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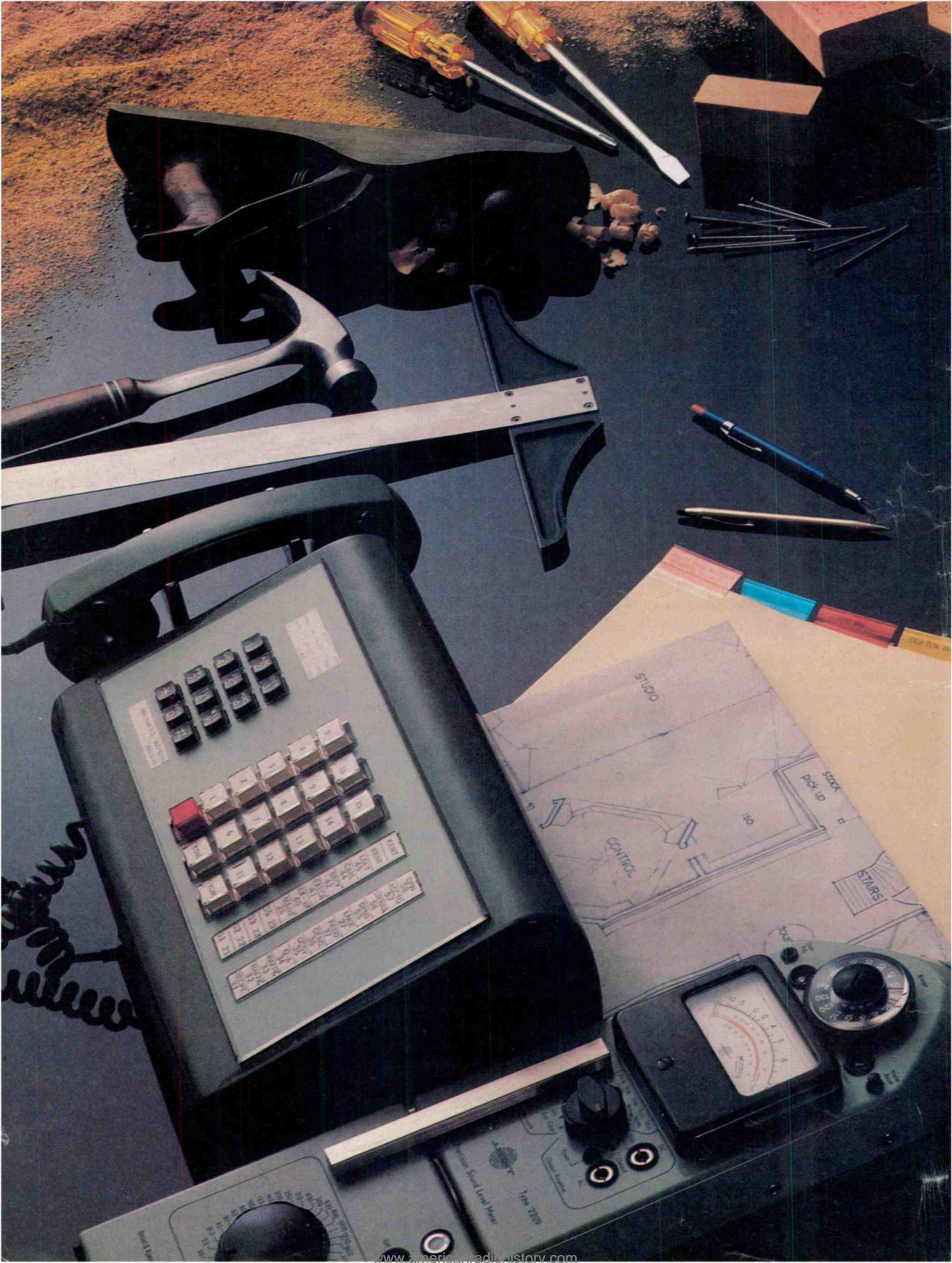
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VOLUME 9 — NUMBER 6

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R-ep 7

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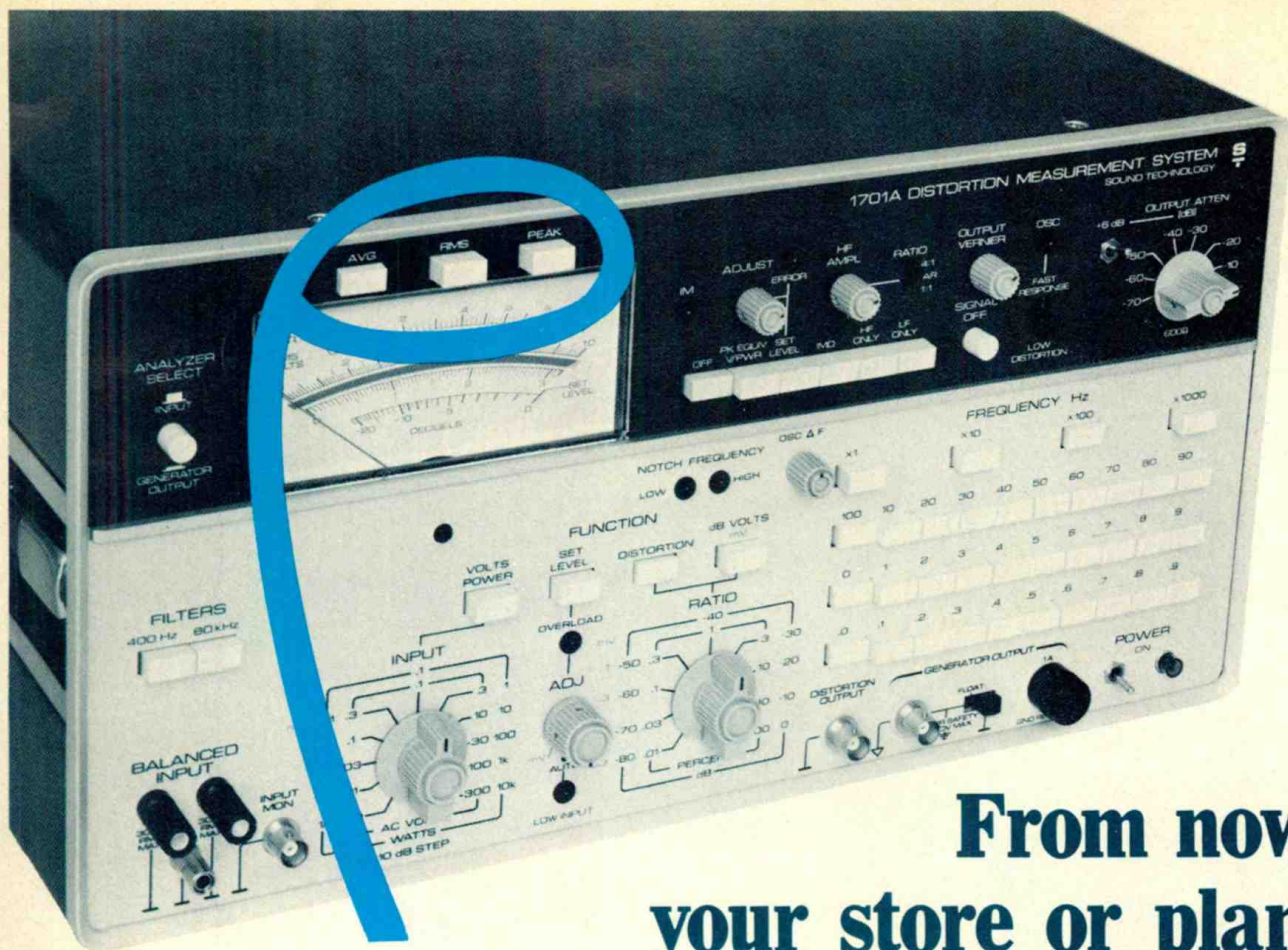
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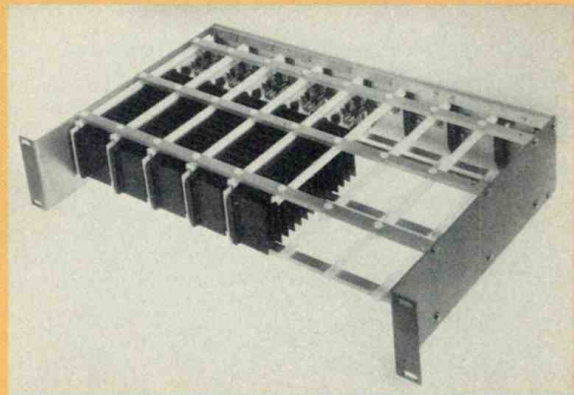


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Letters

from: **Stan Axelrod**
Technical Director
Bananas at Large, Inc.
San Rafael, CA

I'd like to correct a minor point in the article on "San Francisco Small Studios" (October 1978), and suggest another useful method of setting bias in reference to "How To Select and Treat A Mate" (Ball and Dahl, same issue).

In the first article, Tom Lubin mentions a modification we performed on Russell Frehling's Sound Workshop 1280 board. The correction I'd like to make is that the TL074 IC is approximately 6 dB noisier than the HA4741 (not 1/2 dB), but the overall signal-to-noise spec of the board is reduced by 1/2 dB. It's a small point in this application, but one that may well be important in a different gain structure.

As far as setting bias goes, dbx recommends that if you use 406 or 456, set up can be easily and accurately accomplished by aiming for minimum modulation noise. You can see by looking at the spec graphs (page 74) that a minimum modulation noise, 406 gives an increase in third harmonic of less than 1 dB over minimum level. By over-biasing 456 so that modulation noise increases 1 dB, third order distortion is at a minimum.

The method is quite simple, and can be done with only a signal generator and your monitor system. Feed a 10 Hz tone at normal operating level into the machine, and monitor output for minimum noise. The dip point is very distinct (you'll have to turn up your monitor gain, so don't forget to turn it back down again when you're done). By the way, this method is not for use with 206 or 250.

Tuning for minimum noise is especially important for dbx users because modulation noise can become very apparent with some dbx'd program material — but this biasing approach also works well for any set up.

One last bit of nitpicking of a generally excellent article — audio hopefully never modulates the bias, the two signals are just mixed.

from: **Ken Dickensheets**
Boner Associates
Consultants In Acoustics
Austin, TX

The article, "Speaker Wire," by Ray Kimber, in the October 1978 issue, fails to mention one very important parameter in the discussion of the relationship of speaker wire size to the damping factor of amplifiers.

That parameter is the DC resistance of the loudspeaker voice coil, a property common to all dynamic loudspeakers.

The damping factor (DF) of an amplifier is another way of stating the internal resistance (Rs) of the amplifier, or more specifically, the ratio of the stated load impedance to the internal impedance of the amplifier. For an amplifier with a DF of 1000:1 the Rs is .008 ohm, assuming an 8 ohm load. An amplifier have a DF of 100:1 has an Rs of .08 ohm and an amplifier with a DF of 10:1 has a Rs of .8 ohm.

By including the voice coil resistance in the damping factor formula, the formula reads:

$$(1) \quad RL / R_s + R_w + R_E = ADF,$$

where:

- RL = Stated load of amplifier
- Rs = Internal resistance of amplifier
- Rw = Resistance of wire
- RE = Resistance of speaker voice coil
- ADF = Actual Damping Factor.

The DC voice coil resistance of a typical 12" loudspeaker, such as an E-V EVM12L is 6.5 ohms. If this speaker were connected directly across the output terminals of a power amplifier with a DF of 1000:1, the formula reads:

$$(2) \quad 8 / .008 + 0.0 + 6.5 = 1.229.$$

If the speaker is connected with 50' of #10 (7x20) tinned, stranded copper wire, the formula reads:

$$(3) \quad 8 / .008 + .109 + 6.5 = 1.209,$$

a change of 1.6% in the ADF from (2).

If instead, #14 (7x23) tinned, stranded, copper wire were used, the formula is:

$$(4) \quad 8 / .008 + .281 + 6.5 = 1.178,$$

a change of 4.2% from (2).

Therefore, within certain limits, the wire size is not the determining factor of the amplifier's actual damping factor. Substituting in (3), an amplifier with a DF of 100:1, the formula reads:

$$(5) \quad 8 / .08 + .109 + 6.5 = 1.196,$$

a change of 2.7% from (3).

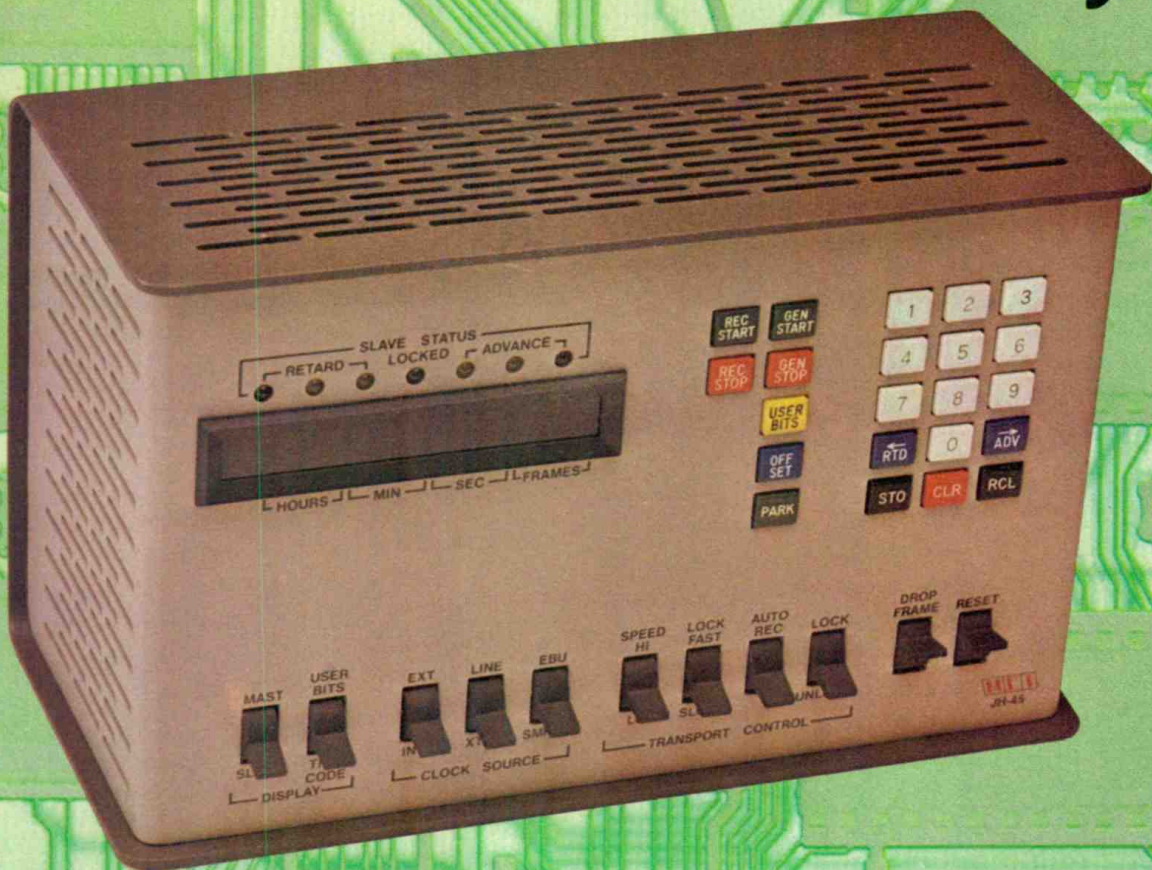
If an amplifier with a DF of 20:1 were used in (3) the actual damping factor would be 1.141, a change of 7.2%.

Until the damping factor of an amplifier reaches a value below 20:1, this damping factor does not have a significant effect on the actual damping factor of the amplifier/speaker combination and until the resistance of the wire approaches a value of



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several ohms, it too has little effect on the actual damping factor of the circuit.

For a more complete discussion of damping factor, I would suggest the article, "The Damping Factor Debate," by George Augspurger which appeared in *Electronics World*, January, 1967.

from: **Henry L. Brooks**
Los Gatos, CA

In reference to the October issue article on speaker wire: It was pointed out that lowering the wire resistance would improve the damping factor which is true to a point. But the speaker DC voice coil resistance must be included in the calculation of the damping factor. With a voice coil resistance of 6.4 ohms being typical, obtaining a damping factor of 40 is impossible. The example given of moving closer by 50 feet would only change the damping factor from 1.21 to 1.23 when the voice coil resistance is considered, not 35.4 to 68.38 as suggested.

The improvement in sound quality would depend on the speaker preference of damping factor and wire resistance in relation to amplifier output impedance and the voice coil resistance.

My references are: *Electronics World*, January 1976, "The Damping Factor Debate," by George L. Augspurger; and *Recording Engineer/Producer*, April 1977, vol. 8, no. 2, "Power — How Much Is Enough," by Chris Foreman (paragraph on damping).

Ed.: Mr. Kimber will have several interesting observations in the February issue.

from: **Jack E. Hunt**
Mastering Engineer
Alshire Mastering Studios
Burbank, CA

"Disk Mastering," by Howard Cummings (*August, 1978*) is an "interesting" article, but deserves comment in several areas.

First is the 45 cutting level. Mr. Grundman references to a "5.5 cm/sec cut at +4 dB." It really doesn't matter *what* the "0 VU" reference level is. That only refers to the voltage when the VU meter reads "0." What is important is the *velocity of the cut*. Mr. Grundman is obviously using the old standard of 5.5 cm/sec lateral at 1 kHz. Therefore, for his 'hot' 45's he will have to go up 6 dB. The industry seems to have adopted the more modern standard as established by the NAB of 7 cm/sec lateral at 1 kHz, which is 2 dB hotter than 5.5 cm/sec. In that case, hot 45's would be raised only 4 dB for the same loudness. I agree with the reasons for cutting 45's at a hotter level, but one reason was left out. It is simply — the louder 45 record level will help mask some of the noise of the poorer quality 45 pressing material. Styrene is used quite often, but it is not as quiet as vinyl.

There is an interesting reversal of facts concerning the 'inside diameter effect' in the article. The *stylus* does not travel at a faster speed at the outside of an LP or a 45 for that matter, but the linear *groove velocity* is greater and slows down as the stylus moves toward the inside. The scanning loss is present, but this can be helped somewhat if the record is played with an elliptical stylus that will better trace the smaller groove curvatures. Also, the use of a Tracing Simulator in the cutting system helps a great deal to deduce the distortion.

Comments on Philosophies — I say "bravo" to Mr. Evans' statement "let's see what we can do with this." That statement I believe, should be the philosophy of every disk mastering engineer in the world. To make a disk that is 'identical' with a good master tape is not really a challenge. Taking that tiny groove we are cutting and making it sound as 'big as all outdoors' is a challenge. Sometimes we are given a tape from a young engineer, who perhaps is not all that familiar with the problems of making a disk, and asked to make a record. That's the challenge!

That's what makes our job fun and enjoyable. We should simply say "let's see what we can do with this" and do it.

Close communication with the client is important. The cutting process is the last point at which any creative work can be done. From the lacquer to the pressing it's quite mechanical.

Different kinds of music do require different approaches, but our goal should *always* be, to make a record that is, if at all possible, better than the master tape.

News

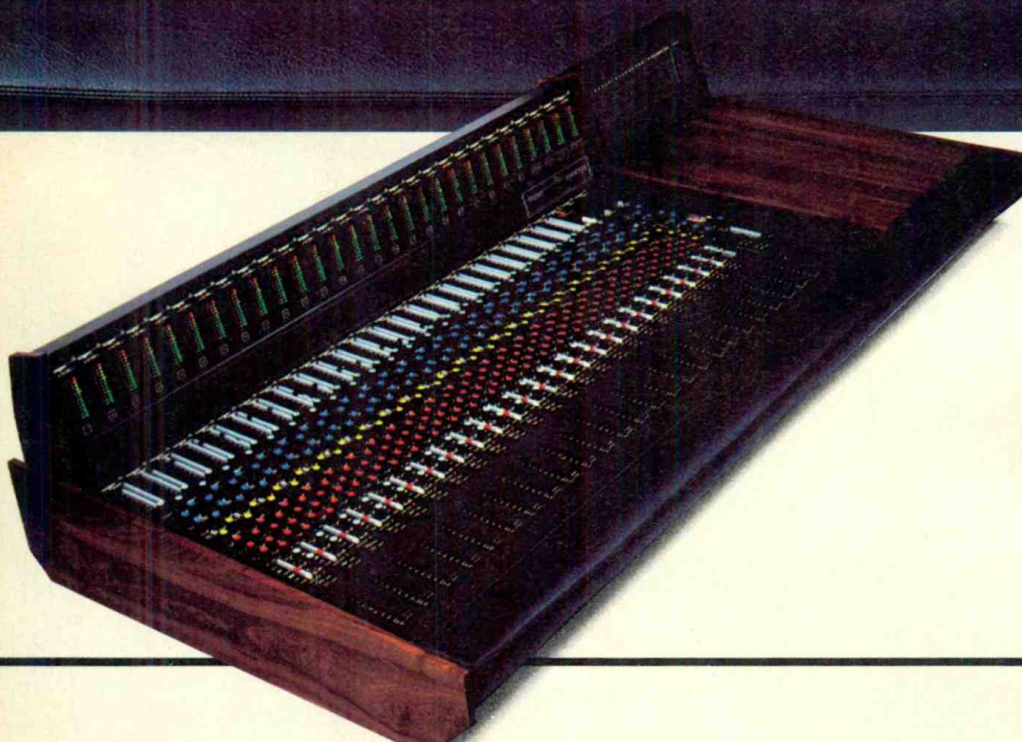
**SOUND WORKSHOP
ANNOUNCES EXPANSION**

Michael Tapes, president of Sound Workshop Professional Audio Products, Inc., (Hauppauge, New York) has announced its expansion in several different areas, including product line, marketing, sales and manufacturing.

Sound Workshop has entered into a long term exclusive marketing agreement with Audio Machinery Corporation, for the marketing and distribution of the Shared Access Memory System which is manufactured by Audio Machinery. Carl DeWilde, president of Audio Machinery, has said that this exclusive agreement with Sound Workshop will not affect Audio Machinery's present OEM agreements with other manufacturers. The Shared Access Memory System is a unique digital-based signal processing system under microprocessor control. The details of the system were released at the New York AES

— continued on page 20

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R-e/p 17

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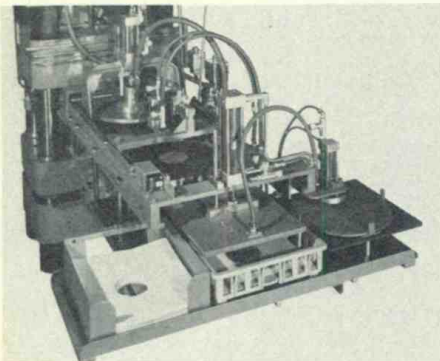
 **Neve**

convention.

Sound Workshop has also announced the appointment of Emil Handke as sales manager. Handke previously held a similar position at dbx, Inc., and will be handling both the domestic and export markets for Sound Workshop. Michael Tapes will continue as director of marketing, and half of the product development team, the other half being Paul Galburt, chief design engineer.

SOVIETS SELECT U. S. RECORD PRESSING SYSTEM

Lened International Corporation, the world's largest manufacturer of phonograph record making systems and equipment, of Elizabeth, New Jersey, was recently the recipient of a \$500,000 contract awarded by Melodia, the official Soviet record company, for the supply of a number of 12" record pressing systems. This most recent Soviet purchase, is the third in a five year projected



schedule of purchases eventually expected to encompass over 200 units.

Lened's previously shipped equipment has been in successful operation at the Melodia plant outside Moscow. Prior to negotiating this last purchase, the Soviets thoroughly researched all competitive machines both here and in Europe including the acquisition of some European machines before determining the Lened units to be best suited to their needs.

The Lened systems were the first of their type to completely automate the entire recordmaking production process from extrusion of the plastics to pressing, trimming and insertion of the disks into protective sleeves. All of these operations are controlled from a single control console and are performed by a single motion mechanism.

NEVE ANNOUNCES LIST OF RECENT U.S. PURCHASERS

In New York City, A and R Studios, Electric Lady Studios, Mediasound, Power Station and the Phil Ramone Studio have all invested in Neve mixing consoles, several including Neve's computer controlled NECAM mixing system. Electric Lady are equipping their studio with 3 Neve mixing consoles valued at over \$400,000; Mediasound is buying Neve equipment valued at \$250,000. The Phil Ramone Studio has

spent \$150,000 for a Neve NECAM computer assisted mixing console for his own personal studio.

Woodland Sound Studios, the Nashville recording company responsible for many of the U.S.A.'s top country and western artists, recently placed an order with Neve for the large 8078 console with VCA sub-mastering valued at around \$130,000.

On the west coast, Capitol Records, Studio 55 and Village Recorder, all in Los Angeles, have just installed Neve NECAM computer consoles. Village Recorder used the NECAM console to record Fleetwood Mac's best selling album, "Rumours". Motown Studios took delivery of their Neve equipment in November.

Rupert Neve of Canada, Limited, has installed three Neve consoles at Eastern Sound. Further Neve consoles have been delivered to Manta Sound in Toronto, Century 21 in Winnipeg, Experience in Montreal and Marc Productions in Ottawa.

Neve's U. S. subsidiaries are based in Bethel, Connecticut, and Hollywood, California, while the Canadian operation is headquartered in Malton, Ontario.

Neve's managing director, Derek Tilsley, to whom the North American subsidiaries ultimately report, emphasized that Neve's policy of giving the overseas subsidiaries full autonomy in providing the highly specialized market support installation, commissioning and after sales service is the key to the company's successful penetration of this large but very demanding market.

RAY M. DOLBY RECEIVES SAMUEL L. WARNER MEMORIAL AWARD

Ray M. Dolby has been given the Samuel L. Warner Memorial Award for 1978 by the Society of Motion Picture and Television Engineers. The Award was made at the Annual Awards presentation of the Society at the Americana Hotel, New York City, October 30.

The Samuel L. Warner Memorial Award is presented to Ray M. Dolby in recognition of his development of a noise-reduction system for use in motion picture sound recording of music and sound effects which improves signal-to-noise from a multiplicity of sound tracks during the pre-recording process, and for the development of a band-selective noise-reduction system for processing dialogue tracks which had been recorded in a high ambient noise environment.

Ray M. Dolby was born in Portland, Oregon, in 1933 and received his B.S. degree in electrical engineering from Stanford University in 1957. From 1949-52, he worked at Ampex Corporation on various audio and instrumentation projects, and from 1952-57 was mainly responsible for the development of the electronic aspects of the Ampex Video tape recording system. Awarded a Marshall Scholarship, followed later by a National Science Foundation

Graduate Fellowship, he left Ampex in 1957 for further study at Cambridge University in England where he received a Ph.D. degree in physics in 1961.

Working in the Cavendish Laboratory at Cambridge from 1957-63, Dr. Dolby studied various properties of long wavelength x-rays, particularly as applied to electron microprobe analysis. In 1961, he was elected to a Research Fellowship at Pembroke College, Cambridge. During his last year in Cambridge, Dr. Dolby was also a Consultant to the United Kingdom Atomic Energy Authority.

In 1963, he took up a two-year appointment as a United Nations Adviser in India, serving as a member of an advisory team to the Central Scientific Instruments Organization. In 1965, Dr. Dolby left India and returned to England to establish Dolby Laboratories. He holds a number of patents and has written papers on video tape recording, long wavelength x-ray micro-analysis, and noise reduction.

Dr. Dolby is a Fellow of the Audio Engineering Society and a recipient of its Silver Medal Award. Recently he was awarded a Fellowship of the British Kinematograph, Sound and Television Society; also the Lyre Award of the Institute of High Fidelity and the 1972 Berliner Maker of the Microphone Award.

The Award was presented by SMPTE President William D. Hedden at a ceremony following the Get-Together Luncheon which opened the Society's 120th Technical Conference, and included an equipment exhibit of professional motion picture and television products of over 100 companies.

MIKE AWARD TO DR. GOLDMARK

Flanking Oliver Berliner are the sons of Dr. Peter C. Goldmark; Peter, Jr., on the right, who accepted the Maker of the Microphone Award on behalf of his late father, developer of the fine groove long playing disk record and a host of other audio and video innovations. Oliver Berliner is grandson of Emile Berliner, inventor of the microphone and the disk record, in whose name the trophy is awarded annually. Dr.



Goldmark was the 15th to receive the award, which will be presented only 25 times, to commemorate the fact that Emile Berliner was but 25 years of age when he invented the microphone, later acquired by the Bell System for use as the "transmitter" in all telephones. □ □ □



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R-e/p 21



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Use the ATR-100 as a four, two or single-channel machine. The tape guides and head assembly change quickly when you go from mastering to mixdown, or to a dubbing assignment. And while this machine is doing the work, you'll keep your eyes on the studio action because the remote control unit contains fingertip switching and LED status indicators.

Ampex designed the ATR-100 as a simple solution to audio excellence. Input/output electronics are modular and clustered in an overhead bay, and all the signal and transport electronics are mounted underneath the transport deck with plenty of room for easy service access.

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STUDIO UPDATE

Northeast:

□ **BLUE ROCK STUDIOS** (NYC) announces the addition of a 20' by 25' auxiliary room for both live and overdub sessions. Treated with brick and wood surfaces the room is typified as acoustically live by president, **Eddie Korvin**, who says it is ideal for horns and strings as well as specialized drum, acoustic guitar and vocal sounds. It will also be used as natural echo chamber, and is linked to the main studio and control room with video and audio lines.

East North Central:

□ **AUDIO SERVICES COMPANY** (Mishawaka, Indiana) is said by president, **Phillip Ostrander**, to have the distinction of being the only 16-track studio in *Michiana*, and has relocated to new and larger facilities where there are two studios serviced by a separate connecting control room. The large studio is used primarily for music production, while the smaller room serves mainly as an announcers booth and isolation area. Audio services is also involved in location recording work, and through its Disc-go Mobile Musicworks division has entered the world of disco. 3016 Home Street, Mishawaka, IN 46544. (219) 255-5198.

□ **SOLID SOUND** (Ann Arbor, MI): This studio has recently moved into new quarters just outside of Ann Arbor. As described by president, **R. G. Martens**, the building was designed and constructed from the ground up, and is set into an incline at the edge of a picturesque wooded area. Acoustic design was done by **George Augspurger**, of Perception, Inc., of Los Angeles. Equipment includes an Ampex 16-track recorder with 'dbx' noise reduction. Monitoring is done through Altec 604s in Perception enclosures, as well as on Rogers' and Auratones. The building also houses a live echo/reverb chamber. Studio rate is \$50.00 per hour for recording and mixdown. Box 7611, Ann Arbor, MI 48107. (313) 662-0667.



Southeast:



□ **CAPRICORN RECORDS** (Macon, GA) announces the recent completion of remodeling of their 24-track studios, with improvements and equipment additions including an EMT 250 digital reverb, the new Allison 65-K programmer, 2 Studer B-67 2-track machines to go with the already full complement of other Studer tape equipment. According to engineer, **Steve Tillisch**, the studios are operated on an open-house policy. 535 Cotton Ave., Macon, GA 31208. (912) 745-8511.

Southwest:

□ **BUFFALO SOUND STUDIOS** (Ft. Worth, TX) after a remodeling expenditure of over \$300,000, which included the installation of an MCI 24-track recorder, **Jim Hodges'** studio reopened in early November. Said Hodges, "This means that now Fort Worth artists and advertising agencies can be in direct competition with Dallas where 24-track has been available." The two studio complex acoustic design was done by **Bob Pickering**, of Dallas. Mixing equipment consists of an Auditronics 501 in the control room, and an Auditronics 110A in the production room. Monitoring is through Mastering Labs, Super Reds (Audiotechniques), with a sub-woofer system capable of monitoring down to 20 Hz, permitting audio to be mixed for theater and amusement park soundtracks. JBL 4301s and Auratones are also available. 910 Currie Street, Fort Worth, TX 76107. (817) 335-7733.



Northwest:

□ **RECORDING ASSOCIATES** (Portland, OR) announces the opening of the first 24-track studio in the Portland area. An established 16-track studio the past 5 years, Recording Associates expects the increased track capability to help focus more national attention on the growing Northwest music scene. **Logical Systems**, of Vancouver, Washington, served as consultants during the enlargement and complete redesign of the studio 'A' control room. Equipment includes: Ampex 24-16 recorder, Ampex ATR-100 2-track, MCI console. Eventide Harmonizer, LSI limiters and noise gates, and a choice of 3 monitoring systems. 5821 S. E. Powell Blvd., Portland, OR 97206. (503) 777-4621.

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R-e/p 25

STUDIO UPDATE

Northern California:

□ **DUSK RECORDING STUDIOS** (Santa Clara) through their president, **Bob Langlie**, announces the addition of an MCI JH-114 16-track recorder with the "Auto-Locator III." According to Langlie, "This updated version of the 'Auto-Locator II' has the new features which include a repeat button that will activate the transport and replay a particular programmed segment continuously." Dusk has been in operation for two years, starting as an 8-track facility. 2217-A The Alameda, Santa Clara, California.



□ **MUSIC ANNEX** (Menlo Park) has opened Studio 'C'. "A multi-use Audio/Video room with an emphasis on pro 8-track media and demo production to join Studios 'A' and 'B', 24-track studios already in operation. 'C' is staged and lit for rehearsal and showcase work with any size pro P.A.," according to president, **David Elder**. 970 O'Brien Drive, Menlo Park, CA 94025.

□ **STAR TRAKS/WOODWEST ESOTERIC STUDIOS** (Sacramento) announces the change in name from Esoteric to Star Traks, as well as the expansion to 16-track capability from 8-tracks, according to owner/manager, **Stephen Estes**, of the two year old studio. He further reports that the studio possesses 24-tracks of 'dbx', so that literally all tapes are 'dbx'd' from master to cassettes. This leads to the claim that Star Traks "is now the only 16-track studio with 'dbx' between the Bay Area and Tahoe." 7529 Sunset Avenue, Suite J, Fair Oaks, CA 95628.

Southern California:



□ **MUSIC GRINDER RECORDING STUDIO** (Los Angeles) chief engineer **Gary Skardina**, reports on their growth from an 8/16-track facility to an 8/16/24-track studio with the acquisition of a new MCI 24 with Auto-Locator interfaced to an MCI 428-B series console. Other recent equipment additions include an EMT 240 gold foil echo chamber, a Lexicon model 93 "Prime Time" digital delay, and an Eventide "Harmonizer." The studio currently monitors on JBL, but will add the UREI Time Aligned system in the near future. 7460 Melrose Avenue, Los Angeles 90046.

