number of revisions.

THE MYSTERIOUS VISITOR

It was at this time (1952) that an interesting incident occurred at Ampex. Mr. Poniatoff received a phone call from a New York banker who stated that an important visitor would soon be coming to our facilities. Though he could not disclose the identity of the mysterious guest or the purpose of his visit, he did indicate that it could result in important new business for Ampex.

On arriving, the visitor introduced himself as "Mr. Edwards," without bothering to disclose why his large gold cuff links and tie pin carried the initials "M.T."

Early in the conversation that followed, "Mr. Edwards" inquired whether the people at Ampex had seen Cinerama (the initial public screenings had occurred just before the visit) and if we could record sound on photographic film prints with magnetic striping.

His next inquiry, whether Ampex had done any work in stereophonic sound recording, was effectively answered by a very impressive demonstration. Our demo of three-channel stereophonic playback, using theater-type loudspeaker systems, satisfied our visitor, who finally confessed that his name was not Edwards at all, but Mike Todd!

Mr. Todd was so impressed with what he had seen (and heard) that he made an on-the-spot decision to select Ampex to produce the sound system for the Todd-AO motion picture system (a further improvement on the Cinerama development).

While working on the Todd-AO project, Ampex developed a four-track multi-directional sound system which was introduced in 1953 and was featured in the first Cinemascope film, *The Robe*. Two years later, *Oklahoma!* was premiered with Ampex six-track sound; it was literally an Oscar-winning performance. Other design advances emerged, and by 1967 Ampex had installed sound systems in theaters around the world.

In 1967 we introduced a solid state, improved version of our wide screen multichannel systems. But these systems, though widely acclaimed, remained on the market for only about two years. The interest in super-wide screen presentations was diminishing and sales were dropping off. Ampex had to face facts and retire from the motion picture sound business.

CONSUMER AUDIO

Let us look back now on an earlier year—1954. It was in this year that Ampex introduced the Model 600, intended initially for the professional market as rack-mounted modules or as a single case portable assembly. This recorder became the second Ampex product to achieve distinction by receiving an award for design excellence and has become the Ampex audio product wtih the greatest total sales volume.

The adaptation of this design to produce the Model 612 brought about the company's entry into the consumer audio field. The 612 was shown at the Ampex booth at the National Association of Music Merchants Show in the summer of 1955 and created broad interest as the world's first stereophonic music system for home use. Subsequently Ampex established a consumer division, separate from professional audio and continued with a long series of

A new model appeared in 1950. This is an Ampex 400, the first portable machine designed to professional standards. It was also the first machine to provide for both the level and microphone input. It operates at 7.5 or 15 in./sec. speed. Photo from Jack Mullin's product museum as shown at a recent AES Convention.

product introductions for a period of sixteen years before phasing out of what had become a highly competitive market place.

To cover all of the consumer products developed through that period is beyond the scope of this article. However the following account has such historic significance that it is included.

FOUR-TRACK STEREO TAPE

In attempting to develop interest in home music applications for prerecorded tape, Ampex, in introducing the stereophonic Model 612, had by 1957 come to the realization that tape could not compete price-wise with phonograph records unless higher tape packing density could be achieved. The resulting engineering effort brought forth in 1958 the four-track stereophonic head. With the introduction of this new head Ampex hoped to coax tape duplicators into immediately bringing out four-track prerecorded tapes, and thereby stimulate sales of stereo tape recorders. The idea didn't take hold, so Ampex decided to take the initiative and enter the duplicating field. The importance of such a facility to the developing home music industry is suggested by the fact that within eighteen months following Ampex's introduction of four-track stereo heads, 750,000 tape recorders had been sold by major manufacturers!

In June 1959, Ampex formed United Stereo Tapes (later Ampex Stereo Tapes) and acquired duplication rights for some of the leading phonograph record labels. These included Verve, MGM, Warner Bros., Mercury, and later London. Elk Grove Village, a suburb of Chicago, became the company's custom duplication center. Equipment consisted of Ampex 3200, and later ADM-500 and AD-150 duplicators. Through the years this facility has developed into one of the largest and most complete establishments of its kind.