□ **CIRCLE SOUND STUDIOS** (San Diego) has been open just three months, and is said to be the newest studio in the San Diego vicinity. Said **Dale E. Sykes**, president, in describing the 7,000 square foot facility consisting of two buildings, divided into three studios, "Studio 'B' is designed for our 1" 8-track MCI gear (Quantum Audio Labs console) now in Studio 'A'. Studio 'A' is 25' by 25' by 10' and has a large isolation or drum booth, and was built for 16- or 24-track. Just completed at Circle is their third room, a 4,500 square foot rehearsal and showcase studio being used by video production companies. One of the first bookings was by San Diego's KGB-FM radio and KGTV-10 television for two weeks to produce KGB's Homegrown Greatest Hits, a multi-media special.

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R-e/p STUDIO UPDATE

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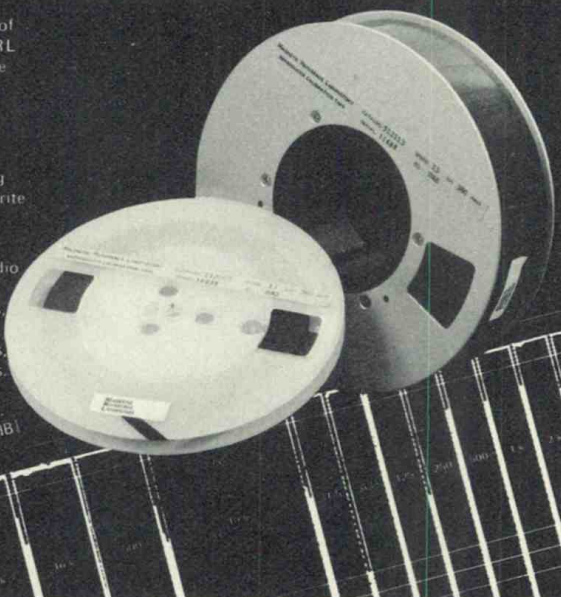
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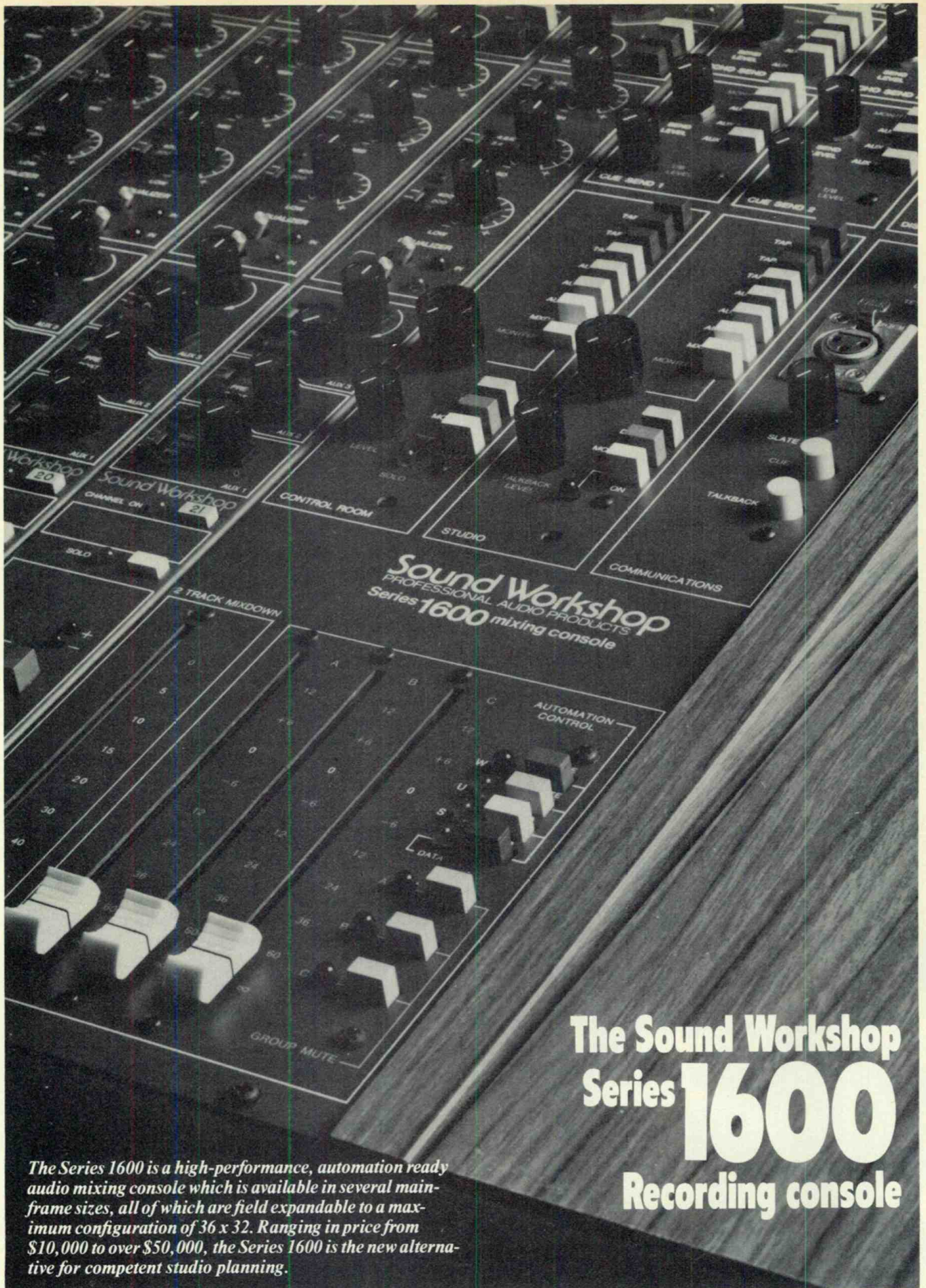
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GEOFF EMERICK

— by Howard Cummings

Three Grammys for engineering in 11 years — an admirable record for anyone — especially when your first Grammy comes at the age of 22! And Geoff Emerick possesses the distinction of being the only engineer to accomplish this feat in the pop category.

After leaving school in London, Geoff wrote away to record companies and was accepted by EMI in 1962 — the same year another group of fellows would start to make their mark in the recording field — The Beatles. Recalls Geoff, "I remember walking into the studio and looking at the roster for the week. I saw 'The Beatles' listed and wondered 'Who are they?'" Six months later, Geoff and all of England found out! The Beatles were recording their artist's test (demo) under the guidance of producer George Martin and, on the basis of the results, were signed to EMI Records.

"The first thing I tape-op'ed on was 'She Loves You' [in July, 1963 and recorded in mono only, *aficianados*]," Geoff continued, "We always used to record twin-track and any overdubs were done twin-track to twin-track. We always used to monitor in mono also — the songs were never intended for stereo. The earlier songs that were released in true stereo were flukes."

Upon the move of previous Beatles' engineer Norman Smith into production (early Pink Floyd), Geoff was approached by George Martin to see if he would like to move into the vacant seat. Flying colors ensued with Geoff bringing rock engineering to the fore with the release of the Beatles' SERGEANT PEPPER'S LONELY HEARTS CLUB BAND.

From time-to-time in this article, Ringo Starr interjects comments on his recording observations in the SERGEANT PEPPER-ABBEY ROAD era.

Seat belts fastened?



Geoff Emerick: My first work as senior engineer was "Tomorrow Never Knows" on *REVOLVER*. That was the first song we cut for the album ['66].

Howard Cummings: Even before "Rain" and "Paperback Writer"? [May '66]

Geoff Emerick Yes. I remember it was still snowing outside so it might have been March or so. We used to have the multi-track machine in another room down the corridor from [EMI] #3, with all the other engineers listening-in, 'cause everytime the Beatles came in, it was a happening you know. The engineers used to listen to the speakers off of the tape machine and when they heard the guitars, etc., going backwards, they couldn't believe what was going on! I'll

always remember that.

On the loops section [in the solo] — don't forget it was still 4-track so we had no spare tracks — we asked the maintenance department to come in and we made all these loops. We sent for about six or seven tape machines and the guys were all standing there with pencils for tension, playing with the faders while the loops were spinning around.

Howard Cummings: Maybe at this time we could go into the board you were working with at that time — the REDD 37 — which you used to achieve some of the effects on parts of *REVOLVER* and most of *SERGEANT PEPPER*. The one I had seen had 4-out . . .

Geoff Emerick: Right . . .

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The Soundcraft Series 3 console is ideal for 16- or 24-track recording studios demanding technical sophistication at a reasonable cost. It has been designed with all the facilities the professional engineer expects plus a few extra features you're sure to appreciate. The technical specifications are excellent, partly due to the use of new integrated devices, giving high slew rate, extended power bandwidth and ultra low noise. The front end circuitry is truly state-of-the-art giving a 1dB noise figure. The extended range of modules allows up to 32 tracks of monitor mix independent of the input channels whilst the layout allows engineer and producer to work together without getting in each other's way. Working with Series 3 is a real pleasure. It is logical to use and sounds excellent. Ask for the 8-page colour brochure or contact one of the dealers listed below. We think you'll be impressed.



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Howard Cummings: and about 8-in . .

Geoff Emerick: That's right . . .

Howard Cummings: With the knobs off to the right of the desk for possibly EQ, sub-mixing, and panning?

Geoff Emerick: We used to put two auxiliary mixers which would accommodate six faders without EQ, and that was fed into one fader. The EQ was just top and bottom, unmarked, probably around 5k and 500, bell-shaped.

Howard Cummings: What about the speakers?

Geoff Emerick: They were 604E's. I used just one, in a simple thin plywood cabinet and no special acoustical treatment for the control room.

HC: Okay, that kind of sets the scene for the SERGEANT PEPPER era [Jan. '67]. I guess the first series of songs for the sessions were "When I'm 64", "Penny Lane", "Strawberry Fields", "You Know My Name, Look Up The Number" with Brian Jones [late of the Rolling Stones] on sax.

GE: That sounds right. Brian was there that night along with Marianne Faithfull and, in fact, most of the other Stones. It was just a good, happy sing-along track.

HC: Could you explain what you went through with the two different versions of "Strawberry Fields" to achieve the final version?

GE: Well, at that time — it's probably very simple to do now — it was

considered an impossible edit. It was two different performances in different keys from about a period of two weeks — and I think we gradually slowed down "version one" to get into the right key just before the edit going into "version two".

HC: I imagine you had to do a lot of bumping [ping-ponging] on a track like that because there's a lot going on.

GE: Not really, a lot of people might assume that.

Ringo Starr: But a lot of overdubbing took place on the LP.

GE: Yeah, PEPPER was 4-track but there weren't many tracks we used to do 4-track to 4-track on. As an example, the first track may be drums and bass; the second track may be piano and guitar plus another guitar. One track's gotta be kept clear for vocals. The other track is for overdubs and all of those have to be done in one go. It wasn't a question of saying, "We'll just overdub the guitar." We just overdubbed a lot at one time.

HC: So you have three or four things assigned to one track.

GE: Right, plus harmony vocals — all on one track.

HC: So the key there was a good balance within your overdubs.

GE: Oh, yeah. That had to be.

HC: Prior to their starting PEPPER, did The Beatles say they wanted this LP to be a showcase for what they

could really do?

GE: No, I don't think that was discussed. It was just a great team effort from every aspect — from George [Martin], from me, from them.

HC: They didn't say, "We really want to create a piece de resistance"?

GE: No. The actual concept of PEPPER came towards the end of the album. Originally it was just a collection of tracks. It was only like into the last third of the album that Paul said something like, "We should treat it like Billy Shears with the "Sergeant Pepper" theme and imagine you're in the audience watching this stage show — a circus, etc." For example, "With A Little Help From My Friends" was cut as a separate track, it wasn't originally thought that "Sergeant Pepper" would cross-fade into the beginning of it — it was an afterthought.

Also, the album was never designed for stereo, it was just mixed in stereo. It was "made" for mono, not for stereo. I monitored in mono throughout the whole album — through one speaker. Again, it was never intended for stereo. [Author's note: Surprised, folks?]

HC: How do you feel about the stereo version?

GE: It's not as good as the mono.

HC: For what reason?

GE: It's just a personal reason — the way it sounds. We spent about two weeks mixing the mono version and about three days for the stereo version. We finished up around midnight and that's when they added that "shout" on the run-out.

HC: The "voice" that everyone tries to identify?

GE: Yes, which wasn't intended to be interpreted as anything. It was just garbled words. That was it — they zoomed away on holiday. Then we [George Martin and Geoff] spent three days mixing the stereo without them.

HC: Do your drum set-ups ring a bell?

GE: Well, it was basically one overhead with [AKG] D19C, quite cheap mikes, about \$30.00 or so, D20 on bass drum and another D19C on the snare 'cause don't forget, the drums were balanced mono — not stereo.

HC: So the overhead would take care of the toms?

GE: Oh yeah, the toms were never miked. Then I started putting a condenser underneath the snare to give it more snap. It was considered an advancement — in fact quite a big one

PARTIAL DISCOGRAPHY AND GRAMMY AWARDS* REFERENCE GEOFF EMERICK

Title	Artist	Studio	U. S. Label & Release Date
1 - Revolver	The Beatles	A	Capitol 1966
2 - Sergeant Pepper's Lonely Hearts Club Band*	The Beatles	A	Capitol 1967
3 - Abbey Road*	The Beatles	A	Capitol 1969
4 - Band On The Run*	Paul McCartney & Wings	D,C,A,K	Capitol 1973
5 - Apocalypse	Mahavishnu Orchestra	C	Columbia 1974
6 - Bridge Of Sighs	Robin Trower	C	Chrysalis 1974
7 - Holiday	America	C	Warner Bros.
8 - Hearts	America	E,G	Warner Bros.
9 - Hideaway	America	F,G	Warner Bros.
10 - Gist Of The Gemini+	Gino Vanelli	C,H	A&M 1976
11 - Long Misty Days	Robin Trower	C	Chrysalis 1976
12 - Harbor	America	I,C	Warner Bros. 1977
13 - Beatles - Live	The Beatles	J,C	Capitol 1977
14 - London Town	Wings	K,A	Capitol 1978

Studios:

A - EMI, London	G - Record Plant, L. A.
B - Apple, London	H - Sound Labs, Hollywood
C - AIR, London	I - Kalaekiki Kauai, Hawaii
D - EMI, Lagos, Nigeria	on the Record Plant Mobile
E - Record Plant, Sausalito (S.F.)	J - The Hollywood Bowl
F - Caribou, Nederland, Colo.	K - Miscellaneous
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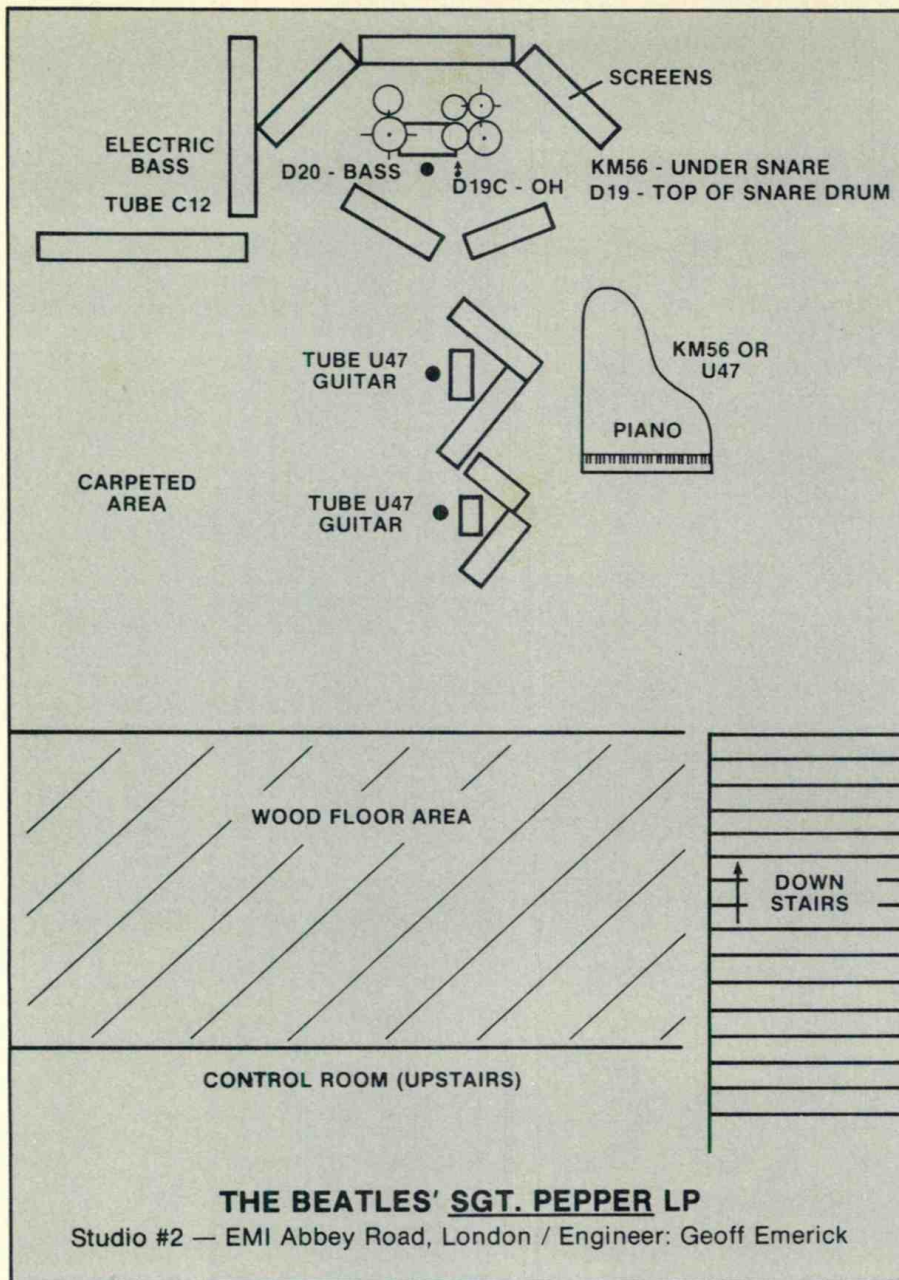
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GE: Number 2 chamber was filled with sewerage-like pipes made out of ceramic to bounce the sound all around and we used valve Neumann 56's for the mikes inside.

HC: Relay the story on the organ cacophony in "For The Benefit Of Mr. Kite".

GE: George Martin played harmonium and for the solo bit we took John's keyboard part, cut it up into pieces and threw it up into the air. Then we pieced it together again so it would be backwards and frontwards. But in fact when we put it together, it was a million-to-one chance and was all joined in the right order [chuckles] except for a couple of bits.

Also, "Sergeant Pepper - Reprise" was done in studio #1 because we couldn't get into #2. Then we go into "A Day In The Life", then into the garbled bit with 15 kHz.

HC: What was the intent of that?

GE: The 15 kHz was just there to annoy dogs. They said, "If anyone's listening to this record and they've got a dog in the house, the dog's gonna go mad", [laughter all around]. But in those days, there weren't that many reproducers that could reproduce it anyway.

HC: Did you cut the lacquers for PEPPER?

GE: That was Harry Moss of Abbey Road. He also cut *REVOLVER*.

HC: How about the isolation of the fellows?

GE: When we recorded *PEPPER*, we just used to have cheap, old screens and probably no screens in front of the drums.

HC: I remember you used to put Ringo against the far wall of #2 near the exit door.

GE: That's right. The echo chamber was behind that door as well.

HC: And then Paul would be to the right of the control room on keyboard . . .

GE: Yeah, right . . .

HC: And George would be in front of Ringo about 10 feet with his guitar amp baffled off . . .

GE: right . . . and John's guitar would be in front of that. Then Paul's bass used to go into the corner next to the drums for overdubs.

And all of the Beatles' guitar sounds, drums and vocals went through a Fairchild valve [tube] limiter.

because no one had ever heard a snare like that in those days.

Ringo: And I was still using plastic heads on my drums instead of calf at this time. I feel my drums sounded better later on.

HC: Does "A Day In The Life" stick out?

GE: "A Day In The Life" — definitely.

HC: I can hear the count-down to the orchestra before Paul's section starts.

GE: That was Mal Evans actually [late Beatles' road manager and assistant]. He also "played" that alarm clock.

HC: Was Paul's section cut-in or was it recorded at the same time — because it was originally a separate

song.

GE: I think we recorded rhythm track with the changes in. I can't remember it being edited in.

HC: John's vocal treatment is really great — for me it's a real "soul song."

GE: Yes. Same thing with Paul on "She's Leaving Home". You could have put anything against his voice — it wouldn't matter what it was — and it would still stand out because of the feeling and emotion he put into it.

HC: I think I remember you put John in a chamber on that.

GE: Yes.

HC: What sort of chambers did EMI have at that time?

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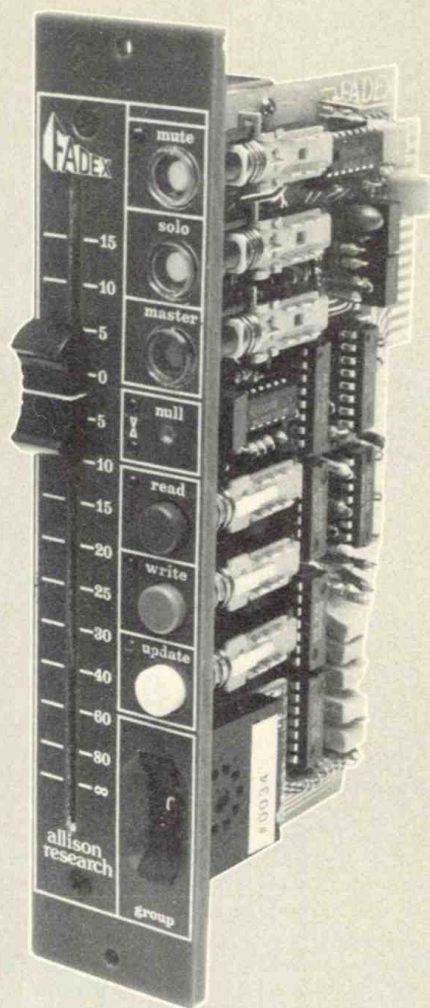
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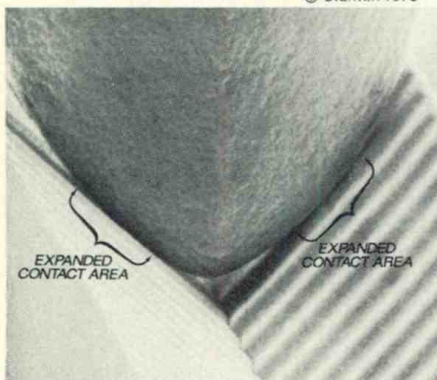
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Marty Pasetta, Andy Williams, Ringo — GRAMMY AWARDS, Hollywood, 1978

HC: In a limiting sense or a compression sense?

GE: In a limiting sense.

HC: We move into the ABBEY ROAD period.

GE: I had left EMI by that time and joined Apple. Then a week later I went back to EMI as an independent engineer for the album and there was a big who-ha. The atmosphere was awful [chuckles]. One of the maintenance guys even locked himself in the toilet when we wanted to get something hooked-up! [chuckles] It was just a matter of, "If Geoff leaves, Geoff leaves. He doesn't come back as an independent."

Most of the bass parts were overdubbed with the old [AKG] C12 mike set to figure-of-eight for ambience, placed about eight feet away from the amp, which was in the middle of the studio. Paul's argument was, "I want my bass to sound as it does in the studio," and the only way to create that was to use the flattest mike possible.

Ringo: And it was around this time I moved over to calf heads and double tomtoms for a richer sound. It was also my album debut for a drum solo [laughter] — which lasted a whole 13 bars! [laughter all around]

Most of side two on the LP was just a collection of unfinished songs produced into one large one.

HC: I wanted to ask you, Geoff — I think the string overdubs for George's "Something" were done in studio 1?

GE: Yes — we linked up two studios on that because we were sending the track from #2 — we had a closed circuit TV

that was going into #1 and we actually did the guitar solo "live" with the orchestra.

HC: So George Martin was conducting in #1 while George played in #2?

GE: Yes.

HC: I think that may have also been the first pop LP to use synthesizer in a tasteful, subtle way as on "Maxwell's Silver Hammer", "Because", and "Here Comes The Sun".

GE: It was George Harrison's machine. No one had heard that sound before and your ears immediately focused in on that — especially the low bass. We used to spend about two to three hours getting a bass guitar sound from an amp — miking it up and compressing it. Now it's just an accepted thing to put a D. I. [direct injection] box in and away you go.

That LP was also the first using the new transistorized board installed at EMI.

HC: When they put it in, did you notice if the board sounded cleaner compared to the REDD 37 tube-type?

GE: It sounded "different." I've always been against transistorized boards because they didn't have the "punch." People can show you on paper they're as good or better than valve desks, but they're not. I'm not really that technical, but I can hear it. We used to set up the same bass drum, the same everything and we listened to it and it hasn't got the punch — it sounds a lot thinner.

HC: Do you feel that PEPPER sounds better than ABBEY ROAD?

GE: ABBEY ROAD is very clean, I must admit. It's a very simple album as well —

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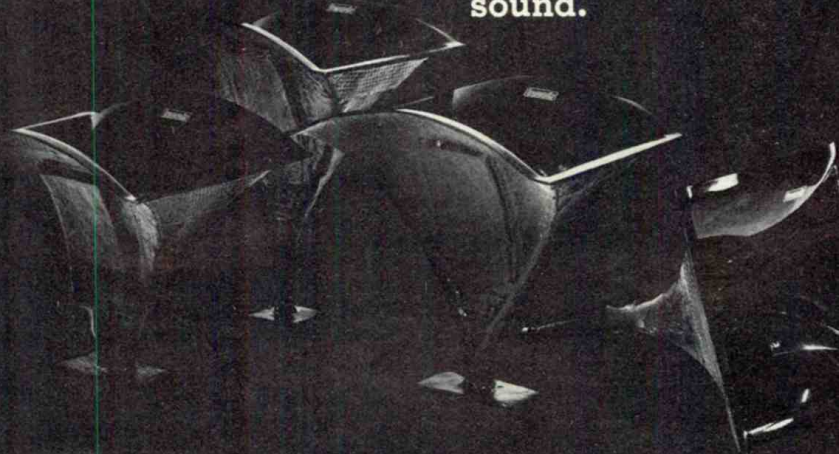
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not very complicated.

HC: How do you feel about it Ringo?

Ringo: I prefer this and the *WHITE LP* over *PEPPER* because the Beatles were more of a band at the time. We were playing better and were tighter as a band.

HC: Do you feel PEPPER is a noisy album, Geoff?

GE: No, no way.

HC: Because some guy in a back issue of R-e/p [Dec. '76, p. 67] said that and it knocked me on my ear! I couldn't believe it!

GE: It's impossible. It couldn't. I don't even use Dolby now because I don't like them.

HC: How about the Apple facilities?

GE: We spent about two years working out the studio. It's very hard to do it in that part of London in a very confined space, but Paul [McCartney] wanted to build a good studio and we did. We ripped out and gutted the basement, built a 40 x 30-foot L-shaped room with seven or eight foot ceiling. It was a beautiful studio, all done in white, different shaped boxes on the walls flooded with colored lights, a nice

geometric design in the ceiling to lend that aura of height to it — lovely parquet floor. The control room had walnut-finished woods, lovely fabrics — just great.

HC: How about the control room?

GE: About 15 x 20-feet with a nice large window. As far as equipment we had a Helios desk, 3M and Studers, Dolby, everything. And there was a cutting room in the front, which was the best cutting room in London.

HC: With Porky? [George Peckham, English cutting engineer.]

GE: Well, basically because of Malcolm Davies who came from EMI, and to me he's one of the finest cutting engineers in the world.

I also got Phil McDonald and some maintenance guys from EMI for Apple.

HC: When did you actually open?

GE: Well, it was hard work — with the architects and all — so two years to design and one year to build — so I guess about 1972. I did Fanny, Tim Hardin, Paladin — and about five or six albums that year and worked solid to get it established. In fact the acoustics are based on Abbey Road #2.

Going back to the cutting work — it was unbelievable!

That cutting room never stopped! It used to go 20 hours a day non-stop between Malcolm, Peckham, and John Smith, who tape-op'ed on the *WHITE* album.

HC: What was Lagos, Nigeria, like for McCartney's BAND ON THE RUN [73]?

GE: Very primitive.

HC: It was Ginger Baker's studio?

GE: No.

HC: It's separate from EMI?

GE: Yes. We worked at EMI - Lagos which was virtually a shed and an 8-track with one stereo machine and no spares. So if anything went wrong it meant switching cards around all the time.

HC: Were you encountering a lot of heat or humidity problems with the equipment?

GE: No, not really. It was primarily the maintenance and they didn't have the "spares". It's a very primitive country.

HC: What was the studio like?

GE: About 20 x 30-feet with about a 17-foot ceiling, and about 13 x 16-feet for the control room. Like I say, it was virtually a shed. The board was an EMI transistor board.

But the studio is very busy. There's about six groups a day going in there — seven days a week.

HC: For native music?

GE: Yes, and the only track we did do at Ginger Baker's place was "Picasso."

HC: Also, a few days before you left, a couple of band members left, so the group was down to three members.

GE: Right. Paul played drums which I put on one track, and I think the bass was separate on the 8-track.

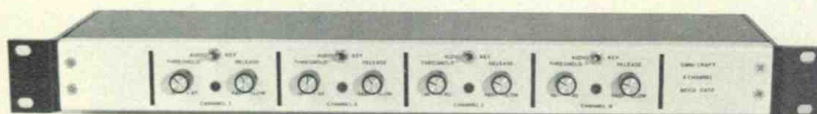
HC: Since the drummer had left the group, was it especially hard to lay down rhythm tracks or did you use click tracks?

GE: No, no click tracks. I think we started with Paul playing drums, Linda [McCartney] on keyboard and Denny [Laine] on acoustic guitar — that was basically the format. Then we put the bass on after.

We never worked weekends, so it took us about four to four-and-a-half weeks to record. Then we took the tape back to AIR [London] and transferred it to 16-track along with the orchestra and

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some vocal harmonies. So we only used about 12 - 14 tracks on the 16-track. It was basically finished when we came back.

It's a good album — it's got a good atmosphere about it.

HC: Well, you won a Grammy for it.

GE: Mmm [yes], but you know I felt that as soon as we started laying down the rhythm tracks — there's a certain "magic." There was the old McCartney magic about it — it's hard to describe, but you can feel it. The basic feel of the vocals and tracks was good.

HC: How long did the overdubs at AIR take?

GE: About two, three weeks. We didn't actually finish it at AIR because we ran out of time and actually spent two days or nights at Kingsway Studio mixing and two nights at EMI and that was it. So we actually mixed it all in three or four days.

HC: I would liked to have heard more high-end on the disk.

GE: We had terrible arguments over that. Harry [Moss, EMI cutting engineer] cut the final version. First of all John Smith cut it as Malcolm's deputy [substitute] at Apple and it sounded fine.

Then Harry cut it and because of their system . . . it's got that little bit of "punch"; it's not quite so hi-fi. If you would have heard the two different cuts, you would have preferred the one that was more punchy. I know what you're saying, but it wasn't there to start with.

HC: Couldn't you have added it in the mix?

GE: No. It just wasn't there. There was nothing to add high-end to because of the way it was recorded — it was just 8-track.

HC: Well, the only cut I've heard is the U. S. cut by Capitol so I don't know if there's a significant difference.

GE: There might be.

HC: The bass was fine — it was great. But the cymbals . . .

GE: There's not many people that take it that far now. All the America [group] masters we've had cut in England and it's come back from five different pressing plants and they're all different. One comes back very toppy and sparkly and the next one comes back very dull with no top on it. All they're giving you is a reference pressing. Then the record in the shops is on different vinyl. So you can only take it so far. At least you've done

your job and say, "I accept that 'white label'" and that's the way they're going to press it.

And, of course, a lot of these younger engineers will take cassettes and tape copies home and say, "Yeah, it sounds great. Just turn the level up, yeah, listen to all that low bass — whoomph." But once it gets on record and they compare it with other records, they can't understand why it hasn't got the punch that other records have got!

HC: Could you describe the AIR facilities?

GE: They're excellent. Every studio is 24-track, Neve, and they've got anything you want. Their large studio — you can get about 100 musicians in. Another studio is about the size of EMI #3. It also has two re-mix rooms — one of which is computerized. There's also film facilities there and the speakers are Tannoy in AIR-designed cabinets.

HC: That describes the facilities you then used for Mahavishnu's APOCALYPSE ['74]?

GE: It was the most complicated album I ever recorded because of using the large set-up of the London Symphony Orchestra. We ran two studios and



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linked them up with TV to prevent leakage because it was all cut live — rhythm group in a smaller studio and 90-piece orchestra in studio 1. That's the only way we could do it, otherwise it would be impossible. The music was so complicated it all had to be done at once because of the time-changes in the music.

HC: How did you work with that machine-gun drumming of Michael Walden?

GE: Well, I just went back to basics again with the 4038 ribbon on overheads, D19 and D190's as tom-tom mikes and D20 or D25 on bass drum. He used two floor toms and about four top toms. The electric bass was definitely D. I.

HC: Did it take a long time to record?

GE: No, about four weeks. Because of the orchestra expense, they had about two days rehearsal. Michael Gibbs did the arrangements and we mixed in about one week. A very complicated album. When you were confronted with it, you'd say it was impossible to record live with the rhythm section and strings, but no way could you have dubbed the strings over those tracks because the timing is incredible.

HC: Was it a Dolby session?

GE: Yes, and I don't like them.

HC: Why not?

GE: It does something to it, technically I couldn't tell you. My argument against noise-reduction systems has been, "Why don't the manufacturers make a better tape?" A good example of that is I once finished a Gallagher & Lyle album and I used GrandMaster for the multi-track and Agfa for the two-track and the results are like something you never heard before!

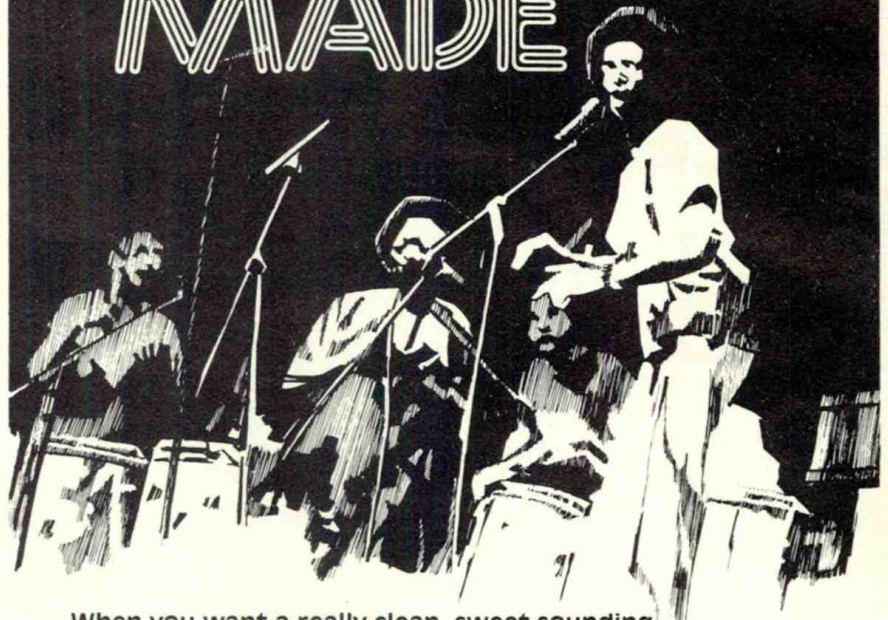
We used to use EMItape at Abbey Road and it wasn't as good. If you were to get three harmony vocals together on EMItape and bump them to one track, you'd get all this terrible beating and bumping going on in the background which was really a nasty sound.

HC: Like a "thumping" or a white-noise sound?

GE: Just like bias and everything beating together — a terrible bubbling sound — it wasn't clean. But you shove it on GrandMaster and it's beautifully clean. The Agfa just smoothed off the sharp peaks from the GrandMaster. The combination was great.

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HC: You notice a better signal-to-noise at 30?

GE: Oh yeah, not only that, but the top-end is better — on paper it's the same according to technicians. But it's not.

HC: What about the low-end rise at 30?

GE: There's none really. When you come to mix something you always add another 2 dB of bass or whatever so I don't see that that's any problem.

HC: You also recorded some Robin Trower at AIR: the BRIDGE OF SIGHS — LONG MISTY DAYS material. It sounded like you used a somewhat different approach in the engineering.

GE: I had to really. The group is basically guitar, drums and bass. Obviously, the guitar has got to be featured and Robin's tonal quality is very low; it's not very screechy at all. On the drums, you don't hear any tom-toms, in fact he hardly ever plays them. It's mostly cymbals and very "open". And the bass just supplements the guitar — it's not really featured — it's just there. So no way would the close-miking, hard, raunchy, drum-sound work with Robin Trower because no way would you ever get the guitar through.

HC: So you stuck to overheads only on drums?

GE: Still 4038's, yes.

HC: Now in the guitars, when Robin has to do some overdubs, did you ever have to do some double-tracking in the solos to fill out the guitar parts?

GE: Not a lot because that's what I admire him for. If a track were 12 minutes long, Robin would go out there and play it perfect every time. The only reason he may not be happy with it is because of the "feel" thing.

HC: Your EQ seemed to be a bit different on the drum also — not as much high-end. That was intentional evidently?

GE: Yes, in order not to take it too far away from the "deepness" of the guitar I suppose, which would have made it sound like guitar, drums and bass — the idea being to merge them into one since there are only three pieces.

HC: So you were kind of into that "wall of sound-gel"?

GE: Yeah. And as far as my production on DAYS, it doesn't really need producing because it's there to start with. They just need someone to tell

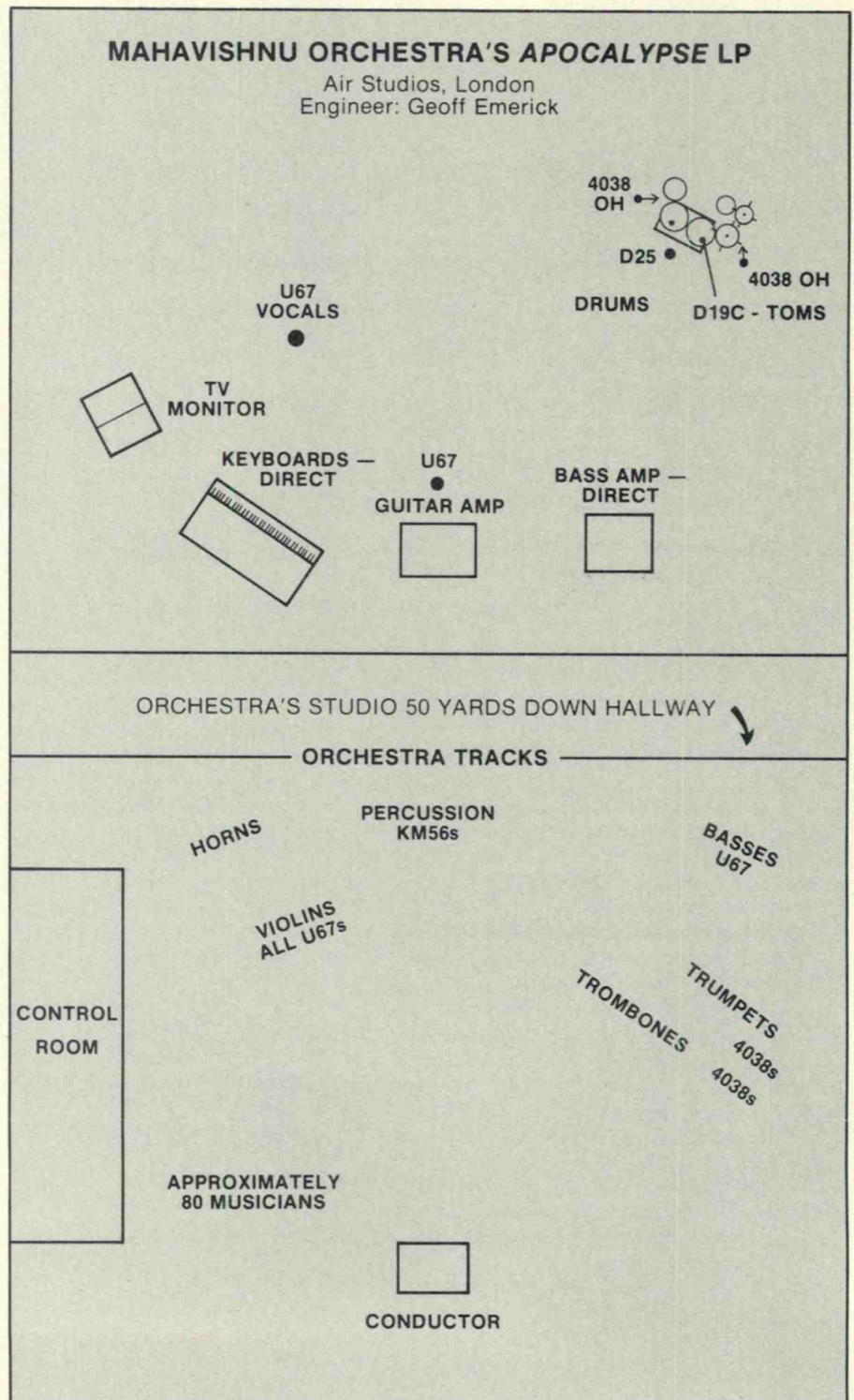
them if it's "there."

When I produce I don't like to engineer as well. I just find a good engineer and don't interfere with him. I used this technique on one of the Badfinger albums I produced. I just don't believe in doing both jobs at the same time — you can't give 100 per cent to both.

HC: Were you with America the first time you went to Caribou?

GE: Yes. That was the HIDEAWAY

album, finished up at the Record Plant - L. A. The board up there is Neve with some 3M's and an Ampex, at the time, and a typical Westlake speaker system. They said, "What sort of curve do you want on the speakers?" and I never work like that — it's the first time I came across that. So I said, "Well, we don't want any. We just want to hear these speakers plus Crown amps — just flat." I don't see the point in curving something to make it sound good if it's not good. The idea is to



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Note: The scope traces in the illustration have been simulated because photography of an actual trace would not accurately report what the human optic system would perceive.



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GEOFF EMERICK

by Howard Cummings

make it sound good if it's not good. Also, we brought our own speakers which were Tannoys which arrived about five or six days later.

HC: Monitor Golds?

GE: Yes, built by AIR. The drum-booth at Caribou was pretty dead so we took them out onto the live hard floor by the window.

HC: Did you notice that the altitude. . .

GE: Oh yeah . . . yeah.

HC: . . . bothers people?

GE: Yes. To me, the facilities at the time were just adequate for doing basic rhythm tracks. It's very pleasant working there. For example, back with The Beatles and others using this ADT thing for vocals and guitars and wobbling things which you can't do electronically — we've had eight stereo machines running in the mix — using delay on the plate, tape echo, ADT on the guitar, on the harmonies and on the lead vocals. They're just very pleasant sounds that smooth-out the sound. But no-way could I ever mix at Caribou because they wouldn't have the facilities to do it. It was hard enough for the Record Plant - L. A. to get all that together.

HC: Then you got involved with Gino Vanelli's GIST OF THE GEMINI.

GE: Yes, after two weeks of rehearsals in the countryside of England. It was the first time I had used Mag-Link as well because we had to run two 24-tracks together in order to build up all the strings and choir. So we had 48-tracks.

HC: Well, actually isn't it 46?

GE: In fact, it's less than that because of the breakthrough of the signal-pulse, so to be in the clear you have to lose two tracks on each machine.

HC: Because of the crosstalk of the time code?

GE: Yes. Then we were trying to get the string sound together on the synthesizer — one note at a time.

HC: One note? Did you assign it all to one track or did you do one note on track 1, note two on track 2, note three on track 3, etc.?

GE: Right, that way. I didn't want to have to start bumping and bumping and bumping to one track because of the loss of quality. So I just bumped the rhythm track down to one track on another machine, put a time code on it, just built up the strings, then bumped those tracks down to the stereo picture of strings.

His drummer had about 10 toms which I miked underneath without the skin to get separation from the cymbals. I think I was up to about 14 mikes 'cause he also had two bass drums.

HC: And one mike under the snare?

GE: Yes.

HC: And one on the top?

GE: Yes, with two 4038's overhead. The floor toms were miked underneath with the mikes in a pitcher because of mike-boom problems. We borrowed a tube U47 from EMI for the vocals, which is still the best mike as far as I'm concerned.

Again, it was a very hard album — just a natural progression.

HC: Was there any different approach when you recorded HEARTS and HOLIDAY with America?

GE: HOLIDAY was the first album George [Martin] produced and was a very fast album. We recorded the rhythm tracks, strings, and mixed it all in about two weeks. I approached it basically as I would ABBEY ROAD which was very little limiting on the vocals, very little EQ, and just building around the natural tonal qualities of the instruments and vocals coming from the studio.

HEARTS was also a fast album recorded in Sausalito — a very relaxed atmosphere.

HC: What brought Hawaii up for their HARBOR LP — a change of scenery?

GE: Yes, the idea being they like to record in a new location every time they do an album. We used a converted house with the Record Plant Mobile.

HC: Spectra Sonics board?

GE: Right. We used the bedroom as a control room. Since most of the houses have very thin wood, we went out and

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GEOFF EMERICK

bought some carpet, draped it on the walls and floor, put some colored lights up, and within a day it looked like a control room. The lounge became the studio and we built a drum booth in there. A lobby led into the lounge and the Grand piano went there, the acoustic guitars went into the kitchen to get separation, and we used our Tannoys to monitor.

We used the NECAM computerized system at AIR to mix on which is really excellent because you can see the faders move.

HC: Because of that servo-controlled system.

GE: Right, so at least you know if it's making the moves correctly. It's better to see it. You can do 999 mixes and use any bit of any one of those 999 and it automatically edits in.

HC: Does it use floppy-disk or track storage?

GE: Floppy-disk with a computer. I don't know how it's recorded upon. It just spins around on suction with a magnetic format.

I must admit, that *HARBOR* was great fun with them and George. I've got the greatest admiration for George's work. He's one of the only real producers I could work with today, quite honestly, and one that I'd give respect to because the guy walks into the studio and does his job. He doesn't interfere with the technical side. He just gets on with his production side and that's it. I do my bit, he does his bit and boom-boom, you can do about three or four tracks in a day.

And I certainly admire Alan [Parsons]. He's tried; he's really tried, I know he has. He's made tremendous, technically good albums.

HC: Were you surprised when you got a call to work on the live Beatles album?

GE: With that Hollywood Bowl album, there were 3-track masters in the can dating back to their 1964-65 performances.

HC: I knew it was in existence. You probably pulled it out of the vault and it said "Reverb and EQ added —

Incomplete" since there was some work done on it years before it was released.

GE: Capitol sent over the masters which had bass-drums-audience on one track, vocals on another, and guitars, keyboards, and audience on the third track. The tapes were in such terrible condition.

HC: Physically, because of the storage over the years?

GE: Oh, yeah. We had to wedge pieces of cloth and material and pads to hold the tape on the heads as it ran through. And also to find a 3-track machine for replay was difficult. We bumped it down to 24-track and then sort of jiggled around with it using some massive EQ to get something that sounded reasonable. It was worth issuing for historical value. It must never be looked upon as a great sound, but it really is a very exciting performance.

HC: And long overdue. In order to get some decent separation and EQ, did you duplicate each track onto the 24-track and then EQ each section independently within that instruments' frequency range?

GE: I duplicated each track to try to get



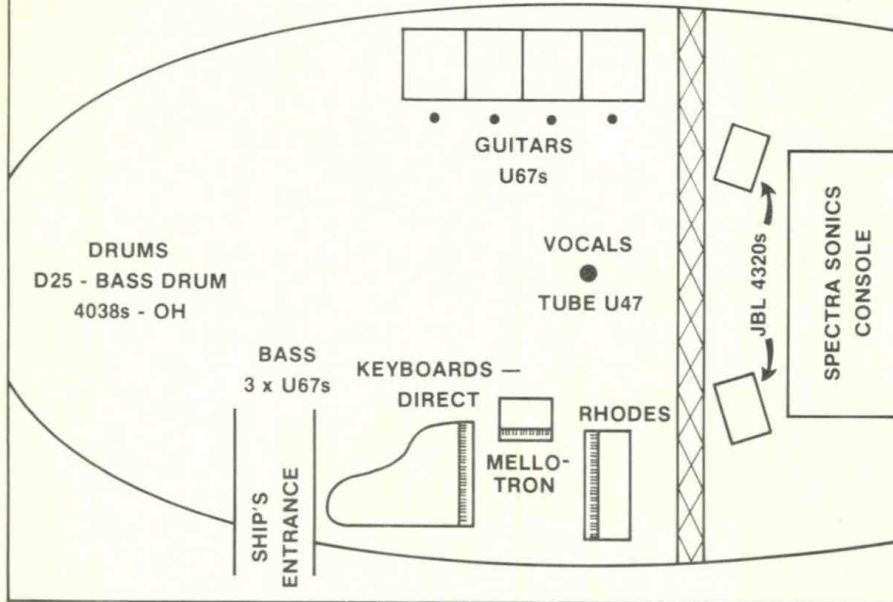
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WINGS' LONDON TOWN LP

Basic Tracks — Virgin Islands - Aboard the Yacht "Fair Carol"
 Engineer: Geoff Emerick



some sort of artificial stereo, so one side would be topky and the other would be a bit bassy by manipulating the faders and the EQ. I put a digital on them as well. That's the only way we could get any

stereo out of it.

HC: How did you feel about recording on a yacht in the Virgin Islands for McCartney's LONDON TOWN LP?

GE: It was a challenge. According to Paul, we didn't expect to get any tracks for about four or five days, but within a short period of time we had about two masters.

We used the Record Plant Mobile, basically, because of the guy that comes with the equipment — Jack Crymes. He's superb. I wouldn't have done the project without Jack because he knows that equipment inside and out. Tom Anderson was also a big help in assisting me.

HC: What did you do about the acoustics?

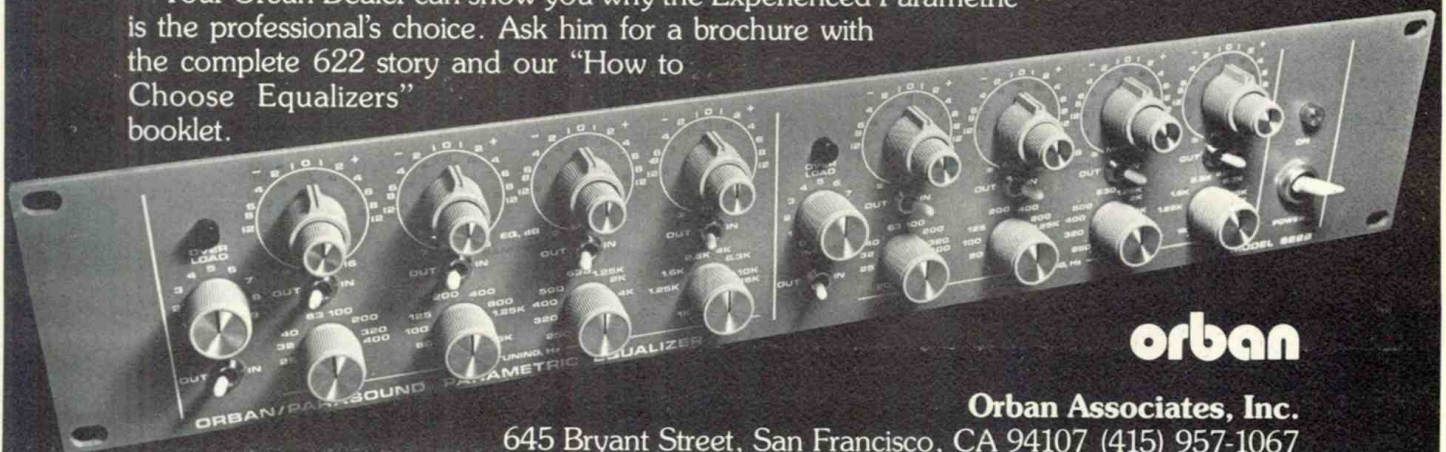
GE: There's nothing I could do. I was presented with this situation and that was it. The "Fair Carol" was the ship we recorded on, then we had another two or three ships various people lived on. The whole thing took place over the course of four or five weeks.

We put drums in the pub area of the ship, because of the wood, and it worked. So we had a facility to record in, we worked with it and it came out fine, in addition to being great fun. . . .

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NEW IHF AMPLIFIER STANDARDS:

A PROFESSIONAL VIEWPOINT

by Bill Isenberg

Why do we need amplifier standards? Any recording studio, television studio, film studio or sound reinforcement company is vitally interested in the quality of power amplifiers in daily use. Indeed, adequate performance within the requirements of the business directly affects profits, customer goodwill and operations problems.

Similarly, when one buys equipment for use in the home it is desirable to be able to objectively evaluate equipment for this type of service. It is important, then, to devise a method of evaluating amplifiers for the intended application.

Unfortunately, there are many different types of usage for power amplifiers. The importance and weight-

ing of various criteria differ with different types of service, thus making the problem of developing a single universal standard very complex. Industry experience has established two major service categories: 1) professional/commercial use, and 2) home hi-fi use.

Most professional situations differ widely from home entertainment requirements, but there are some similarities. It should be noted that we will not concern ourselves with special purpose amplifiers used to drive servos, shake tables, etc. Musical instrument amplifiers are also not considered because they are generally adjusted to aid in the production of music, rather than being used for the purpose of reproducing music or sound effects.

For professional applications the main criteria is reliability; as someone said, "It works, zero per cent distortion — it doesn't work, 100 per cent distortion." Professional equipment typically is run for extended periods near maximum capability and sees frequent service. It is often subjected to high levels of abuse (both mechanical and electrical), particularly equipment that is set up and torn down frequently.

There are many features typical to professional/commercial equipment that are not important to home hi-fi. Seventy volt line outputs are usually available to drive sound distribution systems. The method of input connection is usually Cannon XLR or screw terminals, and provision is usually made for input transformers to accommodate a variety of sources.

Home hi-fi service, however, is primarily concerned with sound quality. The greatest disaster should a home hi-



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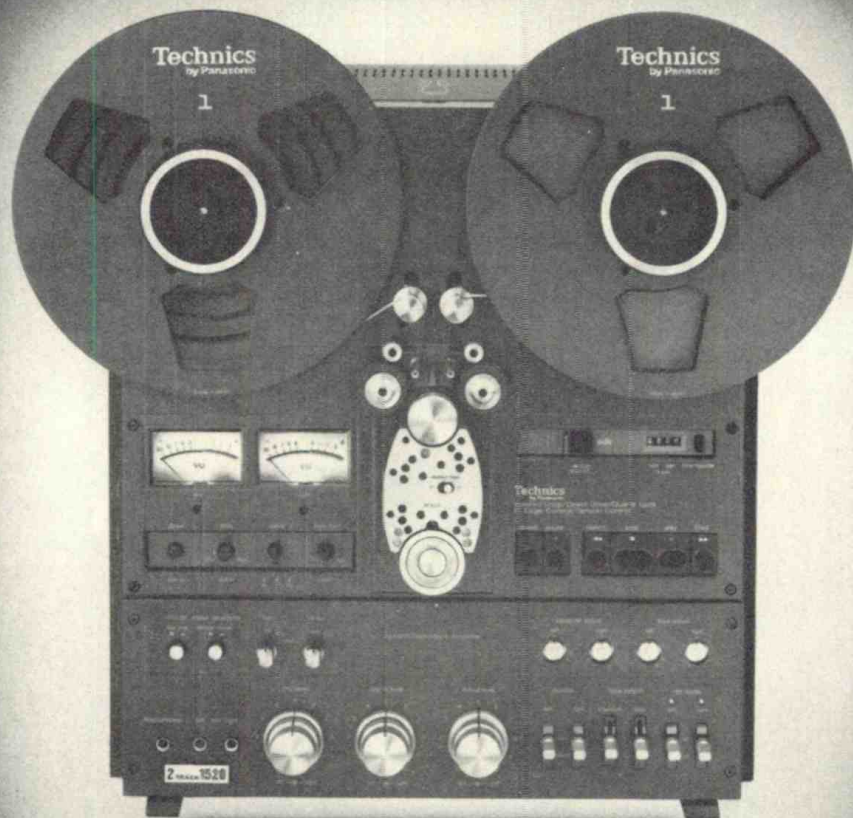


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TEAC's GE-20 Equalizer was designed for recordists, not the audiophile. Each channel has an input level control and input overload LED to guard against distortion. Two output level controls, plus a switchable output level meter, lets you monitor the signal from each channel.

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NEW IHF AMPLIFIER STANDARDS: A PROFESSIONAL VIEWPOINT

fi fail is that one may wait a few weeks with his system down while the unit is in the shop. Typically, home hi-fi equipment does not see long, continuous periods of operation and the typical operating level is well below the maximum continuous power capacity of the equipment. The frequency of set-ups and tear-downs, with their attendant abuse hazards, is much less for home hi-fi than for pro gear.

Some equipment is designed to serve both markets. The reason for this is money. An amplifier that appeals to both has a better sales potential than one that is satisfactory only for professional use; consumer applications represent the highest-volume market. There are many more hi-fi types who buy records than there are studios to record them. Further, the hi-fi user likes to own a "professional" unit. There are also a lot of discotheques that need big, clean sound as well as reliability.

UL's 813 standard covers professional/commercial equipment applications whereas IHF's power amplifier standard is oriented primarily towards home hi-fi

with some applications in other areas as well. Both these standards have been recently revised to provide a more meaningful evaluation of equipment for the intended usage.

The Institute of High Fidelity in New York is the hi-fi industry clearing house for technical standards. Because the existing standard for measuring

Standard Complies With FTC Guidelines

amplifiers (IHF-A-201) has become increasing obsolete, a revision has taken place.

Beginning in 1975 a distinguished panel of high fidelity experts has wrestled with the difficult task of generating meaningful, up-to-date procedures for evaluating examples of current practice. Of necessity the new standards must conform to the Federal

Trade Commission (FTC) ruling of 1974. The result of this is called IHF-A-202, 1978 Standard Methods of Measurement For Audio Amplifiers.

Similar developments in the commercial sound field have prompted Underwriters Laboratories to revise the standards for sound reinforcement amplifiers. Industry representatives have been meeting over the last year or so for the purpose of updating UL Standard 813. The revised edition is dated September 8, 1978 and becomes effective December 1, 1979.

Because UL standards are important mostly to equipment manufacturers, we refer to them only as they affect the end product. However, the implications of these recent changes have been carefully considered from a users standpoint by the UL committee.

Since the choice of amplifiers is a difficult decision, the person responsible must learn as much as possible about available units. Most of the time it is not feasible to bring in all suitable products and evaluate them in actual usage. Although this is by far the most effective technique, time does not always permit a leisurely consideration of alternatives.

The existence of standard methods of measurement permits the user to evaluate potentially useful amplifiers without having to test them personally. We might add that a complete laboratory set up is quite expensive, and for most organizations could not be justified, even on a rental basis.

IHF standards provide a repeatable, reliable method for the user to insure that he is comparing apples-to-apples before he makes a purchase decision.

Since many questions arise concerning output power, distortion and frequency response, the IHF standard has five primary ratings, which must be disclosed to comply with the standard.

1. Continuous average power output.
2. Dynamic headroom.
3. Frequency response.
4. Sensitivity.
5. A weighted signal-to-noise ratio.

Each of these ratings will be discussed briefly in hopes that a more complete understanding is reached. Decimal numbers indicate the selection or paragraph in the IHF-A-202 standard which applies to each topic.

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AMPLIFIER STANDARDS

in RMS volts. The power bandwidth and distortion must be stated. If more than one load impedance is used, the entire specification must be repeated at the alternate load impedance. This combination of load impedance, bandwidth and distortion, together with the power obtained, conforms to the Federal Trade Commission (FTC) specification (section 3.1).

The IHF standard gives us comprehensive protection against fraud by stating numerous conditions which could influence power ratings. The following conditions are specified to cover all the common loopholes. Here is a list of details covered and the reference number of the paragraph which governs each case:

- (1) All channels must be operating (5.0).
- (2) Continuous operation defined (3.1.1).
- (3) Preconditioning defined (2.2.1).
- (4) Test area temperature (2.2).
- (5) Power line voltage/frequency (2.1).
- (6) Harmonic distortion at low power (3.1.6).
- (7) Harmonic distortion defined (2.9.3).
- (8) Spectrum analyzer recommended (2.9.6).

As far as continuous power is concerned, the IHF standard offers an excellent means of comparison amongst competitive units. Additional information is available in the dynamic headroom rating. The purpose of this rating is to give us an idea of how well regulated the unit's power supply is. Because the power available for short transients far exceeds continuous power in some amplifiers, it is obvious that reserve power should be indicated in some way.

Because the music power ratings of 1966 created confusion, the committee wanted to be sure that a wattage figure not be part of any transient power rating. The solution is to measure clipping of a low duty cycle sine wave which is bursted 20 dB. When the burst level just clips, the voltage level is recorded and that level used to calculate what power is available for that short time. Next, the burst power is related to continuous power in decibels to arrive at a dynamic headroom rating.

$$\text{Dynamic Headroom} = \frac{\text{Burst Power}}{\text{Continuous Power}}$$

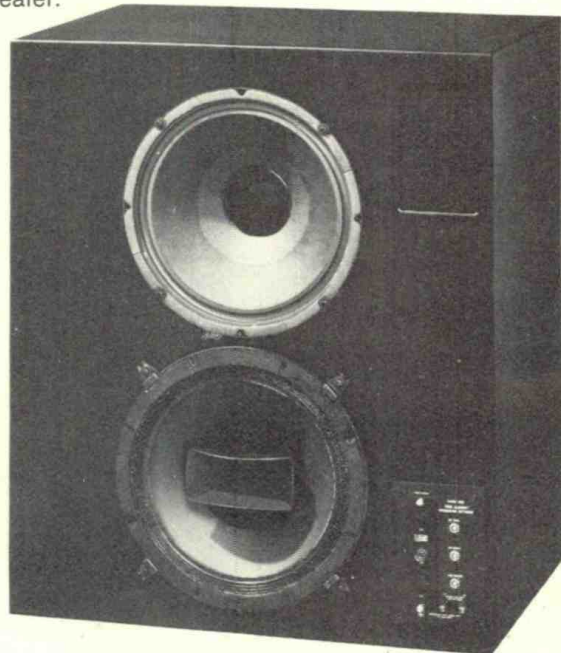
This rating would be 0 dB if the amplifier had a well-regulated power

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supply and therefore could not provide additional power when bursted. If the power supply were poorly regulated, i.e. skimpy power transformer and/or small filter capacitors, it might be possible to do twice the continuous power for the short burst time. If twice the power were available, the dynamic headroom would be 3 dB.

Because a poorly regulated supply is one way to cut corners, we feel that a professional user would most likely want to select a unit with a low dynamic headroom rating. This will insure that unit's power supply is conservatively designed. All of the conditions required for measuring dynamic headroom are given in section 3.2. Additional protection against selective measurements is given by paragraph 3.2.3.1 which indicates that the dynamic headroom rating must be given separately for each rated load impedance.

Frequency response is measured into the rated load or loads when the unit is supplied an unvarying amplitude sine wave at all frequencies of interest. Using a standard source impedance, all output readings are taken reference 1 kHz in

decibels $\pm X$ dB (see section 3.13). Although this may seem obvious to the pro user, not every manufacturer was following this procedure.

Sensitivity rating of an amplifier is now defined as the amount of input voltage required at 1 kHz to reach a *reference* power of one watt. Note that the usual method of indicating sensitiv-

'Dynamic Headroom' Measured In dB

ity is to tell us what voltage is required to reach *rated* output. The intent of this new definition is to place all sensitivity ratings on a common scale (see section 3.7).

Weighted signal-to-noise ratio is determined in comparison to the *reference* level of one watt. Figures obtained in this way will not be as high as those taken in the past which were

usually taken using rated output as the 0 dB point. "A" weighting is used primarily to give a good correlation with perceived noise. Also, a network simulating a normal input will be used instead of the unrealistic shorted input (see section 3.12).

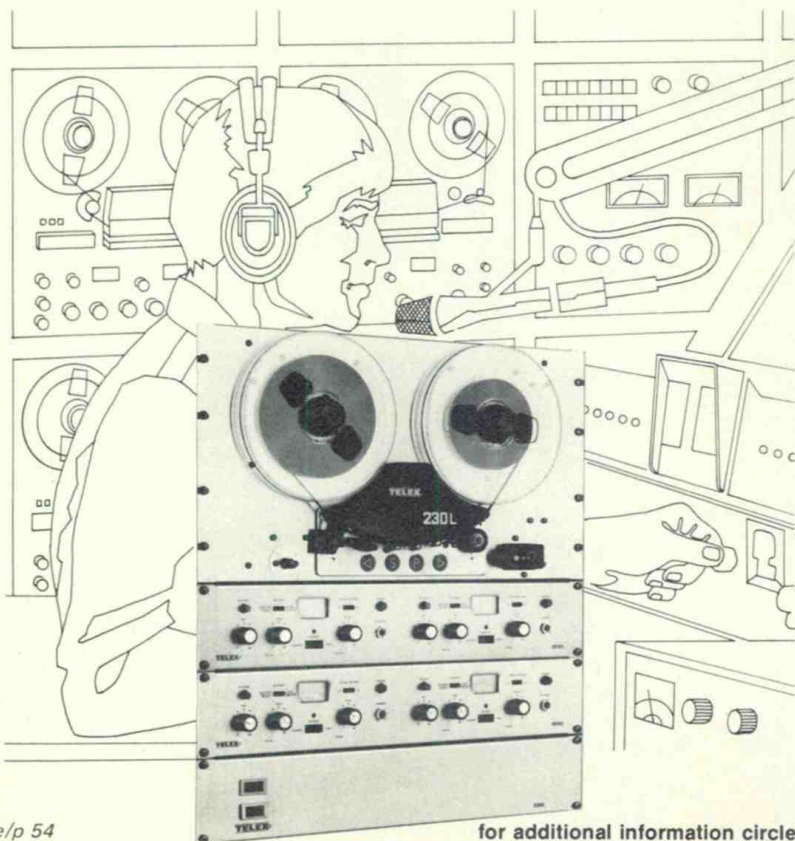
In addition to the primary ratings previously discussed, several secondary ratings are of interest.

Clipping headroom is a method of defining maximum continuous power available at a reduced power bandwidth compared to the rated bandwidth at the rated distortion. It is measured at the single frequency of 1 kHz or over some reduced bandwidth stated with the rating. As in the case of dynamic headroom, the additional power available is not stated as watts, but in decibels (see section 3.3).

Output impedance of an amplifier is described by a graph showing output source impedance vs. frequency over the rated bandwidth. Several methods of measuring the output impedance are discussed (see section 3.10).

Damping factor vs. frequency can be calculated using the output impedance

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AMPLIFIER STANDARDS

curve obtained above. The most important item to remember here is that the damping factor will vary with rated load impedance. If more than one load impedance rating is provided, damping factor information must be given for each load impedance (see section 3.11).

If it is desired to express damping factor as a single number it shall be the lowest number obtained using an 8 ohm load, and will be called the wideband damping factor. In a similar fashion, the low frequency damping factor is taken at 50 Hz using an 8 ohm load.

SMPTE intermodulation distortion vs. output is shown on a graph which begins 12 dB below the reference level of one watt and continuous up to the continuous output power rating of the unit. This must also be done for each rated load impedance (see section 3.15).

Total harmonic distortion vs. frequency is another graphic presentation that is done every 3 dB (doubling of power) beginning 6 dB below the reference level of one watt and increasing up to the continuous power rating. This must be done for each rated load impedance (see section 3.6).

IHF intermodulation distortion (sometimes called the twin-tone method), is a more revealing test than the SMPTE method. Two tones separated by 1 kHz are swept from 2,500 Hz to the upper limit of rated bandwidth. Any spurious outputs related to the twin tones produced by non-linearities in the device under test are listed as a percentage of the RMS value of the two tones combined. This result is taken every 3 dB starting 12 dB below reference up to rated power. Again, if the unit is rated for different loads the results must be shown for each load (see section 3.16). This test is one of the best available for detecting the possible presence of transient intermodulation distortion (TIM).

Transient overload recovery time is determined in a manner similar to the dynamic headroom measurement. In this case the alternate-level signal is adjusted such that the burst level is 10 dB above clipping and the reference level is 10 dB below clipping. When this is done, the portion of the reference level immediately following the overload burst shall be examined with an oscilloscope for resumption of the reference waveform with no visible distortion remaining. This time period is defined to be the transient overload recovery time (see section 3.18).