During the decade 1955-1964, Ampex audio engineering personnel found themselves under heavy pressure to carry on the development programs in which they had become involved. These were the consumer product lines, tape duplication equipment and motion picture sound systems. For the most part new product introductions in professional audio had slowed down.

Only two new professional recorders were introduced in this period; the PR-10 in 1959 and the MR-70 in 1964. The PR-10 enjoyed good acceptance and was continued until its successor, the AG-500, was marketed in 1967. The MR-70, an outstanding design concept for its time, was to have been a state-of-the-art recorder at its introduction, incorporating many mechanical refinements and the best that advanced tubes and nuvistors had to offer. Unfortunately, the development project was timed badly, starting too late to put the recorder in the market place before the onset of the solid-state audio era.

The last of the 350 series, the AG-350 (with transistor electronics), became the basis for the design of a new line of very successful recorders, the AG-440, released in 1967. The years 1967 and 1968 brought many new product introductions. During this time the AG-500, AG-440, AG-440-8, AG-600, the 3400, and the large (12, 16 & 24-track) multichannel AG-1000 and MM-1000 machines were released.

MULTICHANNEL RECORDERS

The decade which followed 1967 to the present brought great emphasis on engineering large multichannel recorders and high speed duplication equipment. Duplicators appeared in 1969 with the BLM-200, in 1971 the CD-200 and in 1972 the AD-15. Introduced in 1973 was the multichannel MM-1100.

The years 1974 and 1975 were without new audio product introductions and some concern was shown in the industry; was Ampex about to give up its position of leadership in professional audio? What was not known by outsiders at the time was that this two-year stretch was devoted to perfecting products to be announced in 1976, a new and improved multitrack, the MM-1200, a highly perfected portable, the ATR-700, and a state-of-the-art analog audio recorder, the ATR-100.

The public display and demonstration date for the latter unit was the May 4, 1976 opening of the 54th Convention of the Audio Engineering Society in Los Angeles.

ORRADIO INDUSTRIES

It is pertinent at this point to recall an event in 1949, although at the time it was not related in any way to Ampex. It was destined in years ahead, however to play a prominent part in the affairs of the company.

We have already referred to the two German Magnetophons that had been sent home after World War II by John T. Mullin and how they influenced Ampex's entrance into the field of magnetic recording. Somewhat paralleling this development was the establishment of ORRadio Industries in Opelika, Alabama, in 1949 by Major Herbert Orr. Orr had also sent home a war souvenir Magnetophon and had, in addition, acquired a formula for making tape. Ten years later the firm, then known as Orr Industries, producing *Irish* brand tape, was acquired by Ampex and eventually became the magnetic tape division.

From this point forward the Ampex tape division placed increasing emphasis on tape development and improvement of manufacturing processes along with the development of a responsive marketing organization. All of this over the

Harold Lindsey died in April of 1982 ending his extraordinary career wih Ampex

I was priviledged to know him. I commissioned the original articles and can think of no finer tribute than this reprint of this two-parter.

Larry Zide, editor/publisher

years added up to wide acceptance and the winning of an important share of the tape market.

ATR-100

The acquired skills of tape design, formulation ,and processing which allowed the tailoring of a new product to specific performance parameters paid off in a big way during the development of the ATR-100. For now Ampex had the advantage of being a company with design skills in both recorder and tape technologies. The result was the introduction of the ATR-100 and Ampex 456 Grand Master tape as "go together" products. One was designed to be used with the other to bring out the maximum performance of each in true synergistic relationship.

History had repeated itself, for just forty years before, the German A.E.G. & I.G. Farben companies had teamed up with their respective skills to create the Magnetophon and its tape.

As we pause at the close of this commemorative year, it may be useful to survey the state of our knowledge and accomplishment, and address the question: Just how far have we come in these past thirty years? Perhaps some insight can be derived from a simple comparison of the performance specifications of two products representative of then and now, i.e. the Model 200 and the ATR-100.