Slew factor is defined as the relationship between the frequency where

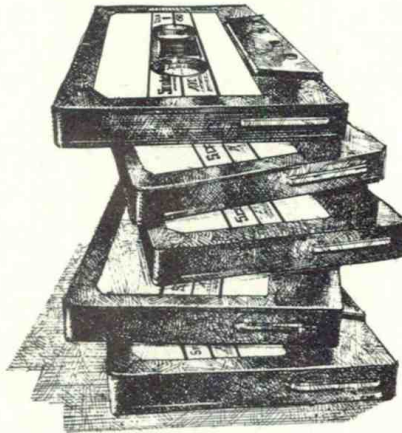
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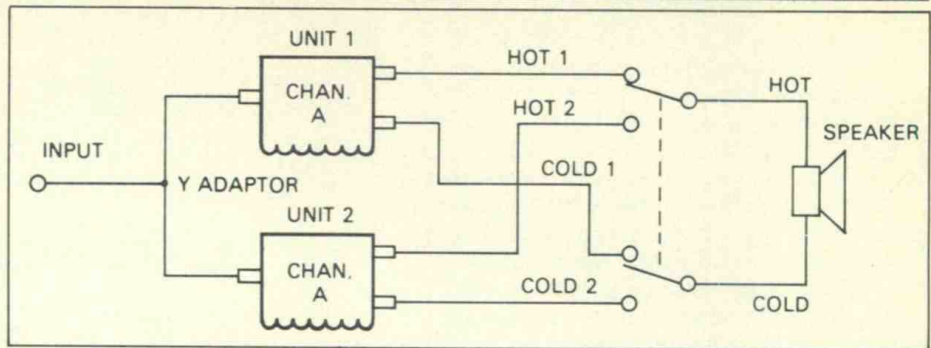
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continuous power distortion reaches one per cent and 20 kHz. To take the measurement, the unit is operated at rated continuous power at a frequency of 1 kHz, and the input frequency raised until THD reaches 1%. When this frequency is noted it is divided by 20 kHz to obtain the slew factor. This method of evaluating performance of an amplifier rests on the assumption that some units have insufficient power bandwidth caused by inadequate slewing capability (slew rate is the fastest possible transition possible at the output, given an instantaneous step at the input). What this means is that a high power unit has to have a higher slew rate to maintain low distortion at high frequencies above 20 kHz than a low power unit. Sad to say, the situation is not that simple. It is quite possible to have a well-designed unit with a power bandwidth of 60 kHz (and a slew factor of 3) be outdone by a mediocre unit which is rolled off quickly at the input and as a result never hits 1% because the level falls off rapidly before it reaches a power output stage with far less power bandwidth.



As a result of this discrepancy, it can be deduced that the slew factor is an inconclusive measurement and should be disregarded. It's not that the problem isn't real; it's very real — it's just that the IHF slew factor fails to address the entire situation (see section 3.19).

The reactive load rating is an excellent concept which spotlights a common deficiency in amplifier measurement. For this measurement, the purely resistive load used for all previous measurements is replaced with a network intended to simulate a loudspeaker load. The device under test is adjusted to supply its rated continuous

power in the vicinity of network resonance at about 50 Hz. If the amplifier can operate this network at the same voltage level as a resistive load, the reactive load rating is 0 dB. If, however, the amplifier reaches 1% distortion under the test conditions the equivalent output voltage is noted and equivalent power assuming an 8 ohm resistive load is calculated from this voltage. This is compared to the rated power to determine the reactive load rating. Supposedly this gives an indication of the degree of protect limiting into a typical speaker (inductive) load.

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AMPLIFIER STANDARDS

determine the maximum value of capacitance that can be connected in parallel with the rated load without degrading performance by more than 10% (see section 3.20 for complete test procedures).

Separation vs. frequency is shown as a graph covering the rated bandwidth. When the desired channel is operating at a level 3 dB below rated continuous power, the other channel(s) shall be examined and the amount of separation in decibels vs. frequency graphed reference the level present at the desired output (see section 4.2).

While this is not a complete list of secondary ratings, all of the important criteria are included.

The full text of IHF-A-202 is available by sending \$7.00 to the Institute of High Fidelity, 489 Fifth Avenue, New York, New York 10017.

By far the most important test for any amplifier is listening. If at all possible, set up the promising candidates two at a time and compare under actual conditions such as a rehearsal or mixdown. With the inputs connected in parallel, switch speaker leads back and forth and listen carefully to specific sounds as they repeat. Those with musical training can usually hear specific details more readily than others.

One note of caution when switching loudspeakers while operating: Please switch both hot and cold for both channels. Two amplifiers momentarily connected in parallel will probably have momentary life expectancy. The diagram shows a suggested connection for one channel. Use two for stereo. Use a heavy-duty switch or relay. □ □ □

Author Bill Isenberg is currently associated with Pioneer North America. In this article he does not speak for Pioneer. Previous associations include Pioneer of America, Scientific Audio Electronics, James B. Lansing Sound, Record Plant - Los Angeles, Daniel Flickinger Associates and Mastersound Recording of Atlanta.

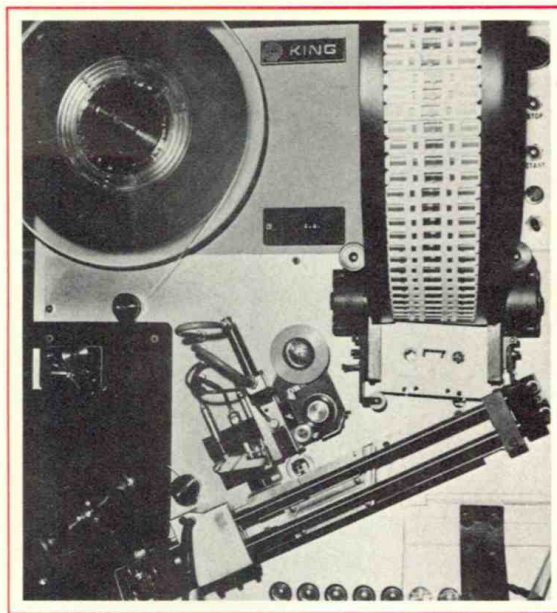
References:

1 - *Standard Methods of Measurement For Audio Amplifiers*, IHF Publication IHF-A-202. 1978.

2 - *New IHF Amp Standard*, Edward J. Foster, Audio Magazine, June, 1978.

The author wishes to thank Stephen V. Lyle, of James B. Lansing Sound, for his assistance.

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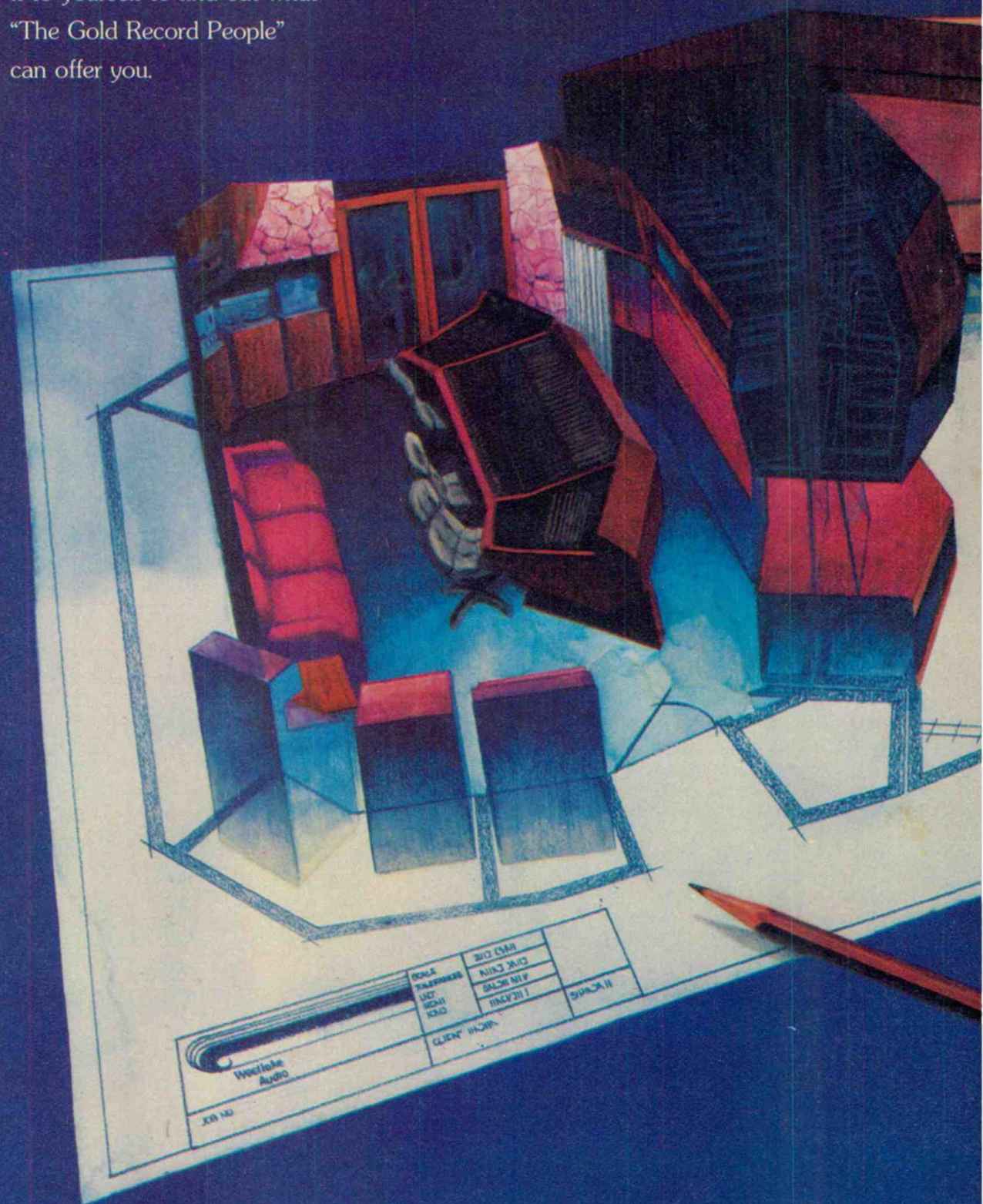
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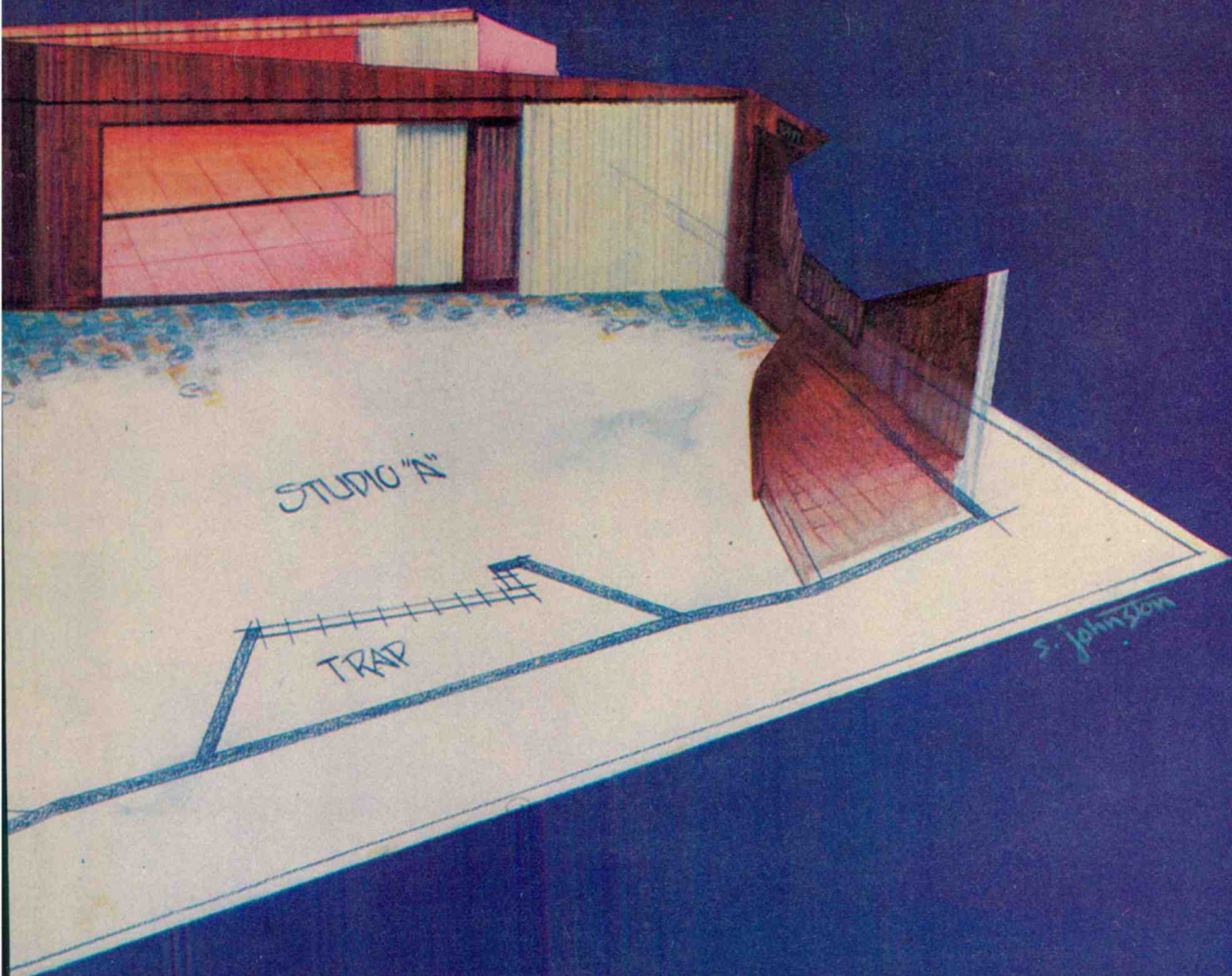
R-e/p 57

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The path that led Buddy King into the record recording field has been travelled by many studio operators. In 1971, he bought some equipment with the intention of recording himself and friends. It was to be strictly a hobby and he was operating out of his home in Huntington Beach, California, a community in the sprawling urban area south of Los Angeles known as Orange County.

King had dropped out of Los Angeles State College in his final year of pre-law/political science study and got a job as a landscaper, which he found to be both lucrative and satisfying. In his spare time, he resumed playing the saxophone, which he had studied in high school, and took bass guitar lessons because the electric sound was popular at that time. Though he had never been in a recording studio, he began toying with the idea of starting up his own.

Talk is cheap, a neighbor pointed out. The neighbor, an aerospace engineer, prodded King to follow through on the idea. King protested that he didn't know how to begin. "You start by going down to the lumber company and you get some two-by-fours," the neighbor said. "Then you put a wall there and then put a wall there."

Following these elementary instructions, King constructed a crude studio in his living room and later put a control room in his dining room. He started recording with a used, three-buss, transformerless Stephens console, a new Ampex four-track recorder and two condenser mikes.

Once the equipment was installed, King decided a burglar alarm was necessary. The alarm installer was impressed with the set up and asked if some friends could record religious music at the home studio. King, himself a man with firm spiritual beliefs, consented. This was a chance to make his hobby pay for itself. That first project was a sampler album entitled MARANATHA ONE, an early product of the contemporary gospel/"Jesus music" movement, which became a classic in its field.

This project led to another and soon King dropped his landscaping job. His sax and bass guitar lessons were next to go. "This was really fortunate," notes King, "because my licks were really bad." By 1972 his recording activities became his profession and so he never did achieve his initial goal, to record himself.

King took only two neighbors into his confidence about his recording studio and simply told the rest that he was throwing parties when parked cars aroused suspicion. A group that pulled up in its custom Greyhound touring bus put an end to that ruse, and in 1975 a letter from the city followed. A city building inspector was impressed by the studio but made it plain



Buddy King (left) and engineer Rick Donaldson in Soundcastle's control room

Photography by Eddie Hoff

The Agony of Success

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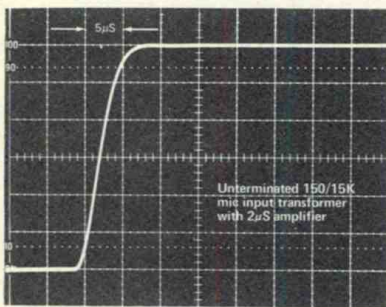
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R-e/p 61

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that it was in violation of ordinances. King was given a few weeks to clear out, but the studio remained there until the Fall of 1977.

He realized that his house was inadequate even before the city discovered the studio and began looking for a new location in 1973. His search for a new facility and his experience as an owner/builder are recounted in his own words, based on interviews conducted by Bob Marich.

The Agony of Success

It was in my third year that I realized that I had to move. One day there was a knock at the door and the man standing there said that he had just got in from Georgia. He told me, "I heard about your studio back home and I wanted to look it up when I got out here."

This guy got my address back in Georgia. It made me realize that where you're located, what the studio is and the vibes that you radiate are a very important thing. To me, a studio was not something that is in an industrial complex, a studio was not something that is on a major boulevard. Quite the opposite, a studio is situated where you have houses next door, where it is peaceful, where you have trees, where it is a pleasure to be. That is a studio to me.

It was really hard for me when I started looking in 1973 because the only places I could find were industrial complexes or abandoned 7-11 grocery stores. I didn't have the money to build from the ground up, so I was looking for an existing structure to lease.

Requirements For A Building

I was searching for a building that met three basic criteria. The building would need a minimum of modifications to make it into a studio. The second thing it had to have, which is just as important as the first, is a good location. By location, I'm talking about having a proximity to recording business. The third thing the building had to have was magic... that intangible something which is a kind of warmth that grabs you when you walk through the door.

I began scouting around in the classified ads of the Los Angeles Times, the largest circulation newspaper in Southern California. The newspaper was a way to acquaint me with various areas. I used to read the Times when I was on the head, every day. Days that I'm not working, I'm driving around looking at places.

One thing I found out about looking in the newspaper was that the ads tend to be misleading. Everything is made out to be desirable and enticing; but when you check

it out you see that, at best, just the good features were pointed out. Still, the newspaper is a good source for leads.

Another excellent source is talking with people in the recording business. I think out loud a lot and I like to see what the reaction to my ideas are. This is how I got involved in locations hundreds of miles from my

Acoustician George Augspurger

After leaving JBL in 1970, George Augspurger established Perception, Inc., as a consulting firm specializing in architectural sound system design. Aiming for a "middle-of-the-road" approach to Soundcastle's acoustics, Augspurger describes his thinking in the following passage:

STUDIO: Rock and roll studios in America are for the most part "dead." The ceiling and all walls are quite absorptive for complete sound separation. They don't want a lot of leakage and they use many mikes. John and I believe that this is not the trend of the contemporary rooms. European studios for the most part are built like recital halls. They look for a livelier sound and use fewer mikes in their technique.

Since Buddy left the design up to us, we decided to take Soundcastle down a middle-of-the-road approach giving it the potential for both sounds. The extreme right is maximum isolation — a dead canopy area that runs the length of the studio. It is approximately 12-feet in depth and approximately 33-feet long. The extreme left wall is all glass. It is a lively area for strings and brass; and, generally, instruments that benefit from acoustical reflections would record very well there. The rear wall maintains the absorption of low frequency and still gives a little bit of high frequency liveliness to the room.

If Buddy had started out from scratch building this building from the ground up, he could not have found a better building. The 20-foot high ceiling gives an opportunity to make much of the room. The design is an interesting attempt to achieve an acoustically neutral room, so as not to color the natural sound of the instruments, which is dry enough for good separation and yet lively enough in the main room so one could pull back and do legitimate classical recordings. Approximately 25 per cent of this area is highly reflective.

The major complaint of not enough isolation between mikes is because the engineer, I have found, is usually inexperienced. I believe a good engineer uses leakage in a creative way.

I have never worked on a building that had one wall completely glass, and it was very interesting to see John Edwards take this negative feature and make it into a plus factor. Buddy's building is one of the most unique designs I have ever come across. The building really is an art form.

Huntington Beach home. I would be "thinking out loud" about building a studio in Hollywood, which is 50 miles north of my house. The reaction would be, "No, don't build a studio in the Hollywood area. There's 400 studios there already. Why do you want to build another one? Go south to San Diego. That is the coming area."

I went down to San Diego and talked with some studio owners as well as firms that supply equipment and services to the studios there. They were the ones that said, "Ahhh, San Diego is not the area — Arizona is the up-and-coming area. That is the place to go. We know a guy who has two rooms there and he has more business than he knows what to do with." Soon after that, I drove to Arizona to check out the recording situation.

Besides talking with studio owners, I always sought input from musicians. Their input would always be different from that of the studio owners. I also did a lot of talking with the people who pay for recording sessions and relied most heavily on their input because, obviously, they are the key factor in the studio business.

When talking with musicians, I got a lot of comments like this: "I don't like recording in the Hollywood area. Go to Santa Barbara [which is north of Los Angeles on the coast]. That area is really nice. I like working up there and it's only an hour away from the city." While investigating the Santa Barbara area, I looked at a building which had been a

brothel at the turn of the century. There's a lot of irony in looking for a new studio, because at one point producer Gary Usher suggested that I relocate in a church.

My search also took me to Las Vegas. Why Las Vegas? I had a friend there playing with a top group. He told me that the city had two recording studios and one had recently burned down.

Whenever I came to an unfamiliar place, I

'I Did A Lot Of Talking With People Who Pay For Sessions'

found out who was recording there and what was being recorded. What turned me off about all those other locations was that they were specialized to my way of thinking. I had come from Orange County and seen specialized recording. If it was at all possible, I wanted to get away from that.

The First 'Candidate'

With this thought in mind, I've got to confess that the first building I seriously considered leasing was in Orange County. It was situated in an industrial complex in the

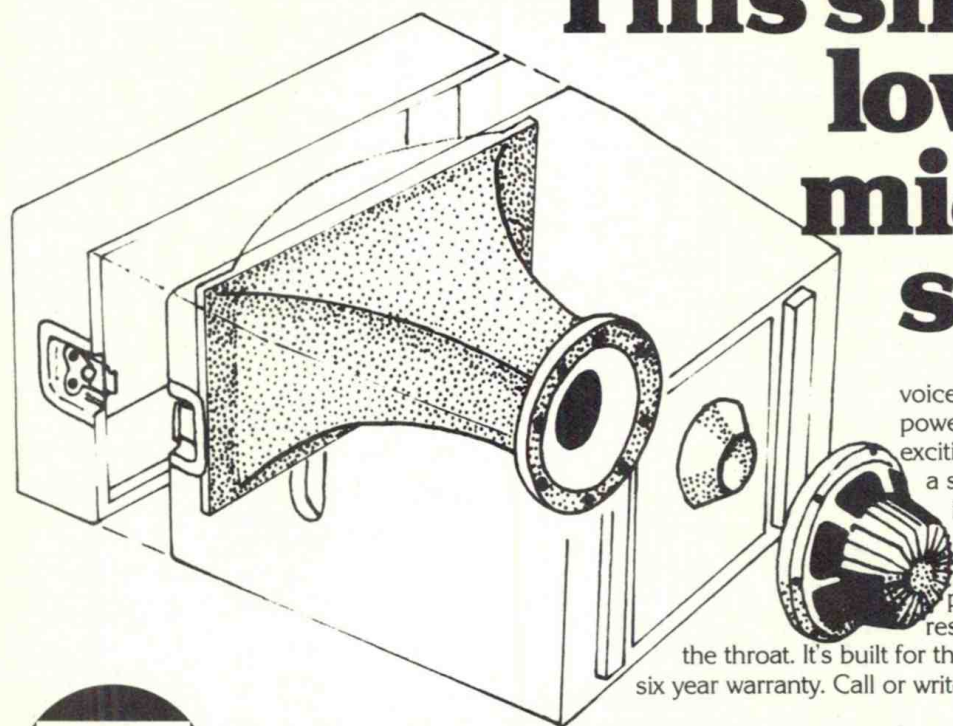
city of Anaheim. The building had a 15-foot, 9-inch ceiling and about 4,800 square feet of floor space.

At this point I should introduce someone who played the key role in evaluating locations that I found. He is acoustician George Augspurger.

When I first got the bug to move I began talking with studio designers. We'd just go out and have coffee . . . shoot the bull. They would get tired of talking with me, of course, but in the conversations, I picked up ideas that helped me define just exactly how to approach looking for a new studio. This was how I met George and he formally took me on as a client.

Poor George, he probably spends half his life looking at buildings for me and other people. He would tell me what the benefits and drawbacks were of a particular location. "Yes, we can do this and we can do that," he would say. "The acoustic treatments, because of the location, would require walls that are such-and-such thickness. There's room for air conditioning and what-have-you. But I must advise you that such-and-such will be a problem. To get around this will require such-and-such modifications." We would even go through some rough designs to help me make a decision.

With all this, George would give me an approximate idea that it would more to remodel a building because of this factor or that factor. I think that this was the best education I ever got as far as helping me



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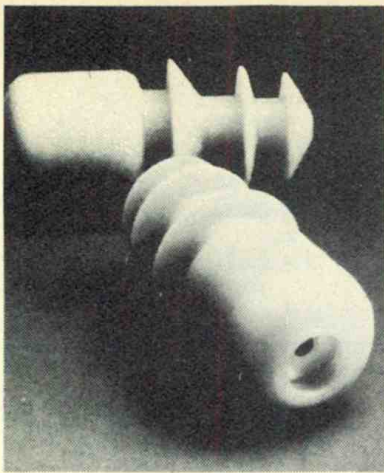
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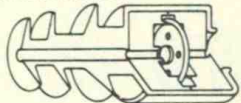
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decide what I wanted. That's the hardest thing for a studio owner. Because at the same time I was looking for a location, I was trying to decide just *exactly* what I wanted.

George came in and pointed out something regarding the Anaheim building that I had not really thought about — it's proximity to the freeway. He told me that there would always be a particular type of rumble there; it was two blocks from a freeway. We could work with it by floating the floor and other expensive treatments. After listening to him, it just seemed that when I would be finished building a studio, I'd have something that would be very sterile. That was my own reaction.

I have a tendency to labor over decisions. So I'm laboring over this one — do I take the building anyway — and this takes me a week. In the meantime, the building is leased to someone else . . . and that settled that.

Dealing With Brokers

There were other ways I found out about commercial properties. I began talking with real estate brokers and must have contacted, all told, about 15. My experience

was that as soon as you tell them that you're looking for a studio, they usually don't want anything to do with you. People looking for studios have requirements that are fairly unique: high ceilings, parking, a site away from traffic . . . and people looking for studios tend to be a little funky from the real estate broker point-of-view. Because of

Brokers 'Usually Don't Want Anything To Do With You'

your unusual requirements for a piece of property, they know it'll be this side of a miracle to find something for you and make a commission for themselves.

They might take a shot at it, I have found, because you are something novel. You could make the broker's day interesting . . .

Architect John Edwards

An architect for 22 years, John Edwards has specialized in the music and film industries for the last 12 years. His clients include RCA, MCA, Motown, Heiders and others throughout the world. Edwards calls Soundcastle one of his most interesting projects in the following commentary:

CONTROL ROOM: After designing more than 150 control rooms, we believe that the control room at Soundcastle is our maximum effort in state-of-the-art design. We decided to build Buddy a true stereo room. (Although this room can be modified for quad, it is still basically a true stereo control room.)

After being involved with many control room designs, we have found quad rooms are too large. They are not appropriate for the long hours that are required for mixing. The monitoring levels have to be much hotter and the sound cannot be as tight as in a true stereo room and, consequently, they are more fatiguing for the people who work in these rooms than in a true stereo room. No matter what you do speakerwise, the definition in a quad room can never be as good as in a stereo room.

BUILDING: In 12 years of designing studios throughout the world, Buddy's building was the most unique type of shell I have ever encountered. I had to treat him with respect because it took a particular kind of individual who would buy a building like this. In the field of architecture, this building will be of great historical significance.

In the back building, because of the large area of glass approximately 17-feet high and approximately 70-feet long, you are made

aware of the exterior environment — the trees, the gardens, etc., so I decided that the studio design should incorporate this same attitude. We concluded a studio design which also had one wall consisting of two independent walls of glass would permit an unusual opportunity for the musicians in the studio to be affected from the outside light, in both a direct and indirect way. Acoustically, this large amount of glass provided a unique opportunity of acoustically tuning the room by the use of draperies of various densities to the needs of the artist. Because of the juxtaposition of the glass walls, we have managed to diffuse the sound in such a way so that drapes for the most part are not really needed.

Redwood slat absorbers were used in areas to absorb the low frequency and yet reflect high frequency back into the room. This was done to give the room an open, airy sound without coloring the natural sound of the instruments. Some of the areas are bright, resonant areas, such as the wood parquet floor. Some portions of the wall are totally absorbent. I might also add that the bright, resonant floor can be acoustically tuned with area carpets.

The ceiling is tuned in different areas, but basically 25 per cent of it is reflective. We mentioned the glass wall on the left side affording the opportunity of being tuned by drapes. Even though the wall on the right side looking out from the control room below the canopy area is fairly dead, it has been acoustically tuned to be both reflective and non-reflective. This was done so the artist had optimum separation but would still give him the feeling that he wasn't playing in an anechoic space.

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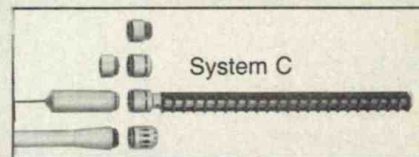
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you're entertainment. They might look in sort of a half-hearted way because of that.

In my experience, I found the large brokerage firm of Coldwell Banker was the most useful. Because of its numerous offices, Coldwell Banker could help me investigate just about any area I was interested in.

Another thing that I discovered was that it's good to have the broker meet the person who is going the acoustics for you. The broker gets it first hand that you're not really a kook . . . there's a reason that you're looking for such an unusual building.

Though my comment about brokers tends to be negative, don't misunderstand me. A broker can prove to be valuable. My point is — don't expect too much.

A Possibility In Anaheim

About nine months after finding the Anaheim building, I came across what proved to be the second building I was serious about. It was located in the City of Orange, again in Orange County. To summarize its qualities, let me say it had a 14-foot high ceiling, 3,300 square feet, two walls that were cement (six to eight inches thick), and air conditioning. There were a couple of rooms that would have been ideal for offices, two bathrooms and a rear loading door that could be very utilitarian. It was very conducive for the medium-size studio that I wanted.

George came in and gave me a favorable



Glass on one wall of Soundcastle's studio allows both direct and indirect sunlight for the environment. Arranging microphones is Buddy King.

evaluation. He pointed out there were railroad tracks nearby that would pose a problem but not all the time. He substantiated that by giving me an example of another major studio near railroad tracks that, every time a train goes by, can't record. This other studio worked around the problem without great difficulty, he told me.

At this point I began to realize how valuable George was . . . beyond just his acoustic expertise. In my contacts with studio designers and other acousticians, I found them very much like musicians. They had a tendency to hype a situation. With George there was no hype. He was very pragmatic and gave me the answers that I needed without trying to sell me a particular point of view.

Anyway, the building in Orange had many good qualities and overall I would say that it was nice. Although it would have been ideal for a studio, in the final analysis, it was still in an industrial complex . . . and that type of location just didn't have magic, to my way of thinking.

Also, it was an Orange County location. The input I was getting from musicians at this time was that Orange County is too far a drive from Hollywood and the San Fernando Valley, where they live. I had heard this type of comment for years operating my home studio in Huntington Beach.

The industrial complex aspect and Orange County location caused me to dwell on a decision . . . I'm always dwelling on decisions. In the meantime, someone else came along and took the building.

Hollywood Is The Place

My thinking at this time was bringing me to the conclusion that I did want a Hollywood location for my studio. All kinds of artists record in Hollywood; it's not at all specialized. I liked that. I decided that after I lost that second building I had learned one thing: I'm supposed to move out to the Hollywood area . . . which I hate. But that is where the action is so this is where I should be located.

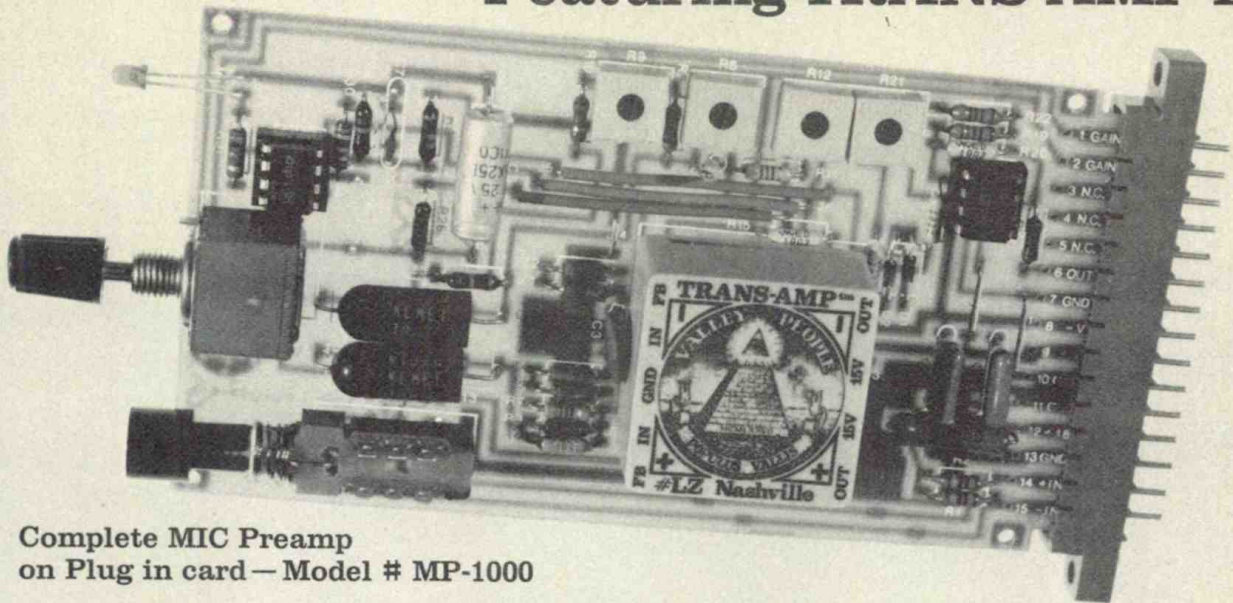
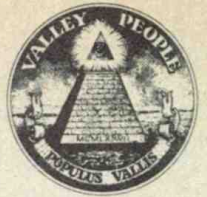
I decided that as long as I have to be in Hollywood, I'll be in North Hollywood — I

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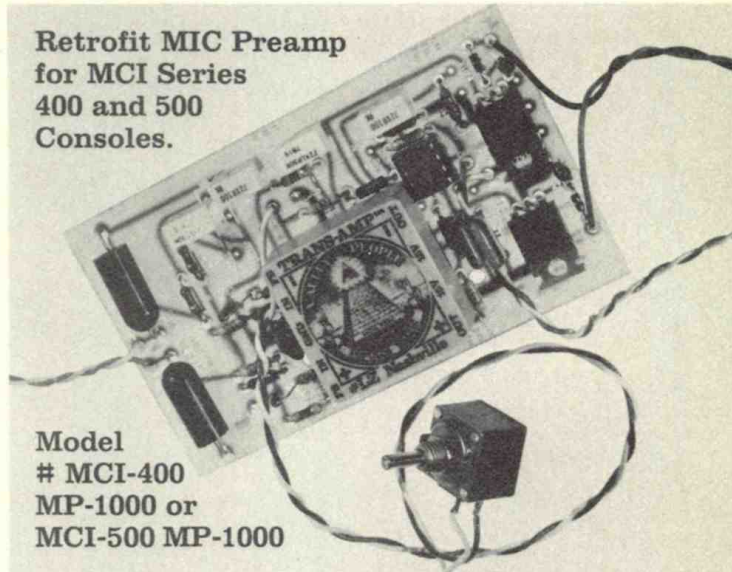
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like the neighborhood better. It's in the San Fernando Valley adjacent to Hollywood. That seemed to be a pretty good location for what I wanted.

Now that I had made up my mind where I wanted to be, I again turned to the newspaper to help me get better acquainted with the area. I found the largest regional newspaper — *The Valley News* — to be the best source for real estate classifieds. *The Valley News* listings were five to ten times as much as *The Times* for that area.

Dealing With The City

During this period, I was still operating the studio out of my house and scouting locations whenever I had a chance. The City of Huntington Beach was on my back telling

'Don't Worry About Saws . . . Worry About The Trucks — That Low Frequency Rumble'

me to move, but I still wasn't ready.

I panicked when this business with the city first came up, but a lawyer advised me how to handle the situation. One thing I found out from the lawyer was that the city could make me leave, but I could make it a long, expensive process for them. One reason for this was that I was a home owner paying property taxes and state taxes on my business.

In fact, paying state taxes on my

recording business may have brought me to the attention of the city. A portion of that state tax goes directly to the city; nevertheless, I had been advised to pay my state taxes or else risk more serious legal problems. When "discovered" by the city, I got a license to operate my recording business, though I must confess, I had to "fudge" in a few places when filling out the form for the license. This was all related to building code.



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*See Modern Recording "Hands On Report," Sept. 1978.



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To bide time, I let the city know of my position — recording was my livelihood. It cost me so much to operate and I couldn't be out looking *all* the time. I made the city aware of my previous efforts at relocating and that I knew that I had to move.

Keeping open communication with the city and being honest helped me, I feel. I would call them every other week and then, towards the end, every other month. I also sent a few letters acknowledging that I appreciated their understanding.

At the same time, I found out what the major complaint was. The major complaint was not that we were creating sound that was getting out . . . it was that people were leaving at three, four or five in the morning. The shutting of doors and starting of cars was the big problem. I immediately stopped recording after midnight. I also asked people who did come for evening sessions to drive over in as few cars as possible.

This is how I got the city to stretch a few weeks into a few years.

Looking In North Hollywood

After about two months of intense search in North Hollywood, a broker steered me to a place that seemed to be the best of all possible worlds. It was in a small industrial complex that had another studio, owned by a major label. The other studio might have bothered some people, but it gave me a sort of security as far as my choice of locations.

The building had 5,000 square feet of space and a ceiling that was 14-feet high. The walls were cement tilt-up, which is something I wanted. Tilt-up would mean less dry wall would be needed, which would save me money in remodeling. The roof bothered me because it had been built as a machine shop so it didn't have much insulation up there. That meant that the second ceiling I would install during remodeling would have to be exceptionally soundproof. Because it had been a machine shop, I would have to tear out a lot of wiring and I really didn't like that. I felt that I could get two rooms in it because of its size. I liked the two heads. Parking amounted to only four spaces and I think something on the order of 20 is more appropriate. But the city was breathing down my neck so I was willing to make some sacrifices.

George came in and said it was okay. The ceiling was low, but we could work with it. I had been concerned about the whine from a rip saw of the furniture manufacturing firm next door. George said, "Don't worry about the saw . . . worry about the trucks — that low frequency rumble. That's the most expensive thing to get rid of."

I learned that an ideal location had no truck traffic, was set back from the street, had no rear or side traffic and no airplanes. If you've got a lot of traffic vibration because you're on a busy street, you've got to float the floor. There's no reason to float the floor, though, if the location doesn't require it.

To cover my bases, I put down a \$1,000 deposit, though I still wanted a chance to look around. How to handle deposits brings up another thing I learned in looking. I always wanted to allow myself contingencies so I could get out of a deal. When putting down a deposit, the contingency was always this: This property must meet the approval of my acoustician. It must be feasible to turn this property into a recording studio. There was usually some negotiation on the wording of this clause, but I always made sure to get it stated so that I could get out of any deal.

Escalator Clauses

Another negative point to this North

Hollywood building came out in early negotiations. First of all, in any lease, you want to get an agreement for a period of five to ten years. You're marrying yourself to a location because of all the acoustic improvements you will have to put in.

Leases are going to have to have escalator clauses because of inflation. There are many kinds of escalator clauses and this is a critical point in a lease, particularly because landlords don't like to make such long-term leases in the first place. I was looking for a lease that would tie future increases to the general cost-of-living.

Escalator clauses can be tied into things like the appreciation of property values in an area. It can be tied into inflation of



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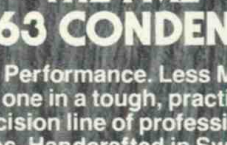
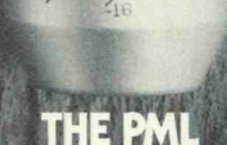
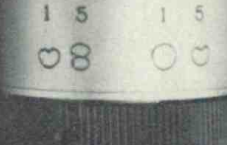
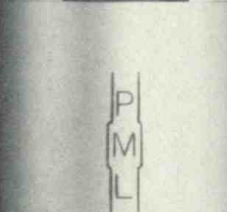
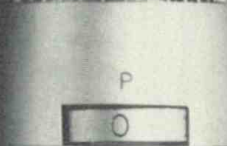
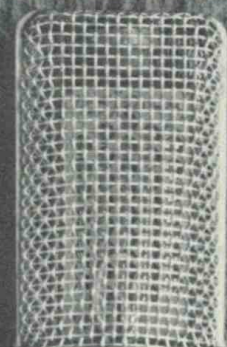
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construction costs alone. One most hazardous escalation clause is to have it hinge on future rents in an area — rents in buildings that haven't even been built. I discovered that everything was twisted to be at the convenience of the landlord, not the tenant.

That's what they tried to do at this North Hollywood location and it really bothered me. We negotiated on that point for several

had not planned to buy a building. Every building I had looked at involved a lease. My original thinking was that I only had enough money to build a studio, much less buy a piece of property.

George looked at the building and was quite enthusiastic because the structure had a lot to offer. It had more than enough air conditioning. The rear building, which I envisioned as the studio, was 140 feet from

A Visit To City's Planning Unit Reveals That A Nearby Airport Is To Be Enlarged

weeks — to get rent escalations tied into the general rate of inflation. Overall I found that the more sophisticated the building, the more they try to get sophisticated contingencies with their lease.

Also, when you're looking at a building, you go to the city planning commission to see if there are any urban renewal plans three years, five years down the road. A freeway could be built there halfway through your lease. All this information is there for the looking. In the case of the North Hollywood building, I found out that there was a master plan to enlarge the Hollywood-Burbank Airport nearby. Houses were going to be torn out and air traffic redirected. The building was on the fringe of all this activity.

We were near concluding the agreement and I told the broker that I would be over in a couple of days to finalize arrangements on the lease. Still, the whole thing didn't feel right.

The Search Continues

I continued to drive around looking at buildings, stalling on the deal for the North Hollywood building. I'm at home one day sitting on the head going through the *Times* checking the real estate ads. I find a place and it sounds pretty good, but then I've read ads about a lot of places that *sounded* good.

I was shown this building and it was absolutely fantastic! The moment I walked through the gate it hit me. This place has *magic*. It was in the Los Feliz-Silverlake area of Los Angeles, five minutes drive east of Hollywood. The area was a mix of residential and commercial structures. There were two buildings on the site with courtyard/parking separating them. After four years, it's too good to be true. It still cracks me up a little even now when I think about it.

I got my \$1,000 back on the place in North Hollywood and began a negotiation period for the new place that lasted three months. In those three months we dickered over whether I could lease or buy it, or rent with an option to buy. We also negotiated over a down payment and total buying price.

You must remember that up to this time, I

the street and had no side or rear traffic. The building was so ideal for a studio that the savings it offered me compared to the North Hollywood location would almost pay the down payment.

The property had been owned by three partners, and the one responsible for building it had passed away. Because some of the heirs wanted money and for tax reasons, it was for sale. I found out from the original surviving partner that the man who had built it had been something of a perfectionist, like myself. The property has an aggregate driveway and clear redwood in both structures, so the builder had gone first class all the way.

The building won an American Institute of Architects award when completed in 1969 "for excellence in design and execution." The award is given only once every three years. The marketing department of JBL had been a tenant for a year-and-a-half.

The Plot Thickens

Two things occurred during negotiations that complicated the situation. First, the broker hinted that someone else was interested in the building. Then, as I was looking in the *Valley News*, I found another building that I liked in North Hollywood.

To investigate this second North Hollywood building, I followed what had become my normal procedure. I always go to see who the neighbors are. I would introduce myself and say I want to build a studio. "What do you do?" I would ask. "Will you disturb me? Will I disturb you?"

Another thing I would do is "babysit" the building 24-hours-a-day. It just so happens I was in my car in front of the second North Hollywood place at 1 a.m. one night when the fog began rolling in. All of a sudden, airplanes started passing overhead so low that it just scared the heck out of me. I had discovered that under certain weather conditions, air traffic from Hollywood-Burbank Airport is redirected and planes fly right above the building I was looking at.

Though I had to rule out the second North Hollywood building because of redirected air traffic, I had already met with its owner. He was a prosperous business-

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man who had built the little industrial complex where the building was located. He took such a liking to me that at one point he offered to become my partner and even build me a facility from the ground up. I gave it serious thought but declined. I really didn't want any partners because there's always accountability when you go that route . . . and that takes time.

But through several conversations over the phone and during business lunches, he taught me how a shrewd real estate investor thinks. I was going to school on his experience, whether we realized it or not. It's hard to nail down what he imparted, but his general approach and attitude toward money were most enlightening. In fact, he gave me advice on how to close the deal for

the Los Feliz-Silverlake building.

So I began negotiating with renewed vigor for the Los Feliz-Silverlake building. Whether or not the broker was giving me a bunch of hype about a second interested buyer, I realized that after more than four years of looking, it was time for me to "put my balls on the line." I went in and made an offer that the broker told me she thought she could make a deal with. At this point the negotiations had gone on for two months and the seller had the chance to meet me and view the rough plans that had been prepared.

I had been quite honest and straightforward with the broker all this time. She knew what my financial position was. I didn't try to "outsmart" anyone; I didn't give her any

hype. By being straightforward, brokers can get good insight on where you're coming from and then they can negotiate successfully for you. I feel that I got one big break in that the owner carried everything on a first mortgage — originally the seller had wanted to get a second mortgage. The broker negotiated no second, which meant a tremendous financial break, along with a slightly lower down payment.

That's why I think it's very important not to be pretentious. Be yourself.

The final deal hinged on the contingency that we could come up with plans that would allow me to make a studio that I could afford. I'm always covering my bases and, in this case, it gave me a 45-day reprieve before my payments would start. I figured that I would immediately start to remodel the place myself. I was simply going to hire a carpenter who would direct me and some friends. We were just going to build a control room at a cost of \$15 to \$18,000.

I had done a lot of investigation, a lot of reading on the subject of studio design and construction, and one thing really stuck out in my mind as a result of this research. A lot of people had made some pretty big mistakes. I read about a studio in Europe that spent over \$100,000 building a control room. When it was finished, they discovered it was too small so it had to be re-done. I had visited another control room laid out by a famous designer that was really too small for the console it had.

How could this happen, I thought? This was the thing that scared me more than anything else. I was paying for the whole thing myself and I could not afford one mistake.

Getting More Input

Prior to purchasing the building, I took a lot of people over to get suggestions on how to build the control room and then later, when finances permitted, construct a finished studio. I've gotten three general opinions on how to do this.

The rear building, which I planned to use for recording activities, is all glass, except for some wood paneling. One opinion I got was to take out all the glass and put in block walls. Another suggestion is to expand the building out by the control room, which would mean taking a specimen tree out. This would give us more space and create an L-shaped, European-style arrangement.

I opted for the third suggestion. It called for building a wall inside the glass, then taking the glass out and boarding it up. That's how we were going to attack it.

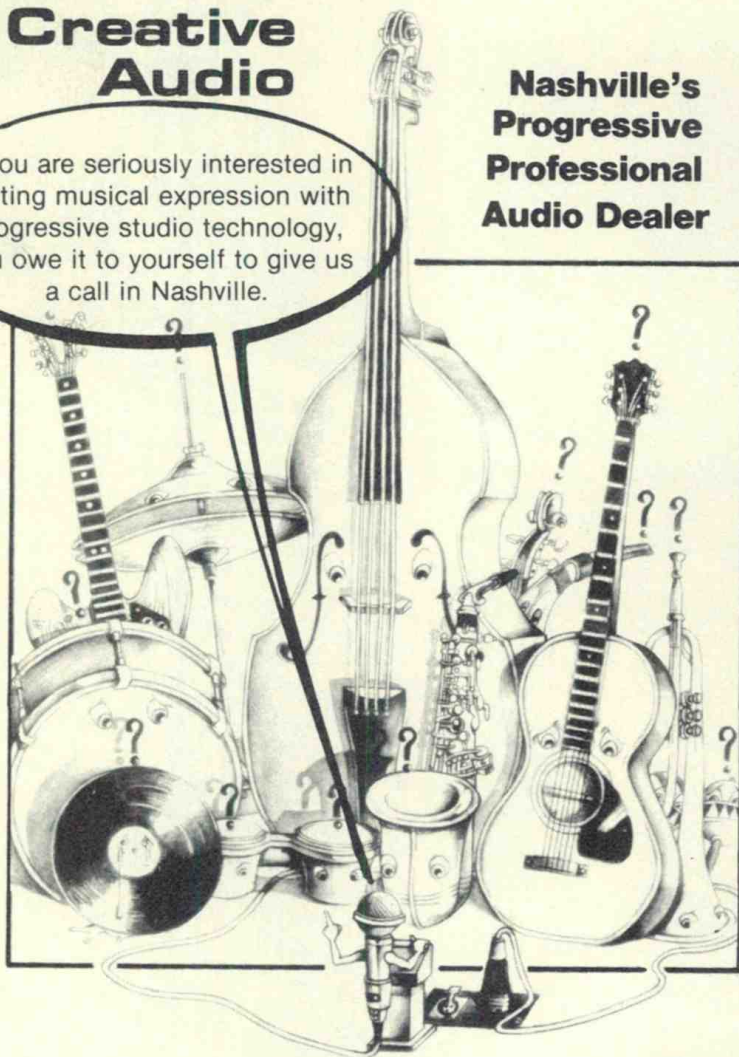
The architect for the project was a friend of mine — a musician who also worked as a draftsman studying to become a licensed architect. He was doing subcontract work for many architects designing houses. Even though he had never designed a studio, I was confident that he could do the job. Besides, George Augspurger would make sure that the room was acoustically sound,



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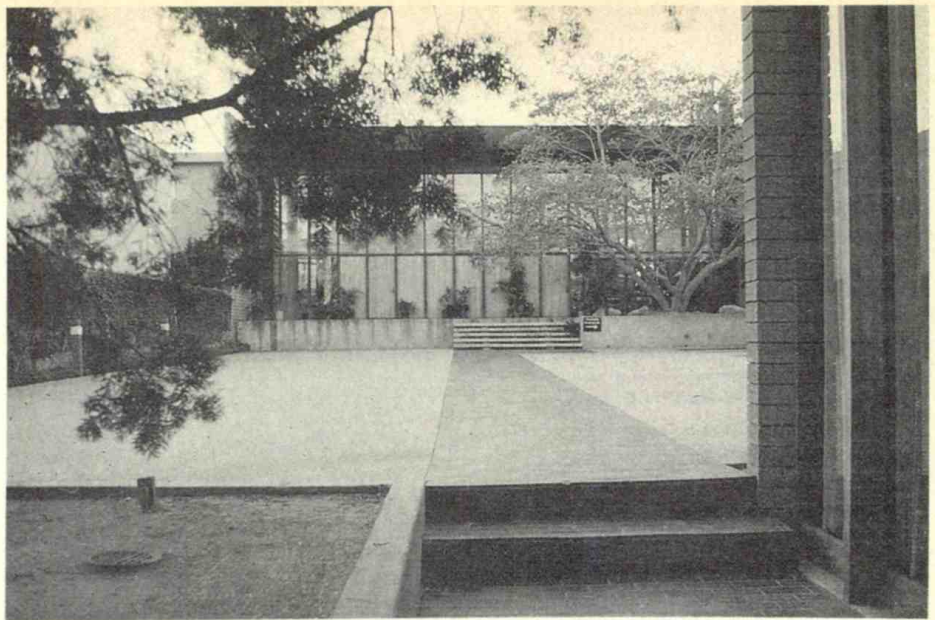
no pun intended.

Because of the aesthetics of the building, we came up with some arty designs. The first design called for excavation of two feet for a sunken control room. The reason for doing that was that on the side of the building with the control room there was a loft with a kitchen upstairs.

A short time later we discarded that plan. The reason I abandoned it was that I had talked with several producers, engineers and musicians, and I came to the conclusion that even if it were better, it would mentally throw off the people who come in here. Everyone is looking for some sort of common denominator in studios because sound can vary from studio-to-studio. If producers, engineers and musicians see that the control room is very different, they could wonder if there are other things here that are different that *they can't see*.

So we decided to take the loft out and design a conventional state-of-the-art control room. In the meantime, my 45 days are gone and the payments start. I thought I was going to be done in two months and I've already lost 45 days. Originally, too, I had a plan that allowed me to build my control room and sit one year without any income, if necessary. But because I had to buy the building and because of something that was to happen very shortly, all that money for a year was spent.

Once the second set of plans were drawn up, my friend the architect went down to



The building used for recording is set back 140 feet from the street at the rear of Soundcastle's fully-enclosed lot. The courtyard provides parking.

city hall and got the blueprints approved with no problems. I hired a carpenter who would direct me and musicians I had worked with in the past. The way I was thinking at the time, all you had to do was go to the store, buy some two-by-fours, some nails and some hammers, and then build yourself a studio. That was it.

At the time I hired the carpenter, another

person made a big commitment to work on the studio full time. Rick Donaldson is an engineer who had worked part-time for four years at my home studio while holding a job at Altec Lansing. He quit his job at Altec Lansing because he wanted to get more experience in actual recording. He was designing consoles and thought that the experience in recording would help him.

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Something Just Isn't Right

I've got the materials and personnel lined up; everything is set. And for the first time, I take a hard look at the plans. They're not right even though George Augspurger saw to it that acoustically the room was satisfactory.

The thing that bothered me was the lines. That's a hard thing to express when you're looking at plans. The lines did not *feel* right. It was aesthetics and that's a very personal thing.

At this point, too, time was my enemy. I had planned to have the control room finished about this time and construction hadn't even started.

I talked with the carpenter, Rick, and a few others about this. Overall, the input I got was that there is no problem. But I could see that the lines were not right.

When I was negotiating for the building, I had asked Glenn Phoenix, of Westlake, to look at the building and tell me how he would build a studio. He had stopped over several times and even brought some friends to look at it. I took my second set of plans back to Glenn and told him that they just didn't seem right to me. He agreed. So I asked him how he would do the project.

The Westlake thinking is they take a particular type of design and modify it to fit a structure. They are constantly refining it but it's basically the same design. His design called for putting up a wall which would leave space for a foyer.

This would keep existing floor-to-ceiling glass on the wall to the outside. Now I liked this idea.

One of the producers I dealt with while at my home studio was Al Perkins, who told me that when I moved, it would be nice to have some glass to the outside in the control room. I thought the idea was a little crazy at the time. What Glenn Phoenix was suggesting was along this line of thinking.

I believe one reason you don't see this

Using Two Panes Of Glass Isolates The Studio Room From Noise

kind of thing is that conventional thinking says a studio owner does not want the client to know what time it is . . . how much time he's buying. You don't want the client to see the sun setting or rising. You want to get the client in there, then make him as comfortable as possible so he spends as much time as possible.

There is merit in this line of thinking, but then the relaxation of a musician is very, very important, too. Letting light in from the outside is a nice way to keep clients in

contact with reality, so that's the philosophy we adopted in the end.

Since Westlake was very busy at the time, George Augspurger suggested that I talk with architect John Edwards. John came over and was really impressed with the building. He was literally knocked out. I showed him my second set of plans that had already been approved by the city. He said, "You're absolutely correct. The lines are wrong. You want contemporary lines that blend in with the architecture of the existing building. And that's what you *don't* have here." He agreed to take the existing plans and clean them up.

As John changed a few things here and a few things there, he found it wasn't jelling. The basic plans weren't consistent with the architectural integrity of the building. This was precisely what had concerned me. As an architect, this was the thing he was extremely interested in also.

The Pieces Fall Into Place

When this was all happening, John was involved in several projects for studios around the world. He put these other projects in abeyance for a short while, and put himself and his two men on my project. In a few days he called me to say he revised the plans completely. "You should also build the studio at the same time you build the control room," he told me. "Both of them should mesh together. The building calls for it." He said he had been in the head the night before and it all came to him. When he told me that he was thinking about my studio while he was in the can, I *knew* that this was my man! He was thinking about my project on and off the job. People like this are very, very rare.

I had gone through somewhere between 80 to 100 drawings for the control room in five months. All the time I had been negotiating for the building, I was looking at designs and changing them. I went over to see what John Edwards had prepared. It was the first time I saw something that made me say, "Yes, this is home. Let's go with it." With that, my plans for an economy control room went out the window. We were going to build two first-class rooms.

John's philosophy was to work with a structure and let its style dictate the design of the control room and studio. For instance, the building had an exterior wall that consisted of glass 17-feet high and almost 70-feet long. This wall of glass was incorporated in John's design. It was George Augspurger who told us how to do it — by using two panes of glass. That way, noise doesn't come inside.

Once John revised the plans, he advised me to take them to city hall for approval. It was his feeling they would be more lenient with me, as builder/owner. We decided to just take them the plans for the control room at first, so there wouldn't be any delay. Because I was behind schedule, we had started construction before a complete set

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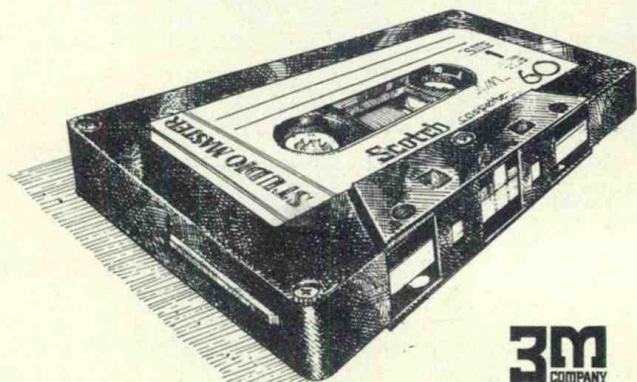
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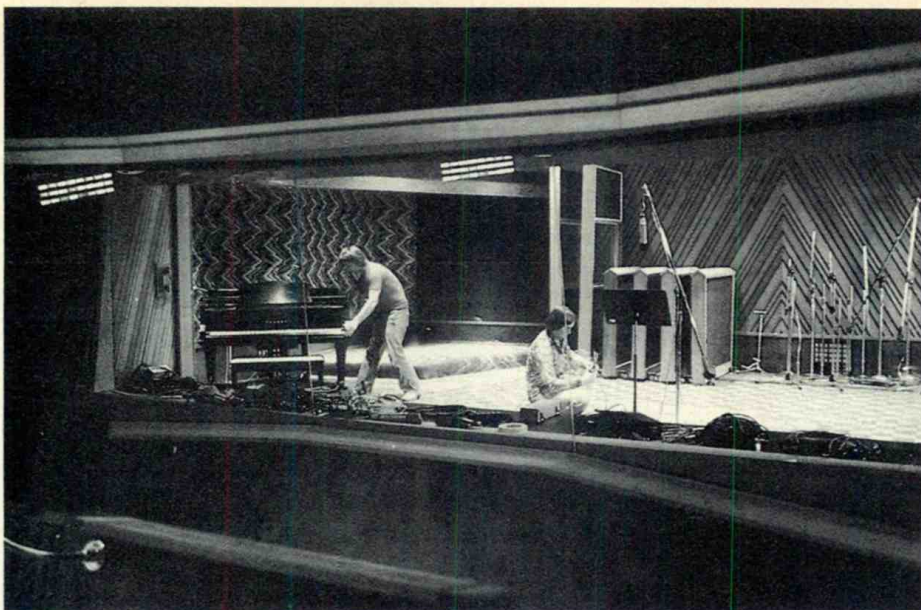
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A view of the studio through the control room window shows Rick Donaldson (kneeling) and Buddy King setting up for a session. At the right is the drum and piano traps which are under a canopy.

of plans was ready.

I had the same inspector that my friend who did the first two plans had, so I'm not worried. But in line there I hear one of the builders in front of me say, "This guy is the worst SOB there is. He's got me doing ridiculous things; he's already slowing my project." Every month I was down and didn't get started was costing me about \$6,000

plus I'm losing business.

Dealing With The Building Department

When my turn came, the inspector was really confused with the plans because he was unfamiliar with studios. It's his signature that approves a structure going up so if something happens, I guess it might be his

neck. He takes one look at my plans and directs me to his supervisor, who I promptly see.

The supervisor tells me, "Well, I don't know why he had you come here." But the supervisor agreed to help me fill out the form to be nice. We started figuring costs and he asked what I thought it would cost me to build the control room. I told him \$25,000.

"What do you mean \$25,000?" the supervisor told me. "That's a \$50,000 or \$60,000 room." I told him I could do it so he reluctantly put \$25,000 down. When we're done with the form, he sends me back to the inspector.

The inspector said he was going to send the plans to engineering and that could take a month or so. I'm almost in tears. I'm not yelling, I'm not screaming. But I'm pleading, "Hey, what is this?"

Another supervisor just happened to be passing by and hears me. After taking a look at the plans, the supervisor says, "This is very simple. Have him do this. Have him do that . . . and that's it." This supervisor was there for three minutes and saved me time that amounted to thousands of dollars.

The things that they were concerned about included the weight of the structure on the cement . . . to make sure the load wasn't too much. They also wanted to check the span to make sure that the 2-by-12's that we were using were fine. I was asked to bring engineering reports from the

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truss manufacturer and other material suppliers, which I did. All this would move "responsibility" from the city building department to the material suppliers.

I think the main thing that really helped me deal with city hall was that I was mentally prepared *not* to let it get sidetracked. If I had not been prepared, it would have happened so quick that I would have been blown right off my feet.

Probably the reason that the plans drawn by my friend before were approved so quickly was that they were so simple. Things weren't spelled out. John Edwards' plans were more elaborate and left less to be imagined. It was two pages compared to ten pages. Being more detailed, they scared the city inspector.

Working with the city is a funny thing, too. They've got their rules to go by and their rules don't include building a studio. Constructing a studio is one of the last forms of custom, creative building and there just aren't a lot of rules to guide you. Building departments are just not used to seeing things like walls with four and five layers of gyp board.

The Carpenter Determines Exactly How Blueprints Will Be Executed

We had just experienced a delay of two months revising plans and this intensified the demands on the building program. Work continued, with the carpenter I had hired supervising me and friends, who were inexperienced builders.

The carpenter was a man in his late 20's from New York. He hated "hippies", which he felt included some members of the crew. I had interviewed 14 carpenters before selecting him. He had worked on the Senate building in Washington, D. C., Disneyworld, in Florida, and big projects here in Southern California as a foreman in charge of many men. He told me, "When it comes to wood, I can build *anything*." When he told me this, there was something that made me believe him. As it turned out, he quit three times in the next four weeks.

Two 'Madmen'

There were groups of as many as 12 persons working at one time. We started a few days behind John, who was putting the finishing touches on the plans, and then got ahead of him. The reason, to be perfectly honest, was that I was very intense and began running a very intense building program here. I was crazy. The interesting thing was that the carpenter that I had hired was crazy, too.

He had an ego. All of a sudden this was *his* studio and that's where friction first started. He didn't want anyone here building when he wasn't around, though he didn't come out and actually say this. Well, because it's my studio, I was working here 12, 14, 16 hours a day. I had hired the carpenter to work 10 hours a day, five-and-a-half days a week. He was here seven days a week putting in days longer than 10 hours.

Even though we were ahead of John, we were able to work things out over the phone. Since he was only five minutes drive away, he visited the site, too. I found that there are so many things the architect cannot put on paper. And there are so many things that he *does* put down on paper, it requires conversation. Unless you've got a carpenter that's built studios before, he doesn't know what the architect is talking about in the plans.

This brings up another point. I did not realize that when a carpenter comes in, he is like a god. You don't do or say anything to upset him. He presides over the project and it is his interpretation of the plans that is the final authority. His consul is even sought by the architect.

I wanted our carpenter to feel like he was a part of what we were doing so I began to let him handle cash. I gave him a couple of hundred dollars because we're always running to the store for something. Then, he wanted to write checks. I went down to my bank to make sure he couldn't cash a check over \$500 and let him do that also. This seemed to give him a feeling of importance and I think he needed to have this.

The carpenter was working very fast, too. John Edwards said, "I've never seen anything like this before. You've got a working fool there."

Learning The Ropes

In this early stage of construction I learned a lot.

First and foremost, everything is a crisis. I don't know why but it got to be an everyday occurrence. Is this wall right? What's the air conditioning going to do over here? When are we going to do this . . . when are we going to do that? And you really don't know the answer to these questions. I can say this. All the trouble you have making an album is nothing, and I mean *nothing*, like building a studio. There's just no comparison.

Early on in the game I found out that everything in construction is bargain. Workers. Supplies. Everything. I don't care if it's a small Mom-and-Pop hardware store, the carpenter taught me to bargain.

It also became apparent that certain people are more proficient at certain jobs. With an average of eight persons working at one time we found that it was essential to get the right person in a job. As an owner/builder, this is a simple way to increase efficiency and thereby cut costs.

We found some guys were really good at putting up dry board or good at framing or

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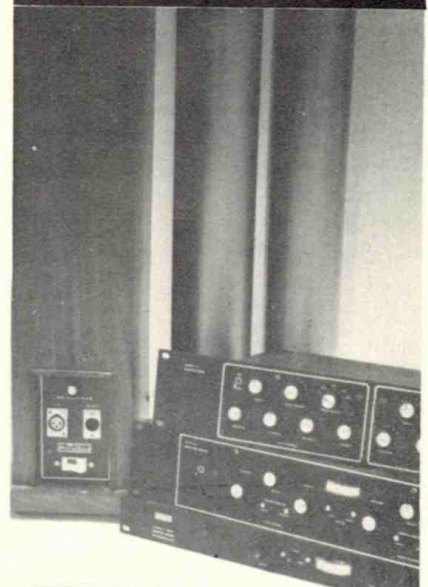
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good at sawing. I can remember that some guys had a real knack for taping. They'd take their time and not leave any wrinkles.

The logistics of the project were mind boggling. My 70-year-old Father and another guy spent every day running errands. It never ends. When they came back, there was always something else to get. We had to do business with four lumber companies for the things we needed.

Electrical Work

When we first got started I had planned to job out the electrical work to some friends who were in the business. I called them and found out that they couldn't help me out.

I asked Rick Donaldson, who had been working for a week, if he had done any wiring before. He answered no. I asked if he thought he could wire it — and I'm talking about wiring for the building, not audio equipment. I'll never forget his answer. He said, "I guess I would if I had to. But I would really hate to do it." I said that I was really sorry to ask, but that he should go ahead and do it.

Rick is anti-government and anti-bureaucracy . . . and he had to deal with the electrical inspectors from the city. It was always change this, change that. Are you doing this? Are you doing that? And Rick was up on it sometimes more so than the

inspectors in many areas. So it was frustrating.

If you're wiring a commercial building in the city of Los Angeles, you have to hire a licensed contractor. We got a contractor who was the friend-of-a-friend of someone helping me. We made a deal that we would do the principle work, which he would check before the inspectors came. This was an enormous savings because that kind of work, done entirely by a contractor, can run to \$25 an hour.

Also, at the time we were building, there was a shortage of insulation and some other building supplies. I had called everywhere, including another state, trying to get some insulation. The carpenter got on the phone at night and found some without any problem. It was things like this that, whenever we got into a bind, he worked it out.

There was one thing that the carpenter could not work a miracle with that came soon after the plans for the studio were approved by the city. We had to put one layer of wall board and one layer of sound board on the studio ceiling and the carpenter said it would take two-and-a-half days working around the clock to do this. It's a very slow process because you have to lift the boarding over your head while you're 20 feet in the air.

I'm in a bowling league with a gyp board installer and tell him about this. He says, "We can do that job in two hours. I'll come down there with a friend of mine and my son, and we'll do that whole ceiling in two hours." My carpenter couldn't believe it and even wanted to bet \$100 that they couldn't do it. John Edwards didn't think it was possible either.

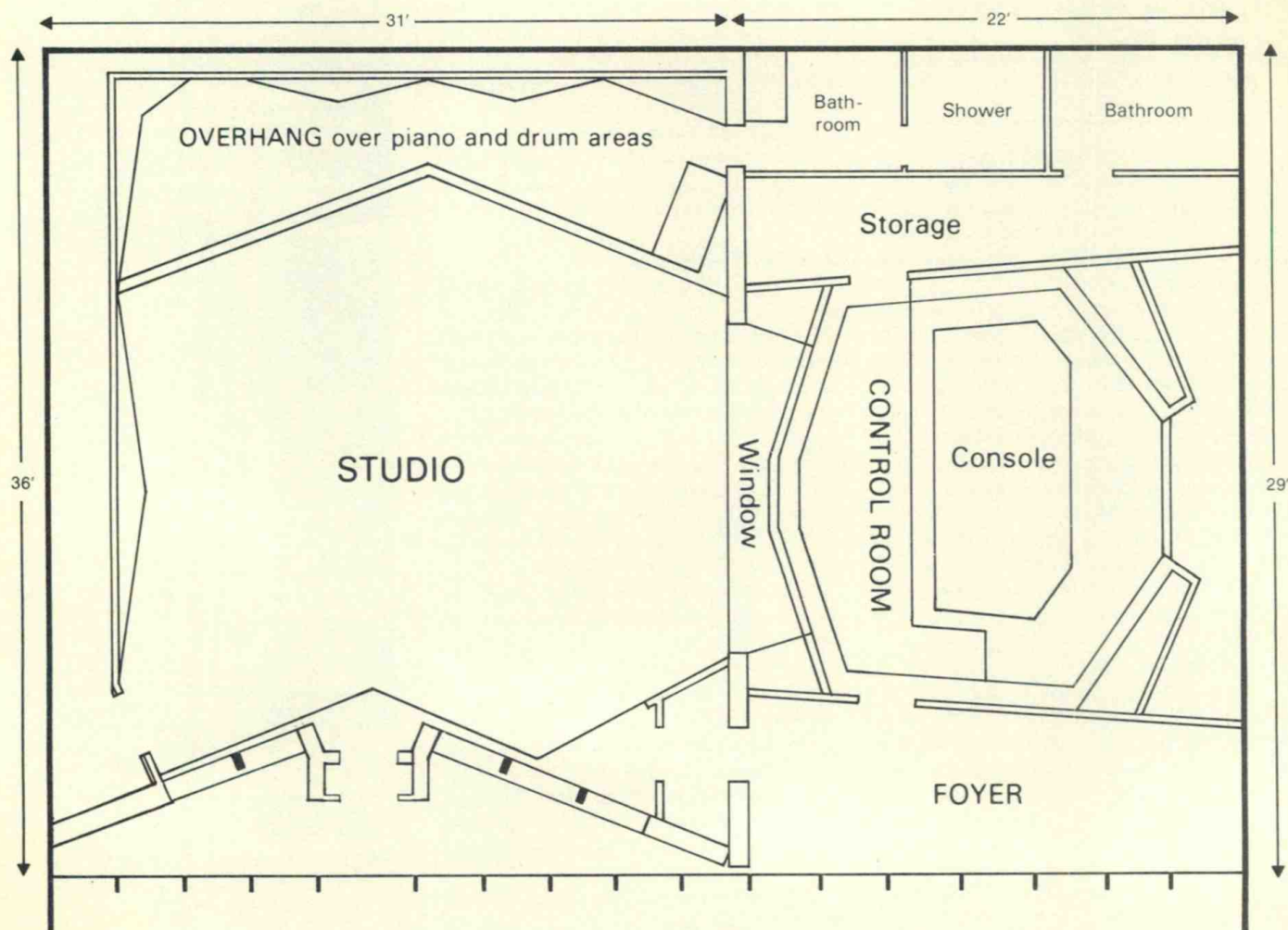
To make a long story short, they came down here and did the whole thing in a little less than two hours. These guys work 200 and 300 feet up in the air so nothing fazes them. After we got the studio up, they helped me put up my second ceiling, which is wall board, sound board and wall board. The work was done for nothing.