DIGITAL VS. ANALOG

As I look over my shoulder at some thirty-plus years of trying to meld art and science in this expanding industry, a thought keeps recurring: in a rapidly evolving technology, today's state-of-the-art can be ancient history by tomorrow.

Model 200 vs. ATR-100: Comparative Performances

Measurement	Ampex Model 200	ATR-100 Ampex
Overall Frequency Response at @ 30 in/sec	Within ± 1 dB 30 to 15 kHz	Within ± 0.75 dB 200 Hz-20 kHz Within ± 2.00 dB 35 Hz-28kHz
Signal-to-noise-ratio taken at 30 in/sec AES full-track.	30 Hz to 15 kHz Unweighted over 60 dB	30 Hz-18 kHz Unweighted 77 dB
System Distortion	Using 3M Co. Type 55 Tape 4% intermodulation distortion at peak meter reading with "harmonic" distortion not exceeding 5% 10 dB above peak meter reading.	Using Ampex 456 (Grand Master) tape SMPTE intermodulation distortion < 1.0% at recorded flux level of 370 nWb/m(OVU)
Flutter & Wow	"Undetectable wow and flutter content even in the most susceptible program material"	NAB rms unweighted at 30 in/sec 0.03%
Speed Accuracy	± 0.03%	± 0.03%
Rewind Time	5,400 ft. (0.002" thick tape) (36 min. P.T.) 1.75 minutes	2400 ft. (0.0015" thick tape) 2.7 minutes

Already the industry is looking to digital audio recording. Digital-to-analogue conversions of 15 bit/50 kHz scan and greater need no longer be regarded as "humpty-dumpty" propositions. It is now possible to make the analogue-digital conversion and put all the pieces together properly. High performance systems are at hand and these most certainly will find their first use in super-critical mastering applications.

Will analogue audio recording survive the challenge of the digital assault? As a practical and relatively simple approach, analogue recording should continue unretarded in its amazing growth. Its position in the industry should be strengthened through supportive interaction with the newer technology rather than being reduced to obolescence. We can all recall that the advent of magnetic tape did not spell doom for the disc, but instead helped greatly in its revitalization.

In the foregoing we have glanced back some thirty years. At this point do we dare guess what may lie ahead over a similar period?

Other audio recording possibilities have already suggested themselves. Vastly improved optical and electron beam recording systems are just around the corner. But where will the next giant step take us? We should not overlook the progress which has already taken place in the development and miniaturization of magnetic core memories. With their almost limitless potential as memory storage devices, there are exciting possibilities for magnetic recording/playback static systems, sans-tape, where motion stability will no longer be a concern, when the only moving system elements will be magnetic lines of force and electrons. ■

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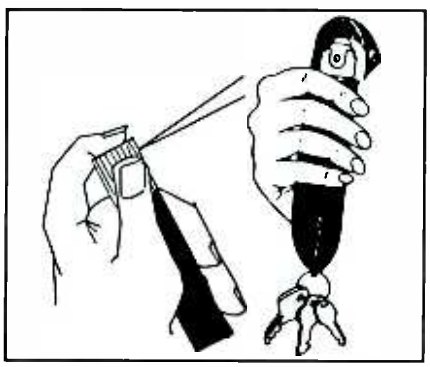

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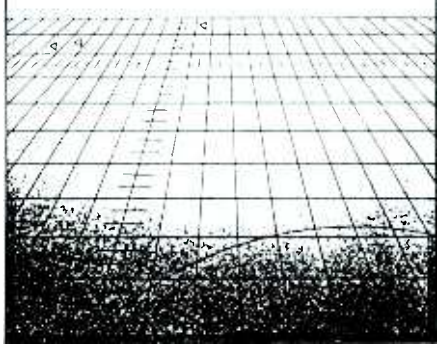

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PEOPLE, PLACES & HAPPENINGS

● Grammy Award winners **Lionel Richie** and **Michael Masser**, as well as ASCAP, BMI, the National Academy of Songwriters, the Society of Composers and Lyricists and Los Angeles Chapter of Recording Arts and Sciences sponsor **scholarships for UCLA Extension's certificate programs in music and film scoring**.