It was things like this that would happen that would help us along. My carpenter couldn't believe it . . . Jack Edwards couldn't believe it. I was just lucky.

Soon after that, I began having more and more trouble with my carpenter.

Finally, the second time he quit I started to check out his references, which I should have done before. I found out that only one of them checked out. He had never worked as a foreman; he was just doing odds and ends.

When I got this input, I spoke to John Edwards. He told me, "Buddy, I've never seen anything like it. You've got a whiz



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down there." I came to the conclusion that I've just got to let things continue because it's to my advantage. The carpenter is working for peanuts and putting in 14, 15 hours a day seven days a week, though he's hard to get along with.

Tension Increases

All during the construction I was checking everything that went up very closely. I questioned some of the walls that the carpenter put up because they didn't seem right. I questioned this and that. Sometimes, if I wasn't watching closely, he might take what I thought was a shortcut to make something easier. By the same token, the opposite was also true. Every carpenter interprets the plans with his own final touch. Sometimes he was putting in four layers of gyp board in a place where the plans called for one layer. But he complained that I'm too critical.

After the third week, the carpenter's relationship with John Edwards began deteriorating. By the fourth week, his overall enthusiasm and zest for work as well as the knowledge he pretends to have are wearing a little thin, too.

The third time the carpenter quit I can sincerely say he did it because he was working himself to death. He was trying to out-work me but he couldn't do it because I was being driven by something that was abnormal. I talked with John Edwards about this, and he suggested that I make a change,

though I didn't want to lose the carpenter until I had a replacement.

I went over to the carpenter's home after he quit the third time because I couldn't afford any down time and he was the only experienced builder I had. I told him to start with complaint number one and go down the line. Crud, we got to 23 before he quit. Then I asked him what it would take to get him back to work. He said, "I don't want to

the plans. Then I asked them what they could do. They said, "Hey, man, we can build anything with wood." I had heard that before.

I hired them and decided to let my first carpenter go. I learned another thing when I started going to our various suppliers. I had not realized that my first carpenter had really been representing me, the builder/owner, to these suppliers — who I had met

'But It Seems Like Everytime I'm Hiring Carpenters, I'm Buying Tools'

see you around the property." I told him, "You've got it."

When John Edwards heard the news, he said that he was glad I got the carpenter back because I wouldn't have any down time. John said he would check up on things at the construction site. "In the meantime," he told me, "you continue looking for some carpenters."

'Anything With Wood'

My friend who had drawn up the first two sets of plans had been helping me build all this time and recommended two carpenters he knew as replacements. So I had a meeting with these two carpenters — they were in their early 20's — and showed them

when we started — and the carpenter did so in a very negligent manner. Some of the suppliers called him "a dumb asshole" because he was playing the big shot and this was a poor reflection on me.

So the two new carpenters came in right away and I didn't lose a day. The new guys are "funky" cowboy types. The first week, they worked like gangbusters and their attitude was terrific. They couldn't work eight hours every day because they were finishing another job, but that's okay. The only thing was that the first thing they put up, the soffits, were wrong. The building inspector didn't like it and it wasn't consistent with the blueprints. That cost us a day.

Another thing about the new carpenters . . . they decided that the saws we have just aren't adequate. It just so happens that the saws they want are going to cost me \$800. I want to keep the people who work with me happy, make them feel important, so I bought the saws. In fact, I told them that if they do what they say they can do, they could take the saws when the job's done. But it seems like everytime I'm hiring carpenters, I'm buying tools. The first one was the same way.

At this point, a new catch phrase was introduced. The new carpenters looked at everything and said, "Hey, man, we can finish this in two weeks." I was to hear that over and over for the next two-and-a-half months.

The last day of their first week, the carpenters charged me for eight hours. Rick, who stays out of the way and is very quiet, keeps his eye on everything as he works on the electrical wiring. He says to me, "I don't think they worked eight hours, I think they worked six." So we agree to keep an eye on them.

The next week we find that they are working four hours a day and charging for eight. It's a funny situation I had then. I didn't want to lose any time and to find the right carpenter is really hard. So it became a little game. I told them that I thought they only worked four hours and they would answer, "We did? Gee, maybe you're right." So they're playing games with me and I'm

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*CARL,
Here are some
thoughts on our thing!
Michael*

Notes-New Product Release

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The mainframe contains two readouts which display how much time is available in the memory and at what bandwidth. Three momentary pushbuttons control the operating modes which include computer setting of the sampling rate, manual setting of the sampling rate, and the initial set-up mode. The mainframe also provides 2 audio input busses and 2 voltage control auxiliary busses which are all accessible from each module. The memory "tap" switch bypasses the analog signal input and "taps" the memory being used by the adjacent module allowing the 2 to be in series without additional D/A and A/D conversion.

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playing games with them.

This lasted a little over two weeks and I decided to make another change. The second carpenters were fast, they were proficient, but they would make mistakes because of their speed. They didn't have a good relationship with John and blamed his plans for many of their mistakes. When I began to have trouble with the second carpenters, I was passing the word on to John Edwards to get his advice. He recommended some carpenters that he had used in studio construction before.

So we dismissed the second pair of carpenters. You know what they did? They put my \$800 worth of saws on their truck, told us to stick it up our ass and drove away. After three weeks and a few strong words, I got my saws back. Looking back, it just seemed that in studio construction you're dealing with people who are not as artistically inclined as recording people. For instance, take carpenters — it seemed to me that all they wanted to do was work, drink and fight.

I called up the carpenters John Edwards had recommended and they're Mexican-Americans. They go by the name Charlie Construction Company and Charlie, the owner, came over to give me an estimate. "I'm going to tell you something about Mexicans," Charlie said. "They take great pride in their work. It's a craft to them."

Well, I'd been burned twice by carpenters and now I've got some guy speaking in broken English telling me that he's going to bring over some craftsmen. I didn't know what to make of it.

Charlie continued, "The Mexicans love their work. They treat it with a lot of love. But they don't like to see the owner work." I

Charlie and I was able to make a pretty good deal. Charlie came in at a time when we were doing the finishing carpentry. They were putting up the things that *showed*.

There was only one problem. It took a lot of time. I'm not saying that they were slow; it's just that they weren't fast. You must remember that the first two carpenters were like buzz saws.

Rick Donaldson gave me the input that Charlie was sandbagging. But then everyone I had ever talked to — including the designers, Jack Edwards and his staff, and the tradesmen that I bowl with — told me that the finishing carpentry takes the most time. All these sources added that you *should* take the most time for the finishing carpentry. I stayed with Charlie.

The end was nearly in sight and I was getting anxious. "How long will this take?," I would ask. Two weeks was always the answer. I heard this for another month-and-a-half and it was hard to take. George Augspurger would come over to check the work and he told me it was great. I would ask, how long before it'll be done? He would answer, "Oh, about two weeks."

Finally, we got the finished carpentry done. Then the carpenters helped me put in the wood floor and we finished that.

I was still looking for good deals wherever I could get them. I got some \$25 a yard carpeting for \$7 a yard. I don't think it's hot. It came out of the house of a guy who sells carpeting. He had it there a month, then decided he didn't like the color.

I got five bids on floating the air conditioning. I selected the medium bidder because I like the way the guy talked. Because the air conditioning equipment came with the building, I figured we were saving money here anyway.

Installing The Glass

One of the hardest things to deal with in the final building stages came next. It was installing the glass for the window between the control room and studio. In talking to studio builders, I found that some had gone through as many as three glass companies on one job because the work wasn't good enough.

Dealing with the control room window installation, I would begin to see why studio building outfits have to charge \$100 a foot. With all the problems and taking on all the responsibility, I began to think maybe they weren't being really exorbitant, after all.

My Dad, who is retired, had been in the mirror business and, through a former business associate of his, I got a deal on glass for the control room. The glass was imported from Italy and I got it for about \$2,500, which is half-price.

It was being installed when one of my people chipped a corner of the mitered, half-inch thick glass. Then we find out that the dimensions of the window are slightly different from the blueprint — and the glass had already been cut. Finally, we discover

Xmas Slow Time For Builders: 'I Could Make A Good Deal'

didn't know what to make of that either. He knew that I had done the work up to this time myself. Was he trying to get more work for himself?

Working With True Craftsmen

I told Charlie that I wouldn't work that much because I didn't want to make a bad impression on his men. When he took over, he told his men what to do. I couldn't because they didn't speak English, although sometimes, I must confess, I did wonder. But Charlie was telling the truth. His carpenters, for the first time, were *craftsmen* and they were gentlemen.

Building a studio around Christmas isn't bad at all I found out. It was a slow period for

that the installers had mitered the glass all wrong anyway so it had to be taken out. There were six men I was paying \$40 an hour to install the glass standing around. The nearest replacement glass was in Italy.

So the man at the glass company tells me, "I'm going to send you my best man to straighten this out." The guy comes over and he's Mexican-American, too. Between these installers and Charlie Construction, all I can say is I had a really good experience with Mexican-American tradesmen.

At this time my equipment — a Harrison console and Ampex 24-track — were moved into the room. It was all new equipment that I had used at my home studio for a few months . . . to get the bugs out.

How we finally opened was kind of accidental. I had a chance for a project while we were finishing work. I told the client that he could record whenever he was ready; just let us know. I figured that was the only way we'd be able to do it . . . to have something to shoot for. As it worked out, Rick finished the console and outboard equipment wiring just hours before the first session. We started remodeling the week before Thanksgiving and this project came in March 1st. It took us just about three-and-a-half months to do the job.

In Conclusion

Looking back at the whole experience, I feel that we made the right decisions at the

right time — particularly in regards to carpenters. We got the best, and most expensive, carpenters right when we were doing the work that would show. We were very lucky in this regard.

I also feel extremely fortunate to have found my building. What I think usually happens to someone looking for a studio is that they are very particular at first about what they want but after they're battered

Surround Yourself 'With As Much Experience As You Can'

down from looking, they compromise. They settle for second or third best. I just wouldn't give up in more than four years of looking; if anything is worth doing, it's worth doing right . . . or not at all.

I think it's extremely important for anyone contemplating the construction of a studio to surround themselves with as much "experience" as you can. George Augspurger was the key to helping me find the right place. He encouraged me to wait, to have patience, because sooner or later the right place would come along. Working with John

Edwards & Associates made it possible for us to successfully complete the job expeditiously with largely inexperienced personnel. If it wasn't for John, I would have either gone broke or I would have wound up with a studio that I wouldn't have been happy with. John is also the one who urged me to expand my goals — build a studio as well as a control room that is state-of-the-art.

For the more than four years that I had been looking, I was getting to know as many people as I could who might help me build the studio. I was talking, listening and establishing relationships . . . getting ready.

I have my regrets. I'm sorry that I really never had a chance to enjoy the construction of my studio. I was under too much stress to savor it. I'm sorry I didn't have the money to have someone else build it, because I would have preferred that. But I'm not sorry for the experience. I learned an awful lot and I think this helps me cope with problems today.

I've been told that many others have tried to do the same thing and struck out. I've been told that I was extremely lucky. Well, I don't think things fell together on luck alone. The faith of myself and others working with me helped carry us through.

Do I think that others should build their own studios, if the situation warrants it? Sure! You're out of your mind if you do. You've got to be crazy.

But do it!

□ □ □

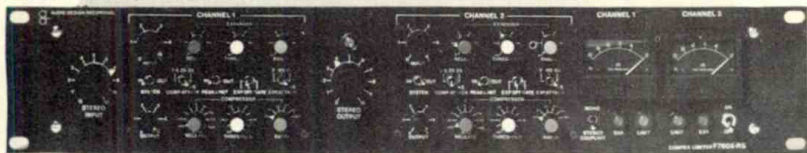
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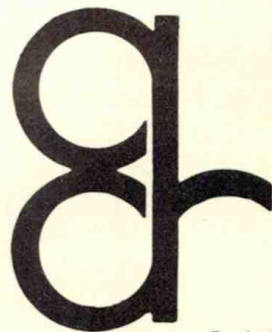
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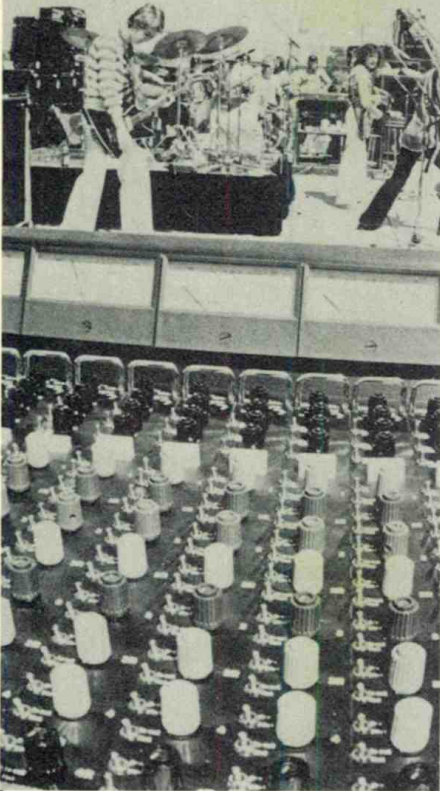
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* Lee De Carlo is Chief Engineer for 'Record Plant Studios' working with such artists as Aerosmith, Aretha Franklin, The Rolling Stones, Angel, and Frankie Miller.



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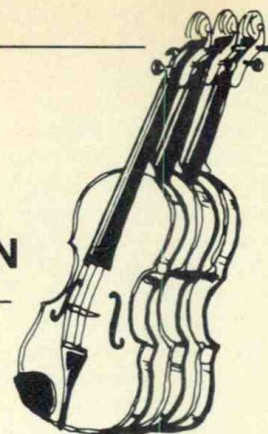
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RE-ORCHESTRATING A FEW PIECES INTO A FULL STRING SECTION

by Paul Lawrence



There are occasions when there is not enough time, money, players, tracks or whatever for as full a string sound as is wanted. In such instances, there are two alternatives: You can either go with what you've got (which might very well work out satisfactorily), or you can try to make what you've got *seem* like more. In the latter case, you want to "fatten up the sound".

Part doubling and tripling are commonly done for this very reason. Using the same signal more than once — as when routing it onto two or more tracks during the recording or re-recording a part already on tape onto an open track later on — will also work. And, of course, high-speed delays are often employed for a fuller string sound.

Now, for the full-blown "orchestral" string sound (a string "section" as opposed to just strings), you'll want to add some space, some air and some depth as well. In most circumstances, this would involve using one or both of the two main techniques for getting that feeling of space — more sound sources

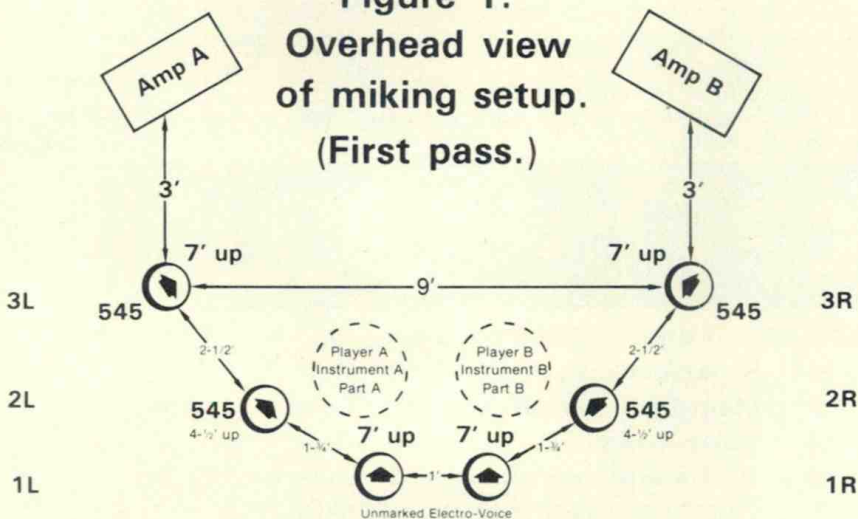
and more perspectives of the sources.

This author once had a situation where there were just two players — a first violin and a second violin — from whom a custom-tailored and reasonably orchestral sound was desired (one reason being for maximum differentiation from the song's two solo violin tracks). Here's what was done:

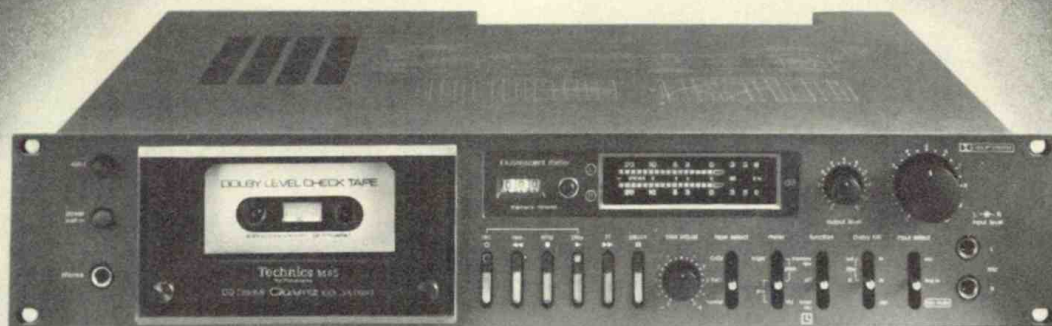
A "cage" nine-feet across was constructed using six microphones arranged in three bilaterally symmetrical pairs: the middle pair were four-and-a-half feet off the ground and the two end pairs were set at seven feet. The players were inside this cage, playing acoustically and amp'd via Buffalo pickups into Music Man 210-HD amplifiers, which were set identically with some live reverb. So there were four sources of sound (the two instruments plus the two amps) going into the six mikes, creating a lot of sound source confusion and effectively simulating the more uniform, binaural and distant texture of an actual string section.

Looking at the setup head on, the

Figure 1.
Overhead view
of miking setup.
(First pass.)



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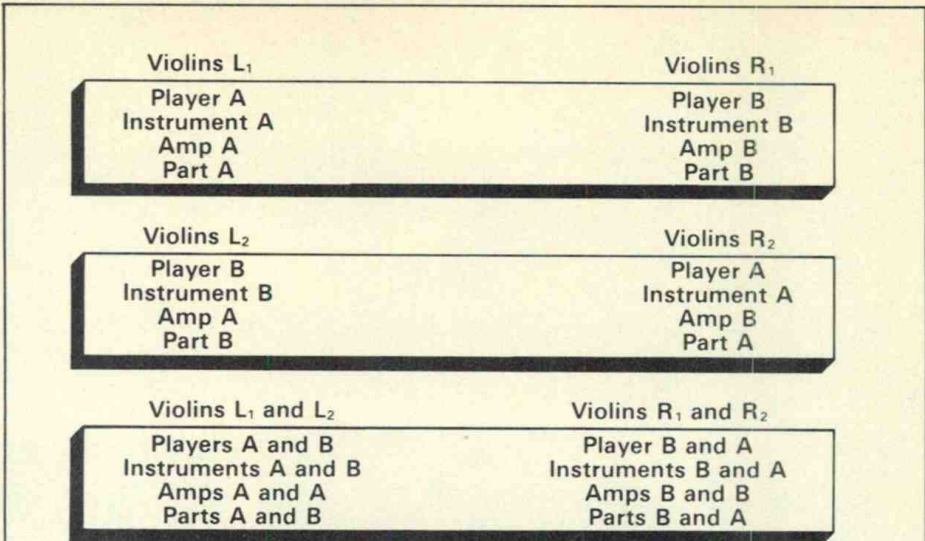
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tracks were allocated so as to preserve the integrity of the player and his part. That which was recorded by the left three mikes became one track of the 16-track tape (called violins L₁) and the right three another track (violins R₁). After a successful take, the players exchanged positions in the cage, plugged into the other's amp and played their same parts again. The left and right

three microphones were again routed to separate tracks (violins L₂ and violins R₂ respectively). As there was ultimately only room for two tracks of strings, the four tracks were ping-ponged down to two, preserving the left-right perspective of each pass in combining violins L₁ with L₂ and R₁ with R₂. This resulted in each side of our "string section" containing a first and second violin part.

This sequence of techniques was most effective in creating the illusion of a larger string section. Though in actuality just four instruments, it could easily be taken for eight or ten. And the sound was different from the standard string sound — "ghostly" — might be a good one-word description. (Whatever it was, the studio's head engineer, on hearing the track for the first time, came over to me and said, "What the heck were you doing there with those strings?")

Les Paul was once confronted with a similar situation. As he tells it, "My son [Gene Paul, Atlantic engineer] came up to me and he said, 'Jeez, I got a problem. A tough problem.' I said, 'There's no problem, kid.' He says, 'Well, they're only gonna have seven fiddles and then they want to make it into a whole string section. What should I do'"

Les Paul's answer?
"Well, you set up the chairs for the whole bunch," the senior Paul suggested. "And you put mikes up for the whole bunch and turn the mikes on. Put the guys in the first row and have 'em play, and then have 'em move back to the second row and play there, and then move back to the third row and play there, and play all the way back."

And a few days later at Atlantic Records, Tom Dowd came up to him and said, "That kid of yours is a genius."

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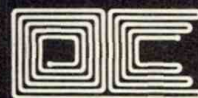
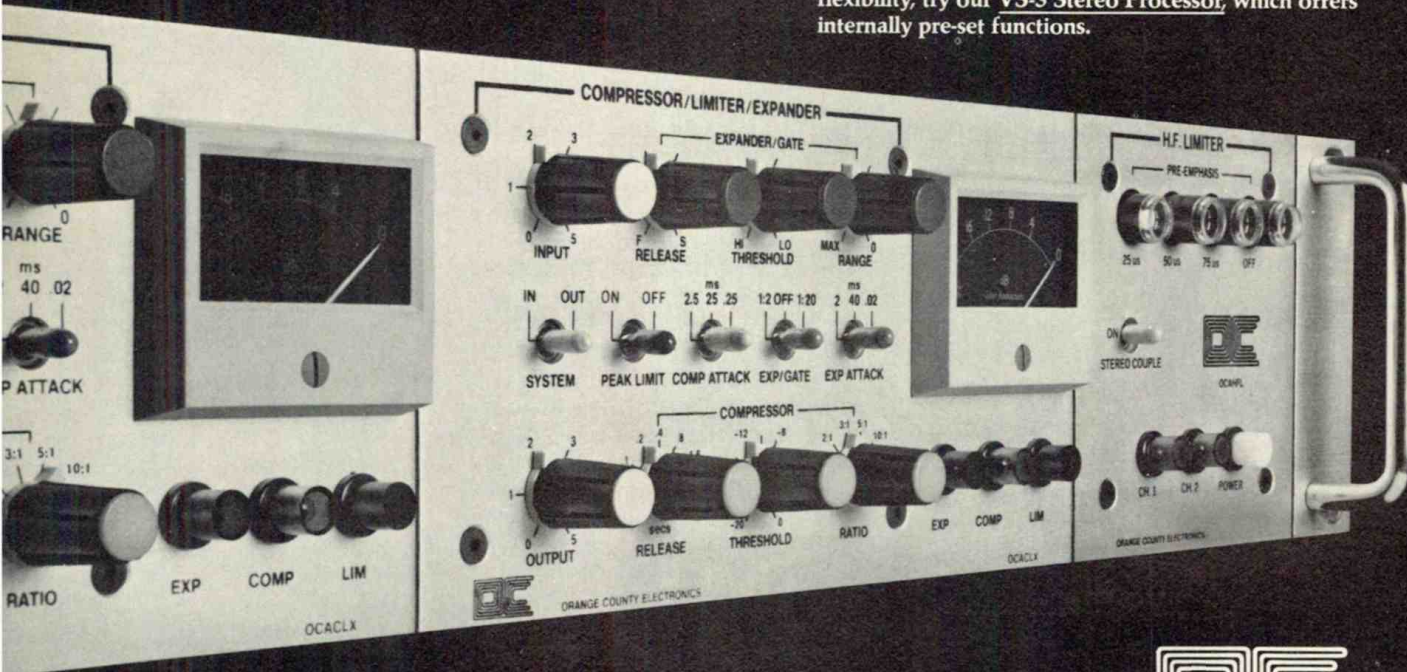
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IMPULSE ALIGNMENT OF LOUDSPEAKERS AND MICROPHONES

by Tom Lubin and Don Pearson

PART ONE

When the earliest recordings were done there was little if any attention given to the acoustic phase or electrical polarity of the mechanical devices used to record and reproduce sound. Phase and polarity have little significance as long as only one microphone picks up the sound and one speaker plays. When recording left the experimental stage it became possible to mix together more than one microphone. This allowed for better control and balance among the instruments.

With advancements in technology, multi-microphone techniques developed. In not too long a time the recording engineer discovered that occasionally when the outputs of two microphones were combined their summed output level would be less than the output of each one separately. In some cases the cancellation was almost complete and affected all frequencies. In other instances cancellation occurred at certain frequencies only. Thus, electrical polarity and acoustic phase cancellation became observable problems with the increased use of multi-microphone techniques.

Similar problems existed when monophonic reproduction became stereo. The electrical phase relationship between the two speakers had to be the same. Multi-speaker systems have made the problem of polarity and phase even more critical as each element must be connected correctly. This may not necessarily mean that the electrical polarity be the same for all of the speakers. Acoustic phase cancellation occurs in multi-speaker systems as well, but not until very recently had it been acknowledged, possibly because it is less distinct than the cancellation which occurs when two or more microphones which are picking up the same sound are electrically combined. When our ears mix the signal from two or more speakers what we hear is influenced by the acoustics of the room, and the fact is we have ears instead of amplifiers doing the combining. Before describing a technique for evaluating phase, polarity and a number of other aspects of speaker system analysis, an

explanation of polarity and phase should be given.

Polarity and phase are relative terms. Polarity refers to the property that physical quantities have of being greater or less than some reference value that we may arbitrarily designate as the point of reference or "zero." A point on a line may be thought of as being closer to an observer than another point thought of as a reference or farther away than that same reference point. Its position may be described as corresponding to a positive number in one case and to a negative number in another. A voltage may be thought of as being positive with respect to one reference potential and another voltage may be observed to be negative referenced to that same potential. Both voltages may be either positive or negative when referenced to the potential of the earth which, by the way, may not be resting at zero with respect to the universe.

Phase is a term that is implicitly linked to an ongoing time sequence of two or more series of events as observed relative to some common reference point in time. Events that are considered to be "in phase" are events that have their time sequences of increase and decrease occurring simultaneously. Events that are said to be "out of phase" occur in such a way that their increasing and decreasing sequences do not occur precisely together. The measure of the difference in phase is always expressed as a time relation, be it in terms of actual seconds, minutes, hours, etc., or as relative time in terms of increments or fractions of complete cycles of events, such as in units of degrees or radians. It is clear that two or more events may be precisely in phase with one another while being of either positive or negative polarity. Phase and polarity are related although one is not precisely identical to the other.

Electrical Polarity

Electrical polarity in a speaker is defined in terms of whether the speaker condenses or rarifies when it is energized by a

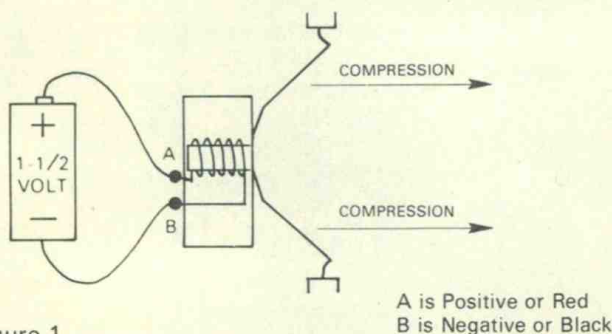
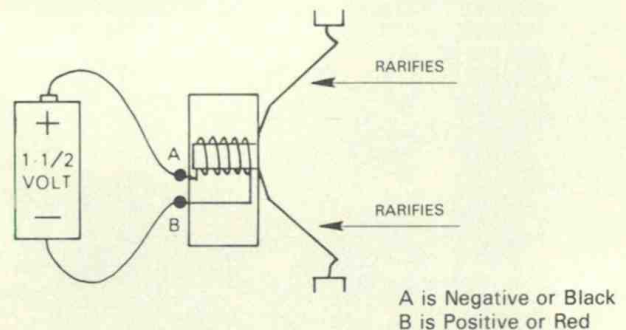


Figure 1



No problem.

That's what TASCAM SERIES mixing consoles are all about because whatever stage of recording development you're in, we provide the solution, not create another problem.

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Mixing Groups. Problem solving is an orderly pattern of thought. Thinking it through, one element at a time, is the most logical approach. In design you find our mixing groups do just that. Each element on every console that makes the total Tascam mixer has been positioned as a group. This means that each time you operate any Tascam console you are able to logically think about what you are doing, not which knob to twist or button to push.

Meters. Tascam meters are not options. They are an

integral part of every mixer we make and they're less visually confusing than a lot of multi-color LED displays we've seen. Compare and see what we mean.

Patch Points. How flexible is your mixer? We have the simplest external patching system in the business. Period. And every Tascam mixer is designed with the same flexibility to provide access to signals and increase your ability to influence and change them to suit your individual ideas.

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A Special Note About The Model 1. Our model 1 is really an inexpensive compact eight by two line-level mixer. It gives you the additional submixes you'll need without costing you a fortune.

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Model 1



Model 3



Model 5A



Model 15

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positive pulse (Figure 1). Most manufacturers indicate with colored binding posts a difference between the speaker terminals. Unfortunately, inconsistent or incorrect polarity distinction is quite common, partly due to erratic quality control and the fact that some manufacturers wire their elements opposite to other manufacturers. The polarity of a woofer can be easily determined with a 1½ volt battery. When the speaker leads touch the battery terminal, the cone will move in or out. If it moves out the terminal touching the positive side of the battery is positive in that it condenses the air. If the cone moves in then the terminals are reversed. The negative side of the battery is connected to the positive side of the speaker causing the cone to rarify.

Unfortunately, high-frequency speaker elements cannot be checked in this manner because the diaphragm movement is so slight and is usually difficult to see since it is usually deep inside the horn.

Crossovers

In systems that use a number of full range speakers the phase

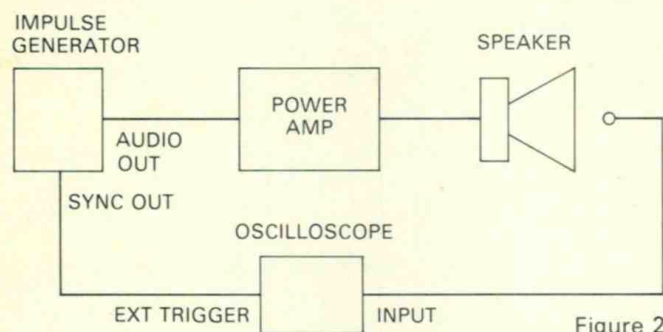


Figure 2

should be the same for all units, however with the use of specialized speakers which reproduce only one area of the audio range, a crossover of some type must be introduced into the audio path. Almost all crossovers introduce some degree of phase shift in order to achieve a sufficiently steep roll off to both sides of the pass band.

For example, let's say we have a three-way network that crosses at 500 Hz and 2,000 Hz. At 500 Hz both the woofer and the mid-range are reproducing a signal that is 3 dB down from their respective full power passband levels. At that frequency both of them are theoretically reproducing an equal acoustic power level, so their on-axis response will sum by 3 dB. If they sum by 3 dB, and they are both down by 3 dB at the crossover point then the system should have a flat response providing all the phases are correct. But what is the correct phase? That's the crunch.

The degree of phase rotation introduced by the crossover will vary from unit-to-unit, but can be considerable. Almost always the phase of the roll-off/roll-on of adjacent bands will rotate in opposite directions at the crossover frequency. The net result will have the mid-range acoustically out of phase with the woofer at the crossover frequency because of the phase shift in the crossover.

In order for the entire system to be acoustically in phase at the crossover point, it may be necessary to alternate the speaker polarity of each adjacent band. Manufacturers of crossovers fail to meet this need as phase reversal switches are seldom provided. The fact that the speakers of two adjacent passbands are electrically out of phase is of no consequence since it is only at the crossover points that they share common information, and must be acoustically in phase with one another.

Finally, a speaker is theoretically a single point source of sound. With the addition of each speaker to a system, the

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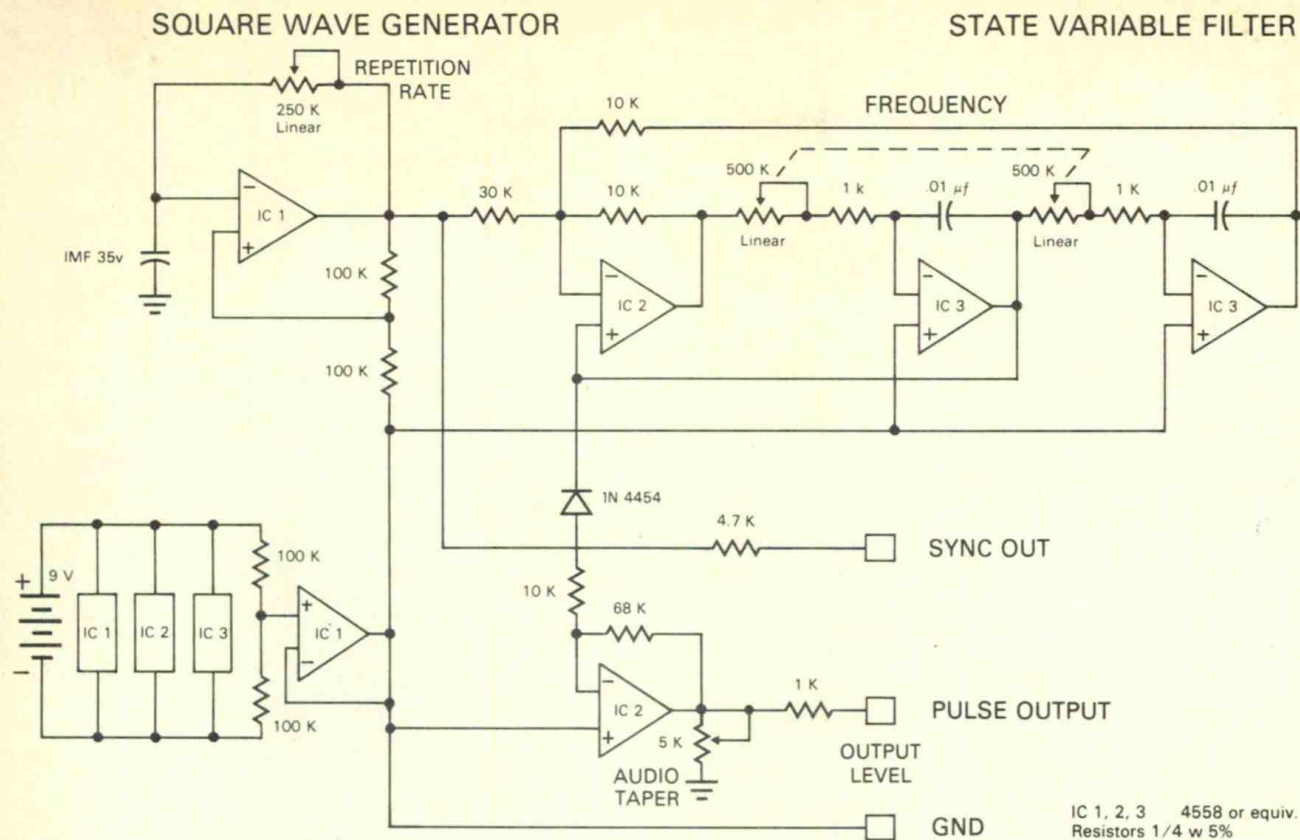


Figure 3

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number of point sources increases. If each point source is not exactly the same distance from the listener then what occurs is an auditory double image. This is particularly apparent at the crossover points. Basically, a single moment in time is generated by all the speakers at the same instant, but arrives at the listener at a number of different times. This causes the intelligibility of the entire system to be lowered.

Clarity is also affected by "out of band" distortion generated by the enclosure. If a cabinet is not adequately braced it will resonate or "ring" substantially. The box can put out almost as much sound as the speaker itself. Likewise metal horns, if not properly dampened, can contribute undesired vibrations.

The solution to many of these problems is fairly simple once an accurate method of measurement is provided. Operating as an independent testing service, Don Pearson and Gary Leo, of *Ultra Sound*, located in Larkspur, California, has developed such a system. With the aid of their computer they provide information on all of the previously mentioned problems as well as a number of other acoustic and electronic parameters relating to the sound equipment used by their clients. A permanent record is kept, in the form of a printout, for these clients who number several very prominent sound reinforcement companies.

A Simpler Method

Ultra Sound has allowed the publication of a simple circuit which when constructed can be used with a microphone and an oscilloscope to measure polarity, phase of a wave, and ringing. Figure 2 is the schematic of an "impulse" generator with variable

frequency and repetition rate. Figure 3 illustrates the proper hook-up of the system. Any oscilloscope with an external trigger will do as will any conventional microphone. Ultra Sound prefers a Nakamichi CM 300 fitted with a CP 3 super-omni 1/2-inch element. The microphone should be placed a few feet from the speaker (the larger the speaker, the greater the distance between the mike and speaker). The speaker's impulse output should be loud enough to mask any room noise.

Before testing can be done, the polarity of the microphone to be used as the standard must be determined. First connect the

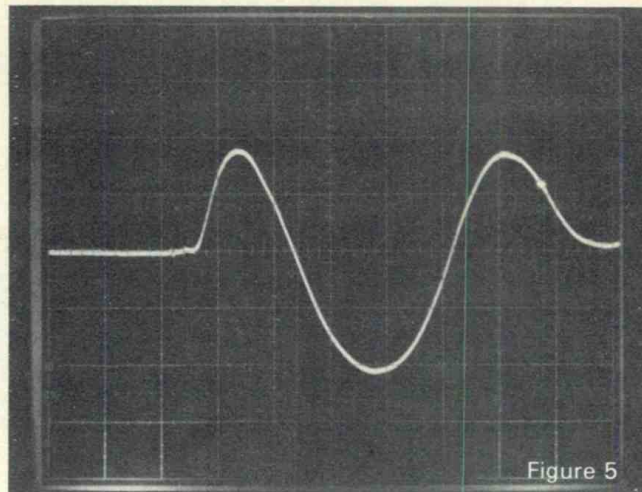


Figure 5

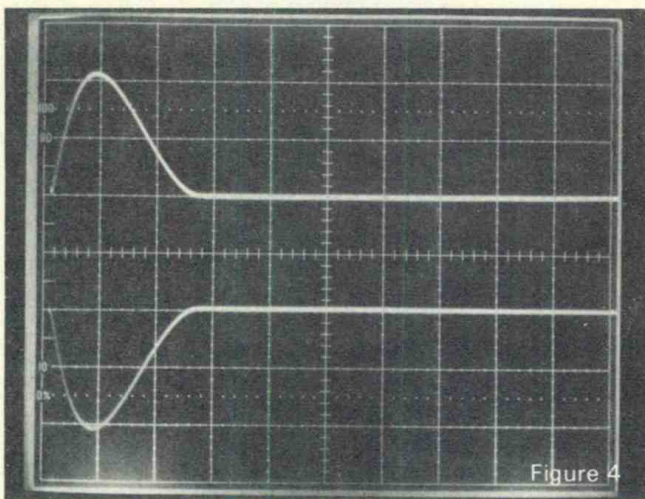


Figure 4

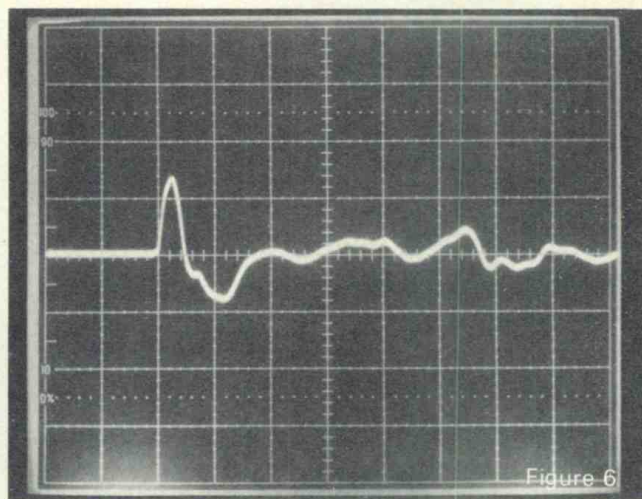


Figure 6

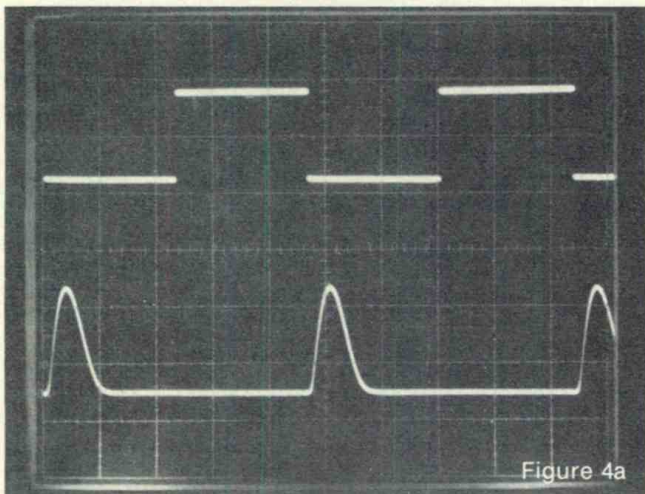


Figure 4a

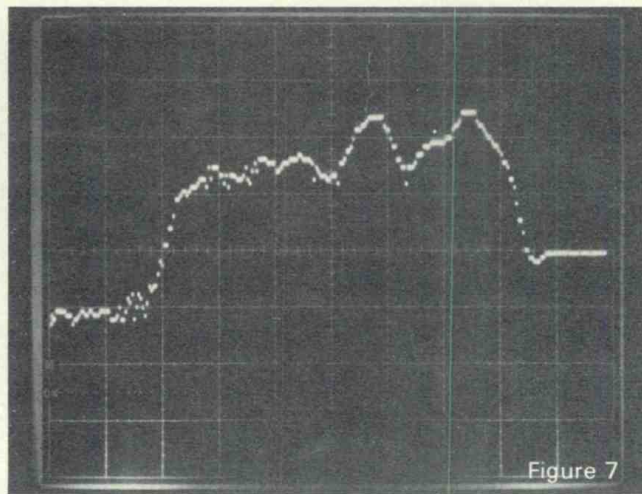
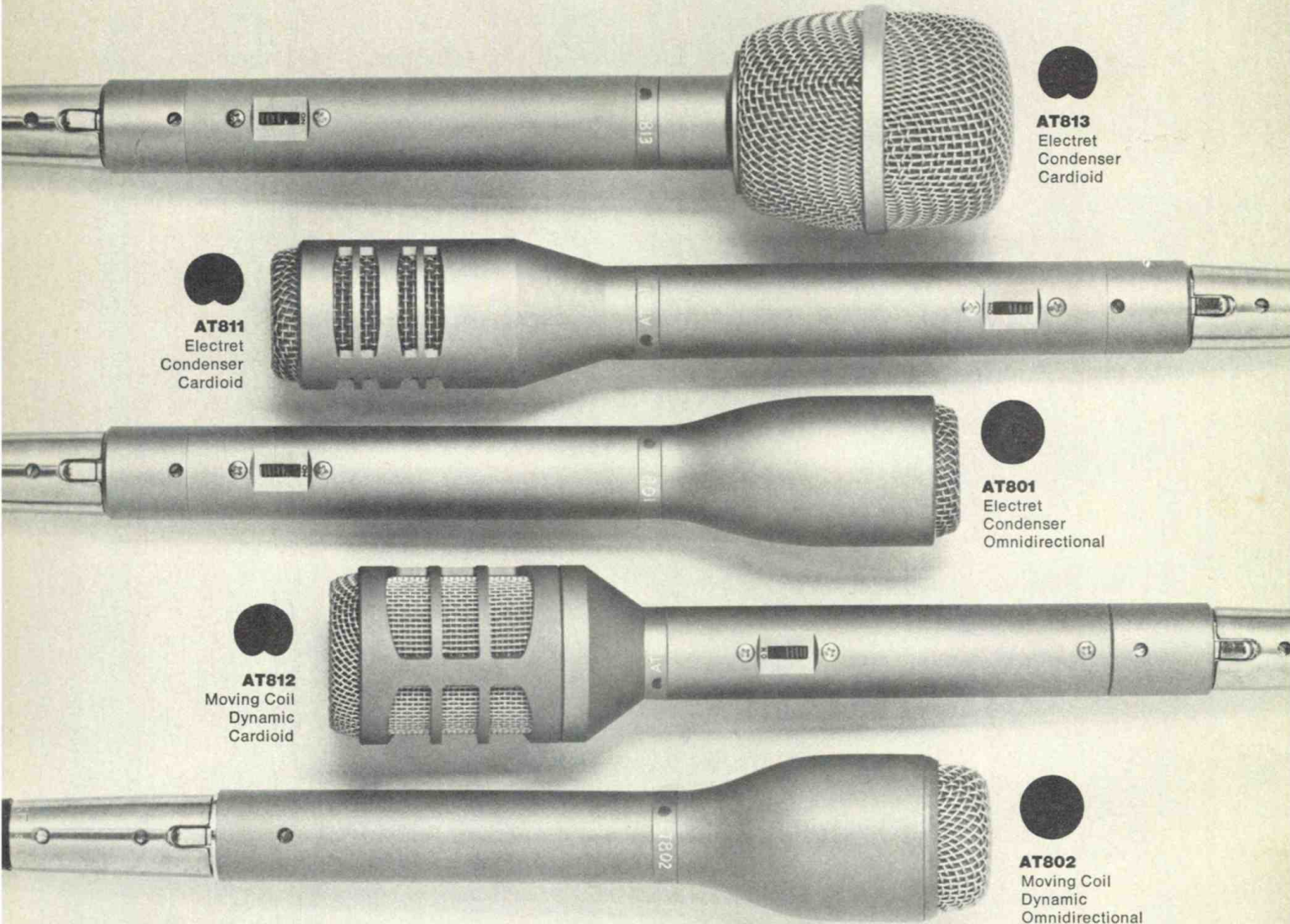


Figure 7

Audio-Technica introduces five new microphones... and a pleasant surprise.



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Electret
Condenser
Cardioid



AT811
Electret
Condenser
Cardioid



AT801
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Condenser
Omnidirectional



AT812
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Dynamic
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AT802
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Take a close look at these new Audio-Technica microphones. Three electret condensers and two dynamics. Plus two clip-on miniature electrets (not shown). All are superbly finished. Carefully thought out in every detail. With the right "heft" and feel. Professional A3M Switchcraft output connectors, of course.

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electret condenser with integral wind-screen is pegged at \$95. All complete with full one-year warranty.

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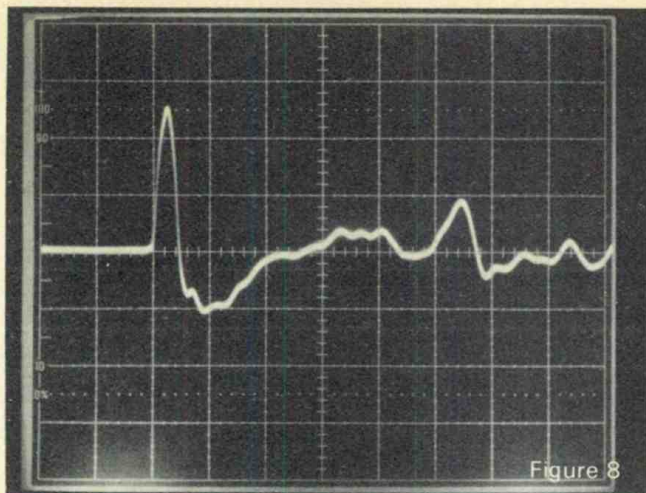


Figure 8

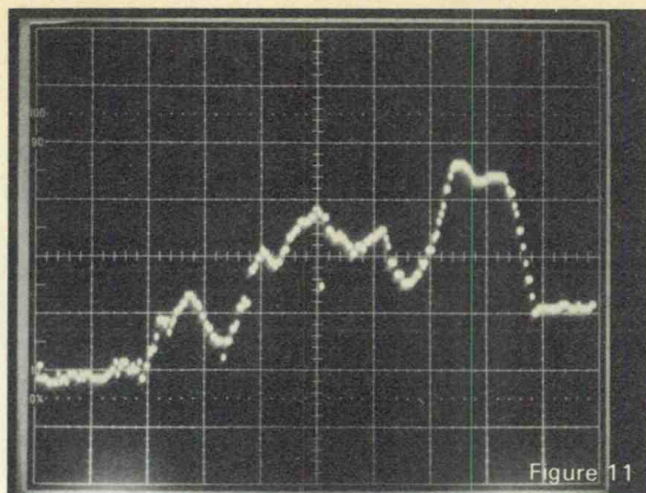


Figure 11

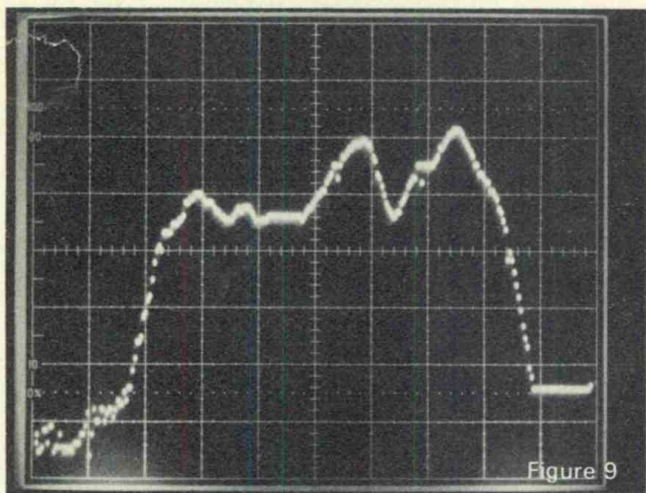


Figure 9

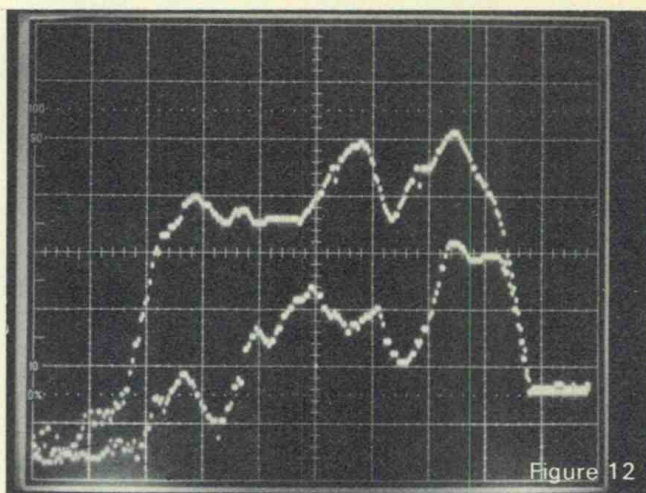


Figure 12

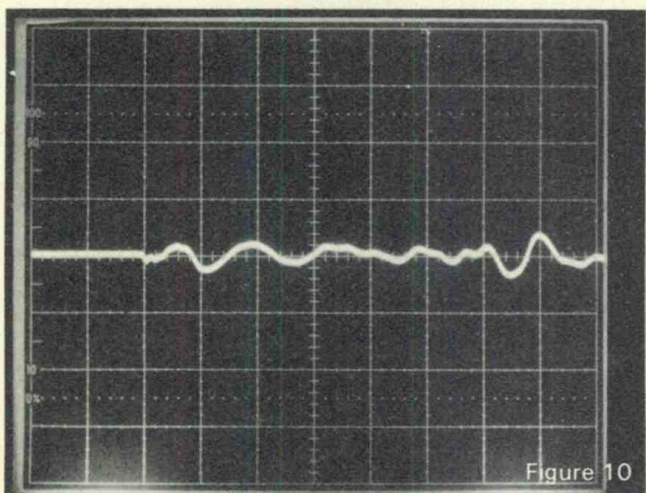


Figure 10

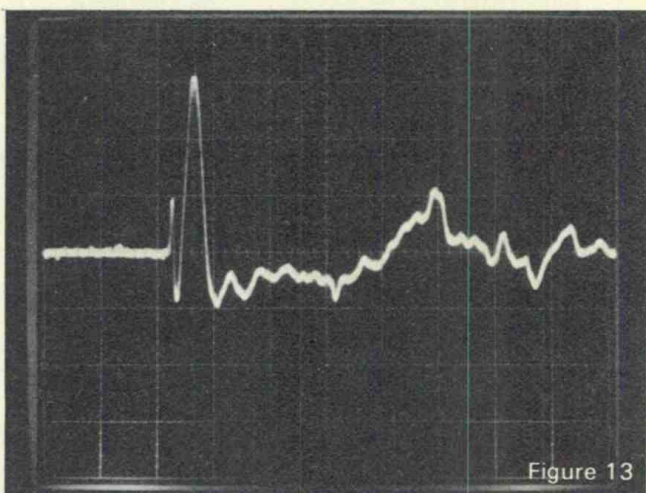


Figure 13

output arriving at the speaker to the input of the scope and observe whether the waveform is positive or negative going (Figure 4). Re-connect the speaker to the amp and connect the microphone to the oscilloscope and again observe the polarity. While observing the scope, adjust its trigger from the generator so that the screen shows the waveform that *first* arrives at the microphone and not a later reflection. At the lowest frequencies, it is possible for the first reflection to look very much like the impulse (Figure 5).

Once the relative polarity of the test set-up has been

determined and the trigger properly adjusted, testing can begin. Whether the test set-up is positive or negative is not important as long as all the adjustments result in the pulse going in the same direction. With the generator putting out a mid-frequency pulse, Figure 6 shows the type of results expected from a five-inch full-range speaker. The erratic waves after the pulse are reflections from the room where the tests were made. As mentioned, the frequency response (Figure 7) will not change regardless of the polarity in a single speaker system.

Figure 8 is the impulse measurement of two five-inch speakers

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with identical polarity. Figure 9 is the response of the pair. Figure 10 has the polarity of the two speakers opposite one another. Figure 11 is the resulting frequency response. Figure 12 is an overlay of Figure 9 and Figure 11. The efficiency of the two curves was maintained so that a direct comparison could be made. The top trace is of the speakers with identical polarity. The bottom trace has them opposite.

Now that the basic procedure and how to read the impulse is understood, let's take a look at a two-way system. Adjust the frequency control of the generator to a low frequency and observe the polarity of the bass speaker. Re-adjust the frequency on the generator to the crossover frequency and observe the polarity of the woofer and tweeter (Figure 13). The small first peak is the tweeter and the second larger one is the woofer. Both

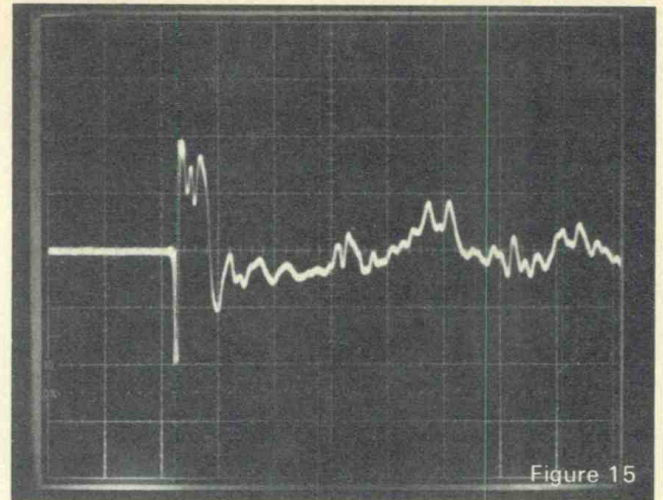


Figure 15

are in the same polarity. Figure 14 shows the response. Figure 15 is the same system but with the tweeter polarity opposite that of the woofer. Figure 16 is the resulting response showing a substantial dip at the crossover frequency. Figure 17 again shows a comparison between the system in phase and out of phase response.

The same procedure can be followed with three- and four-way systems. The frequency of the generator is changed to each of the crossover frequencies until the polarity of all the transducers has been determined. If there is more than one driver in any one band range it will be necessary to move the microphone close (one inch) to each driver to eliminate interference from the other drivers in that range.

The effect of band-to-band polarity considerations will result in

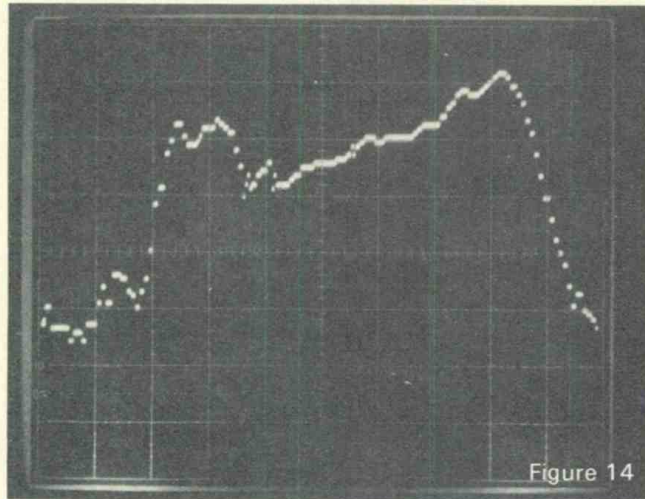


Figure 14

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The btx 4500 SMPTE interlocking system lets you operate any two multi-track recorders in tandem for 14, 22, 30 or 46-track capability. Using standard SMPTE time code written on one track of each machine, any two recorders may be synchronized, including video to audio. You can even mix makes, formats, speeds, and numbers of tracks, with or without servo controlled capstan drive. The btx 4500 is a micro-processor-based system capable of tracking within 50 microseconds of an actual mechanical lock. It's an economical direct plug-in system that's easy to use and ultra-reliable.



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either a peak or a notch in the frequency response at those crossover points.

Another use of the impulse is to check the polarity of microphones. Once the polarity of the test microphone has been determined, other microphones can be compared to it by connecting each microphone in turn to the oscilloscope. If any of the mikes are out of phase with the majority, then reverse the signal wires on that mike's connector. It should be noted that most European microphones are opposite in polarity to American ones.

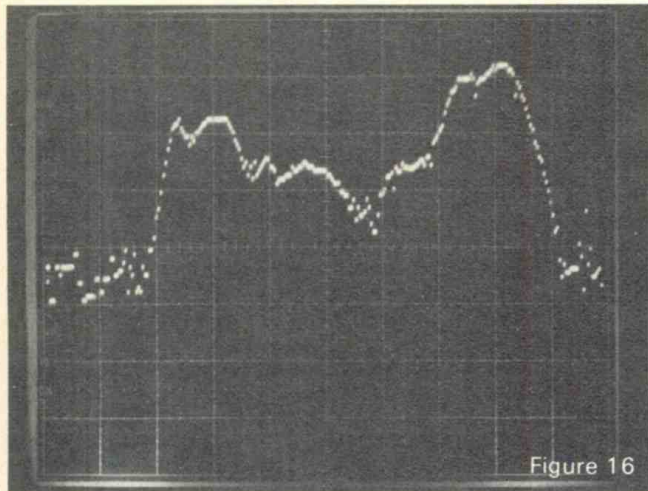


Figure 16

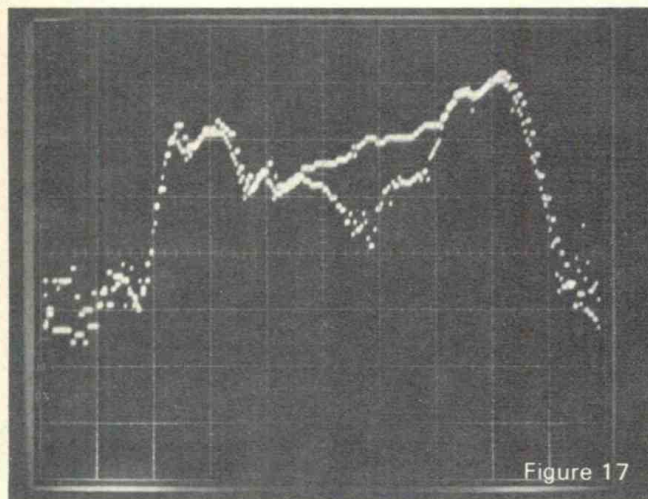


Figure 17

In the second part of this article the impulse will be used to measure cabinet ringing and acoustic phase alignment.

For additional information on this topic Don and Gary have provided the following sources:

"Acoustical Measurements by Time Delay Spectrometry," R. C. Heyser. AES, October, 1967, p. 370.

"Impulse Measurement Techniques for Quality Determination," in *Hi-Fi Equipment*, with special emphasis on Loudspeakers. JAES vol. 19, p. 101, 1971, A. Schaumberger.

Applications of impulse measurement techniques to the Detection of Linear Distortion, Alfred Schaumberger. JAES September 1971, p. 664.

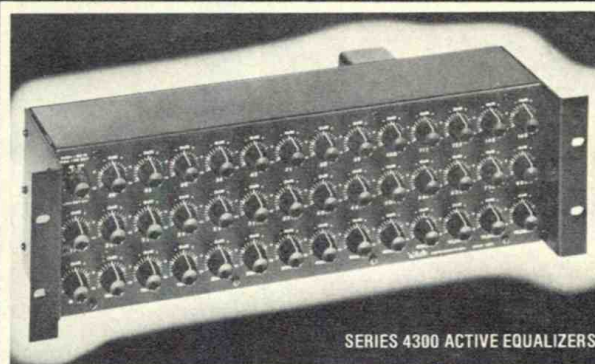
Linear Distortion, D. Preis. AES, June 1976.

The Application of Digital Techniques to the Measurement of Loudspeakers, J. M. Berman and L. R. Fincham. AES, June 1977, p. 370.

Three Dimensional Displays for Demonstrating Transient Characteristics of Loudspeakers, Tsutomu Suzuki, Takshi Mor II, and Sumitaka Matsumara. AES, July-August 1978, p. 511. □ □

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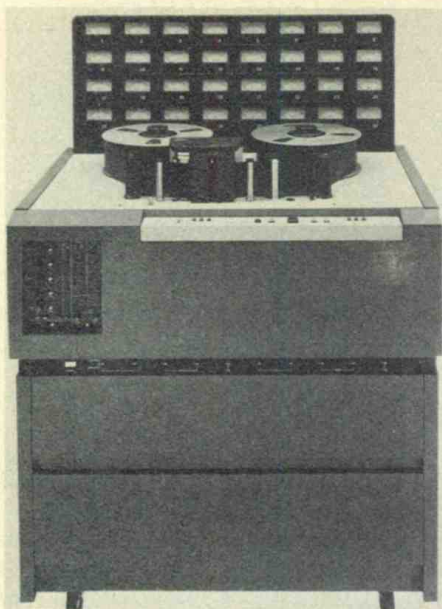
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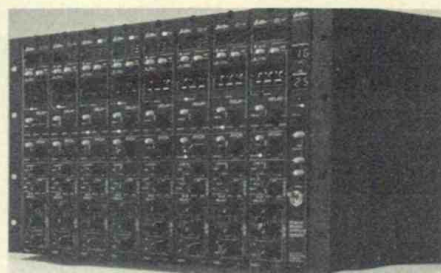
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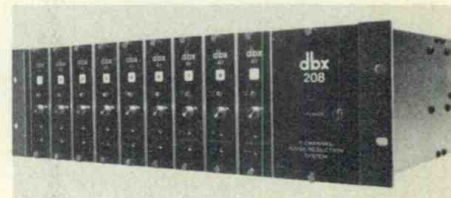
The console will interface with the Allison 65K Computer or can be obtained with a dual 8-inch floppy disk, 16 bit microprocessor. This computer will allow such sophistications as electronic editing using SMPTE Time Code and recording of an infinite number of mixes as well as "snapshot mixes" and remote terminal time sharing. Current price for the computer option is \$17,000.00, subject to currency change surcharge at time of delivery.

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dbx INTRODUCES MODEL 208 EIGHT CHANNEL PROFESSIONAL TAPE NOISE REDUCTION SYSTEM

The newly added Model 208 Professional 8 channel simultaneous record and play tape noise reduction system, like other dbx professional systems, eliminates audible tape hiss, thereby permitting multiple track bouncing and mixing without audible noise



build up. This is achieved, according to dbx, by providing in excess of 30 dB of noise reduction over the entire audio spectrum and an additional 10 dB of recording level headroom. The 208 accomplishes this through retrievable compression — halving the music's dynamic range at the input, then expanding it during playback by a mirror-image ratio of 1:2 at the output, without, it is claimed, audible side effects.

The 208 is designed for use with professional multi-track tape recorders and employs eight active noise reduction modules containing independent and simultaneous record and playback electronics plus a convenient ninth spare plug-in module. Each module has a front panel switch for selecting noise reduction (encoding or decoding) or bypass; and level controls to set operating levels.

It is completely self-contained with an

These are the "big guns" in "professional" power amplifiers. Each of these amplifiers has individual features and abounds with specifications to impress potential buyers and to satisfy the professional user but they are **not** created equal... especially in reliability under professional (rack mounted) conditions.

Some of these "big guns" have been talking about everybody else being "behind", others are talking about comparator LED's, while others depend mostly on their good looks. The Peavey CS-800 comes out on top when you consider the features, the specifications (which are as good or better than anybody's), total power output, and price per watt of professional power.

Some companies have recently "discovered" LED's and comparator circuitry that Peavey pioneered and has been using for years. These recent "converts" were most vocal in the past against LED's...that is, until they updated their "plain Jane" units. Some of the

other companies spend a lot on cosmetics but not much on built-in forced air cooling and large numbers of output devices to enable reliable rack mounted operation under

continuous professional use.

Each channel of the Peavey CS-800 features 10 output devices and 2 TO-3 drivers bolted to massive modular heatsinks that are forced

cooled by a 2-speed fan, has special distortion detection circuitry and LED indicator (not simple overload), as well as a functional patch panel on the rear to facilitate the use of plug-in balanced transformer modules, electronic crossover modules and speaker equalization modules custom tailored to Peavey's SP-1 and SP-2 speaker systems.

In comparing pro amplifiers, one should apply the old commercial sound "dollar-per-watt" rule. The CS-800 is again "on top" at 81¢ per professional watt. The fact is...Peavey is not behind **anyone** in power, durability, features or performance.

Below are the respective published specifications of the "heavies" in pro amps. Check for yourself to see how we all stack up. You might be surprised.



© Peavey Electronics
711 A Street
Meridian, Miss. 39301

HOW DO THE "BIG GUNS" STACK UP?

	OUTPUT TRANSISTORS POWER @ MFRS. MIN. RECC. LOAD	COOLING SYSTEM	SPEAKER PROTECTION	CONSTRUCTION	GENERAL TURN ON DELAY	OUTPUT CIRCUITRY	T.I.M.	LIST PRICE	DOLLARS PER WATT	
Peavey CS-800	800 W Total 400 Watts/Ch. @ 4 Ohms 260 Watts/Ch. @ 8 Ohms (Both Ch. driven)	20	2 Speed forced air cooling	Yes	Totally Plug-in Modular	None Required	Quasi Complimentary. All rugged NPN Silicon Outputs	Not given. No accepted Measurement standards Presently exist.	\$649.50	\$0.81 per Watt Based on 4 Ohms/Ch. min. load
Crown DC-300A	360 W Total 180 Watts @ 8 Ohms 4 Ohms Not Given	16	Conventional Passive Airflow Only	No	Hard Wired	None Required	Quasi Complimentary. All rugged NPN Silicon Outputs	Not given. No accepted Measurement standards Presently exist.	\$919.00	\$2.55 per Watt Based on 8 Ohms/Ch. min. load
BGW 750 B	720 W Total 360 Watts/Ch. @ 4 Ohms 225 Watts/Ch. @ 8 Ohms	20	2 Speed forced air cooling	Yes	Modular	Relay Circuit	Collector drive Complimentary using PNP & NPN Silicon	.02% No measurement details given.	\$1099.00	\$1.53 per Watt Based on 4 Ohms/Ch. min. load
Yamaha P 2200	700 W Total 350 Watts/Ch. @ 4 Ohms 200 Watts/Ch. @ 8 Ohms	12	Conventional Passive Airflow Only	No	Hard Wired	None Required	Emitter follower drive complimentary using PNP & NPN Silicon	Not given. No accepted Measurement standards Presently exist.	\$1095.00	\$1.56 per Watt Based on 4 Ohms/Ch. min. load

All above figures based on manufacturers' published specifications and minimum recommended load impedances as of 11/1/78

integral power supply and power switch, occupying 5 1/4" (13.33 cm) of panel space in a standard 19" (48.3 cm) rack mount.