"Thanks to the generosity of these outstanding individuals and prestigious organizations, musicians with the talent and ambition to succeed in the music industry now have the opportunity to be supported in their study at UCLA Extension," said Ronnie Rubin, head of UCLA Extension's Arts Department.

The Lionel Richie Songwriting Scholarship was established for students enrolled in UCLA Extension's Certificate Program in Songwriting, a career training sequence that is presented in cooperation with the National Academy of Songwriters (NAS) and the Society of Composers and Lyricists. The award covers the candidacy free and full tuition for all courses in the program and membership fee in NAS. One recipient is selected each year. Applications are now being accepted through December 1, 1992.

● **Michael Greene**, President and CEO of the **National Academy of Recording Arts & Sciences** announced that **Los Angeles** has been chosen as the host city for the **35th Annual Grammy Awards**. After a two-year absence, the presentation of the music industry's most prestigious awards is returning to Los Angeles with one important change. For the first time in the Academy's history, the show will be broadcast live from an arena, The Great Western Forum.

● **Eastern Acoustic Works** has named **Beverly Brignolo-Seidler** to the position of Director of Sales Operations. "Ms. Brignolo-Seidler brings with her over fifteen years of experience in managing trade shows, facilities expansion and internal operations," commented EAW President **Ken Berger**. "We're very pleased to have her join EAW, and we're confident that her skills and experience will help us maintain and enhance our level of customer service throughout this period of rapid growth. Beverly Brignolo-Seidler joins Eastern Acoustic Works from **Solutions Systems**, a PC software company. She has also managed sales and marketing activites for **Kurzweil Music Systems**, and others.

● **BASF Corporation Information Systems** announced it will restructure its North American magnetic media business. "The restructuring is part of a worldwide effort by BASF to improve profitability in the magnetic media business," said **Dr. Hans Schmidt**, Group Vice President of BASF Corporation Information Systems(headquarters for BASF's North American magnetics business). To take advantage of economies of scale and to place production close to BASF's research and development headquarters, professional audiotape production at the Bedford, Massachusetts, plant will be discontinued by the end of April. Production for that product line will be concentrated in BASF's European sites." This will require a reduction in our workforce in Bedford of 170 people," Dr. Schmidt said. "We deeply regret this will be necessary. We are providing severance packages based in grade and length of service that will also include continuation of health and life insurance and outplacement counseling. Additionally, we will assist employees in trying to find jobs within the BASF organization and in the local area."

.● The executive management of **Yamaha Corporation of America(YCA)** has announced two organizational changes.

John Gatts, general manager of the Audio, Guitar and Synthesizer (AGS) Division, has been named new Business Development Manager, with responsibilities encompassing the entire company.

Concurrent with Mr. Gatt's appointment, **Ron Raup**, senior vice president of YCA, will assume additional responsibilities as General Manager of the AGS Division.

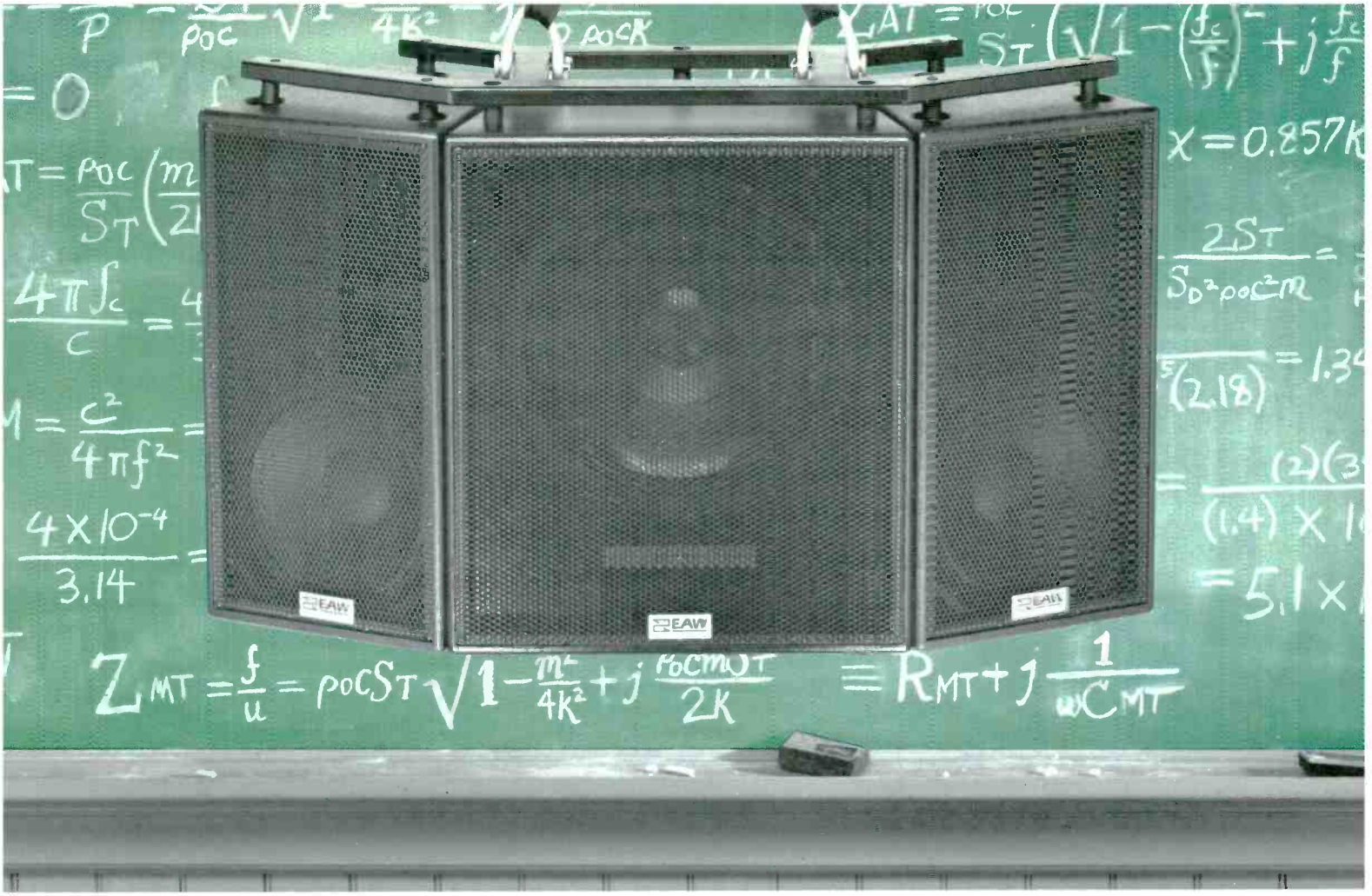
"These appointments are considered vital for the company's continued growth," said **Mr. Masahiko Arimoto**, YCA President. "The extensive experience each of these individuals possesses will serve them well in achieving their goals."

● **"Big" Ed Learned's** upcoming West Africa Tour Schedule with the Holmes Brothers has been set in May 1992.

- May 3 - May 8 Niamey, Niger
- May 8 - May 11 Bamako, Mali
- May 11 - May 15 Ouagadougou, Burkina Faso
- May 15 - May 18 Lome, Togo
- May 18 - May 21 Cotonou, Benin
- May 21 - May 25 Conakry, Guinea
- May 25 - May 28 Freetown, Sierra Leone

He has promised us a major article upon his return.

● Veteran composer/producer **Kelly Bryarly** has joined the staff of **Music Annex Recording Studios** in Menlo Park, CA. According to Music Annex Studio Manager, **Charles Albert**, "Kelly's arrival enables Music Annex to offer a complete solution to clients who require music scoring in addition to the audio recording, mixing and production services we already offer. His outstanding compositional, instrumental and orchestration skills give his scores a very fresh sound." Bryarly states, "I'm very excited about my move to the Music Annex Recording Studios. The resources available at the Music Annex greatly widen what I offer my clients. In addition to a dedicated scoring suite, having five different studios means I can accommodate any size project from an orchestra to a solo guitar."



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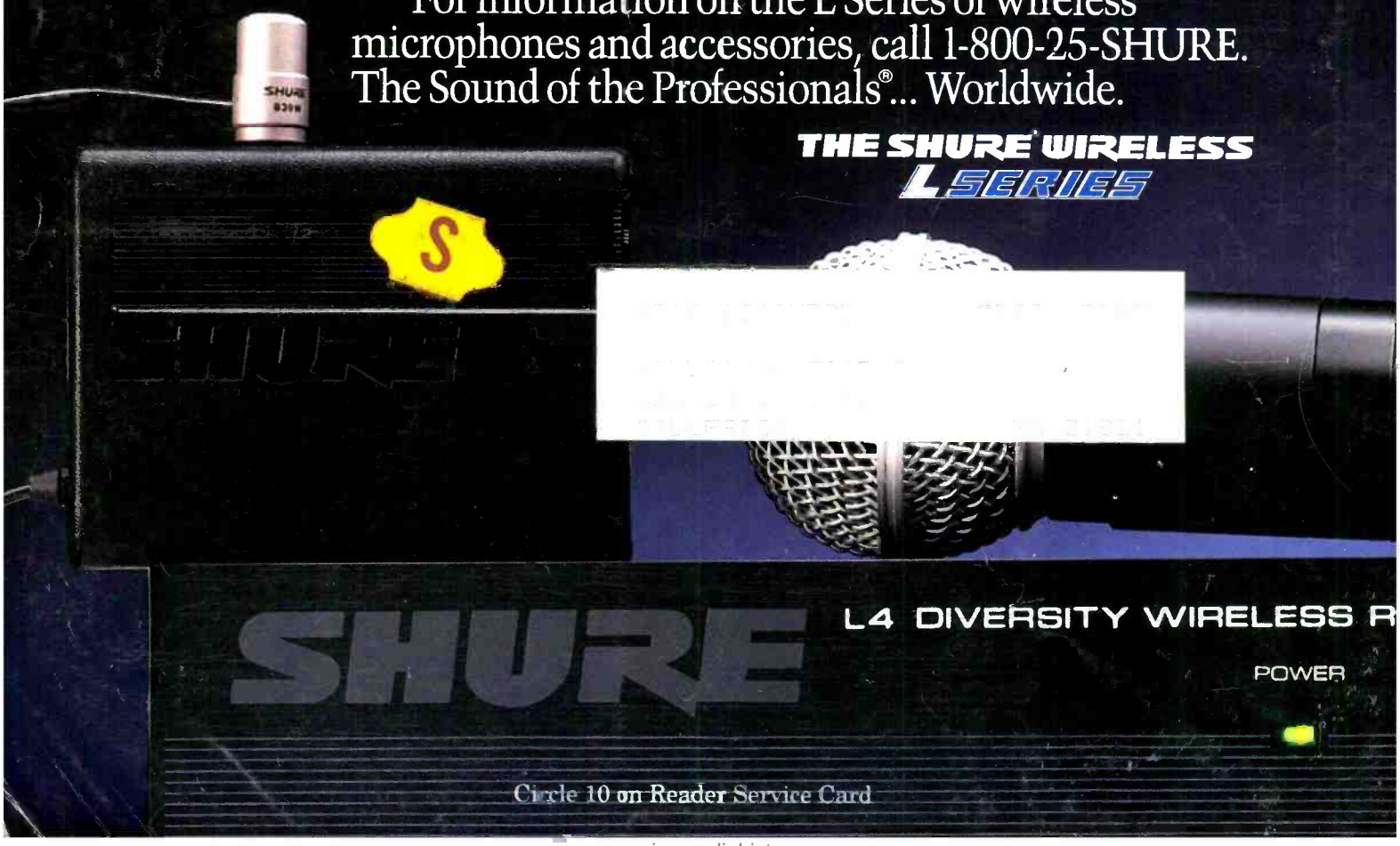

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