The dbx system eliminates the need for level calibration procedures since compression/expansion is linear over the entire audio range. LED's indicate channels in the noise reduction mode.

Signal connections are made via 27-pin gold plated audio connectors mated to a set of four 10-foot input and output cables with XLR connectors for interface with professional consoles and recorders.

The dbx 208 system is fully compatible with all other dbx professional tape noise reduction systems and if desired, can be stacked to create 16- or 24-channel capability.

The Model 208 is available for immediate delivery at a nationally advertised value of \$3,300.00.

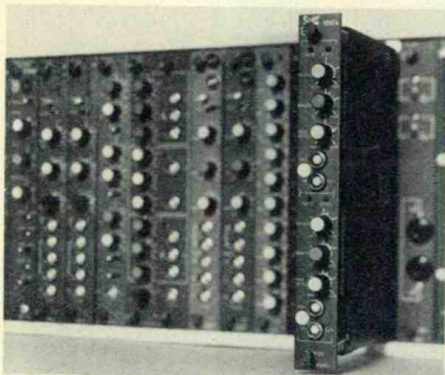
dbx, Incorporated
71 CHAPEL STREET
NEWTON, MA 02195
(617) 964-3210

for additional information circle no. 77

**AUDIO & DESIGN
RECORDING ANNOUNCES
TWO NEW SCAMP UNITS**

Through their U.S.A. subsidiary, Audio & Design Recording, Inc., have announced the following additions to the Scamp range of signal processing equipment; the S-02 Mike Preamp and the S-100 Dual Gate.

The S-02 Preamp, one of the original concepts of the Scamp system, has many



features including: Low noise (better than -125 dB), 30 dB PAD and phase reverse switch, high pass filter (30 dB/oct), transformerless, auxiliary send, pre or post (switchable), 600 ohm line amp drive on both outputs, 70 dB gain with optimum modulation indicator, Hz input on front panel jack socket.

The Scamp S-02 Microphone Preamp was specifically designed and developed to broaden the scope of Scamp system applications. When incorporated into the Scamp rack the S-02 Microphone Preamp will interface between low level signals at source and the whole range of Scamp signal processors.

The S-100 Dual Gate emphasizes numerous multi-gate facilities in a very small package, at an extremely competitive price. One Scamp rack can house up to 34 such noise gates (17 x S-100 Dual Gate Modules).

It's simple to operate, and has LED indicators to show operating state. The electronics are said to be totally maintenance free since there are no pre-sets that can wander and no user setup procedures — it comes to the user factory set. With optimized

attack (or open) time of around 10 microseconds (which, despite some manufacturer's claims, is the theoretical limit in the audio band) there is the assurance of no audible transient loss. Release (or close) time, range of attenuation and threshold are all variable and researched to be within the most useful limits, thus simplicity of operation is guaranteed.

The unit is keyable from any external, line level signal source and a system in/out control provides A-B or "proof" listening.

The S-100 Dual Gate has balanced inputs, super low impedance outputs and excellent noise and distortion figures. Each S-100 Dual Gate order is supplied complete with a sheet of self-adhesive channel number stickers for customizing and channel identification.

Operationally the S-100 Dual Gate, with a threshold continuously variable between -50 dBm and infinity, can provide low level source noise reduction and automatic attenuation of non-contributing channels. It will tighten up flabby drums, eliminate cross-mike pickup on overdubs and crispen vocals, etc. Broadcasters can cut down on infuriating line noise on phone-ins and film makers can restrict ambience.

**AUDIO & DESIGN
(RECORDING), LTD.**
84 OXFORD ROAD
READING RG1 7LJ
BERKSHIRE, ENGLAND

for additional information circle no. 78

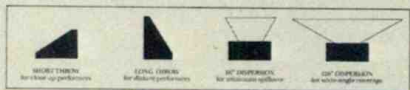
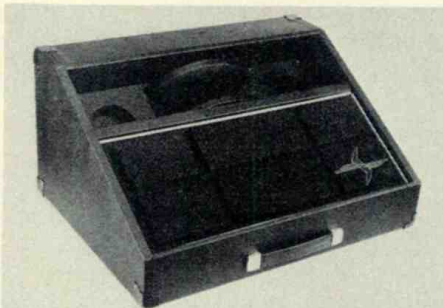
**NEW SHURE MONITOR
SPEAKER FEATURES UNIQUE
VARIABLE DISPERSION CONTROL**

The new stage monitor speaker with a unique high frequency variable dispersion control allows the user to tailor the horizontal sound pattern to a variety of coverage requirements.

This versatile, compact two-way monitor speaker is called the Shure Model 703 and is designed to provide control of high frequency dispersion through the use of removable acoustic wedges. This feature, in conjunction with the capability of two tilt angles, provides the user with four possible coverage selections.

Sound can be dispersed over a wide 120° angle to cover several performers or to permit greater freedom of movement on stage, or a tight 60° angle for narrow, "personalized" coverage and minimum sound spillover. The speaker can also be set on its back at the front of the performer for short throw (close use) or placed upright for long throw coverage when the performer is farther away.

Another important feature of the Model 703 is its shaped frequency response, which



properly emphasizes the presence range and effectively eliminates undesirable bass boominess. This feature not only enables the Model 703 to cut through intense ambient sounds on stage, but also provides a very natural sound to the performer.

The Model 703's high frequency driver and two eight-inch heavy-duty speakers provide excellent sound reproduction. Power handling capacity is 100 watts of continuous program material. The speaker is an eight-ohm system and can produce 97 dB SPL with a one-watt input at four feet.

Overall dimensions of the speaker enclosure are 283 mm (11-1/8 in.) H x 587 mm (23-1/8 in.) W x 438 mm (17-1/4 in.) D. Weight is 14.3 kg (31-1/2 lbs.). User net price for the Model 703 is \$730.00.

SHURE BROTHERS, INC.
222 HARTREY AVENUE
EVANSTON, IL 60204

for additional information circle no. 79

**ACOUSTILOG ANNOUNCES
NEW, LOW COST REVERBERATION
MEASUREMENT SYSTEM**

The new Acoustilog 232A Reverberation Timer, a high performance audio measure-



ment system, digitally displays reverberation time (T60) within each of 19 different frequency bands. A marked improvement over the original Model 232, the new 232A features lowest total system cost, higher accuracy, and easy one-person operation with instantaneous readout. It is now available from Acoustilog, Inc.

Among the other important features of the new 232A are: automatic level detection, which assures uniformity of readings despite different people using the instrument; 2% basic accuracy; 63 Hz - 12.5 kHz measurement range; two noise averaging filters, zero-crossing circuitry for external inputs; internal pink noise generator; recorder output; AKG phantom-powering; calibrated Send and Receive controls; unique LED level indicators.

ACOUSTILOG, INC.
19 MERCER STREET
NEW YORK, NY 10013
(212) 925-1365

for additional information circle no. 80

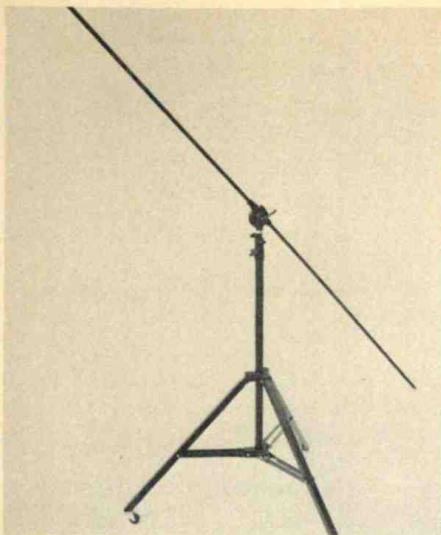
**NEW KEITH MONKS
MICROPHONE STANDS**

Keith Monks (U. S. A.) will be releasing a new range of floor stands. These are especially designed for the user to pack away effectively when portability as well as stability are essential.

The SHD/3 is made in tough steel and reinforced aluminum and weighs 15 lbs. Through the center is a large stem, with suction pad, which rests on the floor to give extra stability. There are three collapsible feet and it is in anti-shine black anodized finish.

The HD/1 is similar to the SHD/3 but has no center support on the floor. It is equipped with three castor wheels all fitted with a brake, and the weight is 12 lbs. The suggested retail value is \$85.28.

Also announced are very useful accessories to go with these stands, including a heavy duty



boom arm with tilt head at a suggested retail value of \$65.68, and a loudspeaker plate valued at \$15.99.

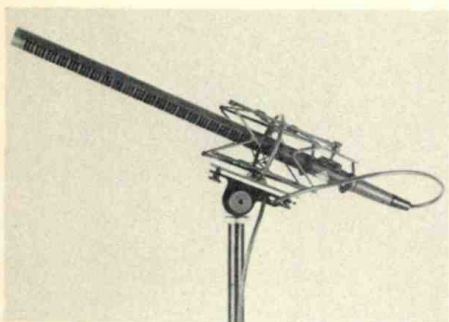
The units are available from your local distributor or from Rolls Electronics Company, 4260 Lankershim Boulevard, North Hollywood, California 91602 for the west coast; Audio Consultants, Inc., 1200 Beechwood Avenue, Nashville, Tennessee 37212 in the southeast; and Audiotechniques, Inc., 652 Glenwood Road, Stamford, Connecticut 06906 in the northeast.

KEITH MONKS (U.S.A.)
652 GLENWOOD ROAD
STAMFORD, CT 06906

for additional information circle no. 81

**AVAILABILITY OF THE FIRST
NEUMANN ULTRA-DIRECTIONAL
LINE CONDENSER MICROPHONE:
KMR-82i ("SHOTGUN")
ANNOUNCED**

After a great many years of experimentation, the Neumann Company has announced that it will market its first ultra-directional "shotgun"



microphone identified as model KMR-82i.

As explained by the manufacturer, "The reason Neumann is so late in making such a unit is that it has taken this long to produce one which is a significant alternative to the many now on the market. It displays a smooth frequency response and a remarkable directional pattern which differentiates pattern vs. frequency less severely than traditional models now available. The result is a unit less susceptible to off-axis sound coloration."

The KMR-82i will be available in charcoal matte "TV finish". Its accessories are a foam wind screen (included), elastic suspension, wind-proof "blimp" and a unique "active handle" for hand held use, containing the 9 V

battery for the 48 V phantom powering converter.

Availability is late 1978. The price will be about \$795.00.

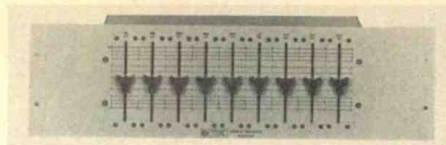
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(212) 741-7411

for additional information circle no. 82

**OPAMP MODEL G-9
GRAPHIC EQUALIZER**

The Model G-9 graphic equalizer is a line level unit having nine frequencies: 50 Hz, 100 Hz, 200 Hz, 400 Hz, 800 Hz, 1.6 kHz, 3.2 kHz, 6.4 kHz and 12.8 kHz. The response at each frequency may be adjusted ± 12 dB. The amplifier output capability is +24 dBm. Heavy

duty production film type slide potentiometers are used throughout. Available in 5 $\frac{1}{4}$ " H x 5" D



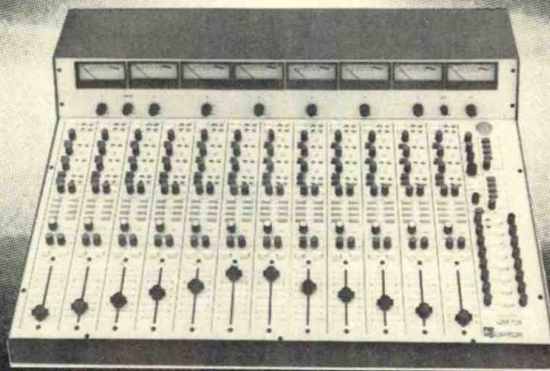
x 14" W or 19" W rack mount panel chassis. The unit weighs 7 lbs.

Kit price is \$325.00. A completely wired unit is available for \$400.00.

OPAMP LABS, INC.
1033 N. SYCAMORE AVENUE
LOS ANGELES, CA 90038
(213) 934-3566

for additional information circle no. 83

Dr. Les Remsen has faith in Quantum Mixers!



QM-128 - 12 In, 8 Out

WHO IS LES REMSEN ... AND WHO CARES?

A while back, Les Remsen bought a Quantum QM-168 mixing board and set up a small studio in his church. Since that time, he's made over 100 classical music albums for about half a dozen labels, plus assorted demos and audition tapes. Incidentally, Les holds a Dr. of Music in performance, was formerly first trumpet in the L.A. Philharmonic, and heads Avant Records.

LES CARES

He may not be recording the Bee Gees or Peter Frampton (they have their own Quantum boards), but Les Remsen wants every track he lays down to be the best. That's why he chose Quantum.

WE CARE


Because every artist wants his demo and master recordings to meet the highest professional standards, we build small Quantum boards with the same care that goes into our large studio consoles. We also sell our mixers at a price young artists and engineers can afford. Dr. Les Remsen puts his faith in Quantum, and so do a lot of others on their way up. How about you?



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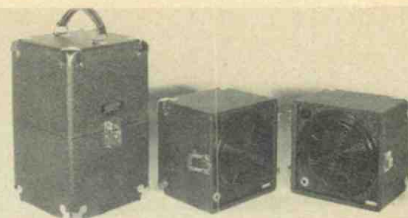
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NEW AURATONE 5RC SUPER-ROAD-CUBE™ MONITORS ANNOUNCED

Featuring a unique protective closure system, the new 5RC's were developed to enable engineers, producers and artists who have come to rely on Auratones in the studio, to have a convenient and safe way of transporting this reliable reference monitoring system on the road.

The units have: Fused blow-out protection, 1/4" phono jack for fast set-up. Are covered in tough black vinyl, with durable hard plastic grille. they are equipped with steel reinforced corners, leather handle, break-away hinges and locking latch with key.

As with other Auratone products they feature: Low resonance Acousticwood™ sealed, insulated enclosures. 26 ounce magnet structure 5" round full-range drivers. High compliance half-roll treated cloth suspensions. Heavy duty heat resistant voice coil on aluminum former. Audible response: 50-15,000Hz, plus or minus 3-1/2 dB from 200 to 12,500Hz. Power rating: 30 watts RMS (60 watts peak at 150Hz.) Impedance: 8 ohms at 400Hz. Sensitivity: 89 dB (1 Watt/1meter).



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The 35-2 is a new mastering deck with optional dbx, a rugged transport system and an electronics package that includes full logic with motion sensing, up-front bias and EQ controls, and a separate 1/4-track playback head to complement the 1/2-track record/play head.

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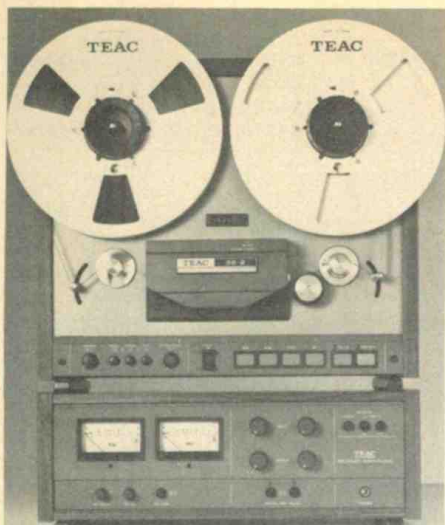
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logic control system with motion-sensing direct mode changes, four high-density permaflux heads for 2-track record/play and 4-track play, pitch control for accurate tuning of the tape speed, punch-in recording facility, cueing and

editing, and flip-up head cover for easy editing and maintenance. The unit is boxed in rosewood.

On the electronics side, the 35-2 features optional plug-in dbx noise reduction cards, six-step bias selector and variable REC EQ control for precise matching of the deck to various tapes, 3-position monitor switch for source/cal/output, independent left and right level controls for input and output, and wide excursion VU with LED peak indicators.

Sacks said the separate transport and electronics designs allow more flexibility in installation.

The 35-2 accepts 10½- and 7-inch reels, has a wow and flutter of 0.03% at 15 ips, overall frequency response of 40 to 22,000 Hz at 15 ips, signal-to-noise ratio of 100 dB with dbx, overall harmonic distortion of 0.6% at normal operating level, and stereo channel separation of 50 dB/1,000 Hz. The unit measures 18-13/16" x 16½" x 10½" and weighs 72¾ pounds.

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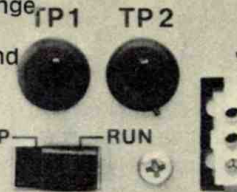
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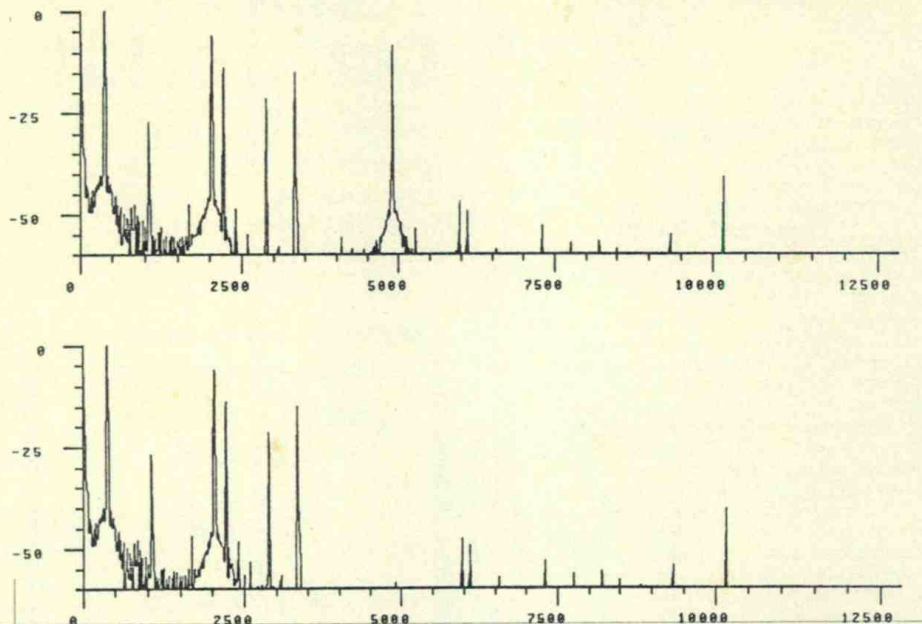
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digital audio report

STANFORD'S DIGITAL RESEARCH CENTER FORMS CONSULTING GROUP TO ASSIST IN IMPLEMENTING ITS SOFTWARE-BASED SYSTEM

An approach to digital recording based largely on computer software has been developed at the Center For Computer Research in Music and Acoustics at Stanford University, Palo Alto, California. Memory and software program storage is facilitated by standard computer hardware while manipulation of music program material based on software is executed with a sophisticated digital synthesizer developed at the center.

The system is conceived as completely digital from initial conversion of analog stimulus at the microphone pre-amp to the digital-to-analog conversion of signal just before the loudspeaker's power amplifier.



(top) Spectral analysis of a sample; (bottom) Sample with spike at 5 K removed, analogous to filter effect.

Loren Rush, a co-director at the research center, said that another year-and-a-half to two years of research and development will be needed before the system is fully developed.

To develop commercial applications of the system, the research staff has formed the Computer Music Corporation (CMC) — a non-profit entity separate from the university — that would act as a consultant on a contract basis. Software and other research at the center is already in the public domain because the work has been supported by Federal funds. CMC is envisioned as a consulting arm to market and supervise installations of the system. CMC would also perform digital technology R & D services with results of its efforts becoming exclusive property of a contracting organization, presumably commercial firms.

To describe the system, CMC has prepared the following outline of features and capabilities:

Channel Capacity: 32-tracks continuous,

40 tracks burst.

This means that 32 tracks can be continuously played or recorded. *Burst* mode defines that situation where the same track must be recorded and played simultaneously, such as during the switch from play to record for a punch-in. If one is playing all 32 channels, for instance, one can only punch-in on up to 8 channels simultaneously. Sequentially, one can punch-in as many channels as there are. The limitation is only on absolutely simultaneous punch-in.

Likewise, the number of 32-tracks is somewhat misleading. The system is capable of preserving a large number of *virtual* tracks, such as different takes of a given track, as long as it is not asked to play more than 32 at a time. One could, for instance, keep 60 old takes of a certain track around, or as many old takes as the total channel time capacity would allow.

It should be noted also that this is just the

capacity of the standard storage medium. More analog input channels can be used, but they cannot be used to record simultaneously except in groups of 32.

Channel Time Capacity: 1,300 minutes total track time, straightforwardly extendable up to 6,500 minutes.

If we run 32 tracks full to the brim, this gives slightly over 40 minutes per track. Likewise, if we had 64 tracks, of which 32 could be played at once, we could get 20 minutes per track. It must be pointed out, that partially filled tracks only take up space when something is recorded there. For instance, a punch-in on a previously un-recorded track of just a single verse, chorus or word, only takes up the channel time capacity corresponding to duration of the punch-in.

Signal-To-Noise Ratio: More than 85 dB.
Dynamic Range: More than 92 dB.
Bandwidth: Within 1 dB to beyond 20,000 Hz.

These figures are a little deceptive in that these are the specifications of the 16 bit D-A and A-D converters commonly available at this time. Since the storage medium operates at an effective 18 bits and all the arithmetic is done in 24 bits, there is no perceptible accumulation of noise for any signal processing operations, such as equalization, reverberation, mixdown, track copies, *ping-ponging*, compression, delay, and so forth. Likewise, since the storage medium does operate at a higher sample width, any future developments in converter technology can be used immediately to upgrade system performance.

Sampling Rate: Continuously variable up to 54,000 Hz, can be externally synchronized.

The default sampling rate will be 50,400 Hz, but can be varied in steps of 50 nanoseconds (.25% accuracy) over a wide range. External synchronization can be used to match the rate to, for instance, analog tape, film dubbing, or video tape recordings. We will accept frame rates of 24, 25, 30 or anything else. Complete compatibility with SMPTE or NTSC color frame rate is available.

Signal Processing Capacity: 2,800 processing units available simultaneously expandable 350 units at a time up to a maximum of 5,600 units.

This needs some explanation. The user has a budget of 2,800 fundamental processing units that can be performed simultaneously. These can be distributed in any manner among the various channels, and among the choices of treatments. For instance, a single second-order section filter costs 12 processing units. A full equalizer with four such sections then costs 48 processing units. 32 channels of such equalizers costs 1,536 processing units, leaving 1,264 still available. If an equalizer is not used, or only partially used on a given channel, it does not consume all its processing units. One channel of very high-quality reverberation costs 75 processing units. One channel of flanging costs 10 processing units. High-quality compression is 15 units. A full 1/3 octave graphic equalizer (24 controls) costs 288 units. A 24 channel vocoder without pitch tracking costs 650 units. Pitch tracking adds 65 units. Any number of channels may be used in a vocoder up to the maximum number of processing units. Pitch shifting uses 55 units.

There are many things that must be said about these processing units. First, there is no audible distortion in the processing, even with the graphic equalizer system. Next, a single track can be processed in any manner and recorded on another *virtual* channel, as long as the total channel capacity or channel time capacity is not exceeded. This recording of the processed signal is done without audible error so that one may process a given channel many times, each time using very sophisticated treatments without loss of information or accumulation of noise except for whatever noise was present in the original recording.

In addition to these features, there is also the option of using *zero-phase* equalization, at an increased cost in terms of processing units. This means that for no more than 120 processing units, the equivalent of a second-order section can be realized with no phase distortion. The phase lead or lag will be identically zero at all frequencies.

Any of the control parameters can be automated such that regular, random, or pre-designated patterns may be used (such as in *wandering* phasing), or signals derived by following the envelopes of other signals may be used to control any parameter. For example, highly complex compressors may be built up deriving the compression factor from any filtered or otherwise processed version of any track.

Editing Facilities: Complete.

Any form of post-editing is allowed: *tape* loops, adjustment of timing either by delay of advance, retuning of selected portions. Gaps between notes may be deleted or augmented, sections of different takes can *spliced* together without distortion down to the word, note, or even a sample level. Some amount of semi-automatic segmentation is available.

Loading and Offloading: Occurs at track speed.

When a session is finished, the intermediate results may be stored either on a digital tape recorder or on conventional analog equipment. The offloading occurs in one playing time of the channels to be dumped. This can be done, for instance, simultaneously with one of the last editing or mixing passes. If it is desired to save the *virtual* channels in excess of 32, extra time will be required. All control information (processing history, mixdown levels, etc.) is stored with the audio data. Likewise, the onloading at the beginning of a session can occur at the same time as the first pass is made through the audio.

Console: Every control fully automated.

The console is fully assignable. Any slider can be used to control any parameter. Visual displays are used to present the current assignment to a given control. The default settings are arranged to be largely similar to conventional mixing boards, although this is not necessary. The user may *tailor* the functional configuration of the board to suit his own needs. Since no audio flows through the board, individual physical layouts can be constructed to a user's requirements if this proves to be necessary.

All manipulations are recorded by computer and can be edited. Any degree of grouping or sub-grouping is allowed, not only with levels, but with any processing, such as equalization, flanging or reverberation.

The default configuration of the board itself is set to resemble that of standard fully automated desks to help reduce the time required to familiarize oneself with the board. One must remember, however, that the board itself is programmable, and thus the functions can be completely reassigned to any control or group of controls. Different console setups are remembered and may be recalled either identically or with modifications.

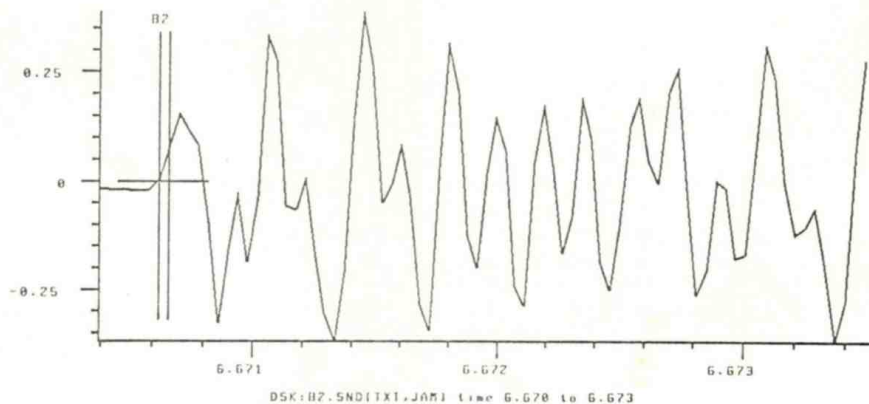
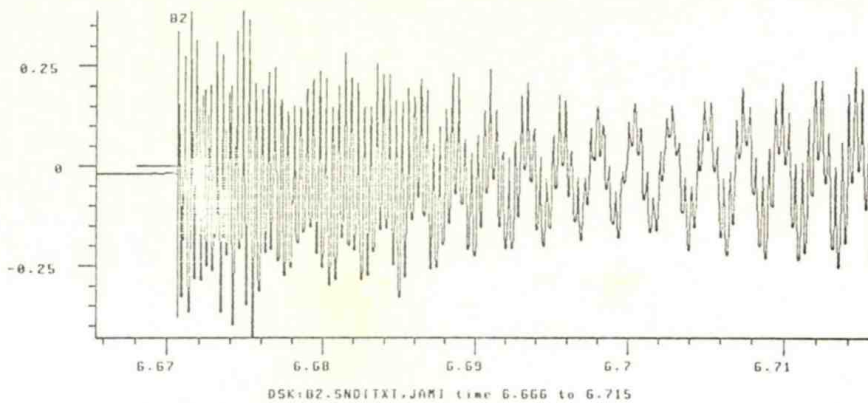
Synthesis Facilities: Up to maximum number of processing units.

Since the operations required for signal processing are identical to the operations required for music synthesis, part or all of the budget of processing units may be used for synthesis. This may be controlled by a standard organ-like keyboard with sliders and buttons. All of the standard synthesizer features are available in polyphonic form. Complete

sequencing and editing of sequences may be easily performed. The sequencer capacity is virtually unlimited (40 million sequence steps directly available, more on request). All synthesis console manipulations are recorded and may be edited just as with the mixing console. Oscillator frequencies have crystal-controlled accuracies down to 0.003 Hz and are absolutely repeatable. Controlled

However, the limit of diagnostic capability was reached in earlier de-bugging and listening tests are currently used to identify "subtle bugs," which are then traced and corrected. Moorer added that a similar digital synthesizer going to a commercial purchaser in the future would probably exceed the current model's speed requirements by a substantial margin.

It was explained, that the device was



(top) Waveform of 45 msec of sample; (bottom) a 3 msec portion from top waveform magnified.

randomness may be added to diminish the repeatability if desired. Synthesis may be performed concurrent with recording, and synthesized tracks may be considered to be in no way different from any other audio tracks.

At the present time, the digital synthesizer and associated software are the most advanced components of the proposed system. The design of the digital synthesizer was a joint effort of the Center's research staff and Systems Concepts, Inc., a hardware prototyping firm in San Francisco that manufactured the device. Since being delivered in May, 1978, the digital synthesizer has undergone extensive de-bugging by James A. Moorer, a co-director at the center.

"We've gotten through all the easy bugs," said Moorer, who has a Ph.D. in computer science. "Now we have bugs that only show up in these immensely complex patches. You'll hear a tisch, tisch, tisch here or a tacka, tacka, tacka somewhere in there, every once in a while. Even though the synthesizer has very high speed logic, we find that some part in it will not be quite fast enough. We then have to replace it with a different issue of the same part that has higher speed specs."

The digital synthesizer has a built-in diagnostic capability to trace problems.

designed to manipulate every aspect of sound. This includes amplitude, phase, frequency, and timbre. Included in the synthesizer, which is a 20 bit integer device, are the following, all of which are under direct computer control:

- 256 oscillators with separate and independent amplitude and frequency envelopes.
- 128 modifier units that can, depending on mode, act as boost or cut resonators, white noise filters, balanced or ring modulators, dual input mixers and other functions.
- An interconnection facility which provides completely automated patching.
- A total of 48 K delay registers which can be organized in up to 32 groups to accomplish phasing, flanging, reverb and digital delay.
- Four channels of audio output, expandable to 16.
- The ability to generate several types of waveforms.

"The standard waveforms produced by the oscillators are sine, square, sawtooth and pulse, or what we call band limited pulse, which is frequency limited to a certain number of components," said Moorer. "You can also gang oscillators exactly phase-locked to do a whole harmonic structure, and you can put different envelopes on each one of them. That's what we call additive synthesis. So for

some very, very complex timbre, like the violin, you might group 16 oscillators with separate amplitude and frequency envelopes. In that case, you could get 16 violins, which is a pretty good violin section."

Three types of operation are possible. Direct synthesis produces an entirely artificial sound based completely on software. The second operational format would take an existing signal, direct synthesis or converted analog, and modify it using any number of the software-controlled processing capabilities. (Typically, these would include equalization, enhancement, filtering, compression, etc.) Finally, synthesized program material could be combined with converted analog performances — which is analogous to overdubbing.

It was pointed out that when recording human performers, an acoustically "dead" studio would be ideal. Reverberation from a "live" studio would, it was explained, interfere with reverberation that is added in post-production.

Fifteen years of effort have resulted in a sophisticated inventory of programs on file, written by students and researchers who have worked at the Center. For instance, Moorer's doctoral thesis on continuous musical sound produced software programs for synthesizing numerous musical instruments.

The computer terminal — a teletype keyboard with video display terminal capable of generating graphics — is used to input commands. To implement modification of signal (analogous to mix-down) any individual sample or group of samples can be extracted from memory and be processed. Program material that is extracted may take the form of digital data or graphic displays. For example, a portion of the material may be displayed as a spectrum analysis graph. Thus, manipulation of program material easily modifies the frequency spectrum, frequency, amplitude and/or phase.

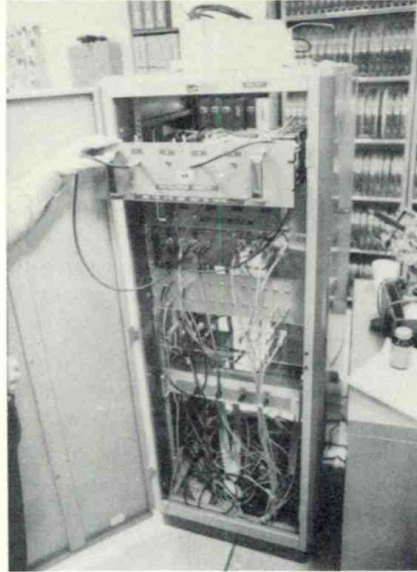
Commands for synthesis and signal manipulation can be input from a device of any design once appropriate software has been developed. An analog-style mixing console could be made for the system, if a user so desired. However, dedicating controls to specific functions, would, it was explained, limit flexibility. An input device such as a teletype keyboard is more appropriate, because it can describe an electronic patch to any signal processing function. Once the manipulation has been performed, the electronic patch "dissolves" and instruction may be input for patches to other signal processing functions. Hence, patch cables and discrete signal processing devices found in analog studios of today would be supplanted by the software-directed digital synthesizer manipulations.

Through spectral and other analysis, the research staff says it could create software routines that duplicate the function of virtually any signal processing device currently in use. To perform the analysis, the output of a signal processing device would be compared with its input. Comparison would indicate the introduction of noise, harmonic distortion, phasing and non-linear effects. Curves representing the application of these effects would be used for creation of software to duplicate the function of the device.

That concept may even be taken a step farther, according to Elliot Mazer, a principal

of CMC. Mazer, who has been active in commercial recording for 17 years, has major album credits as an independent producer. The same sort of analysis could be used to create software necessary to duplicate the signature sound of an engineer or producer.

Research staff and Mazer emphasize that synthesis and signal processing would not be able to replace musicians because human interpretation of a composition would be lacking. However, digital capabilities would allow highly sophisticated manipulation of



Stanford's Digital Synthesizer

recorded signals. The synthesizer would be a sophisticated tool to enhance recordings as well as serve as a tool for composers and arrangers.

The software approach to digital recording permits a variable sampling rate from 20 kHz to 50.4 kHz. The variable rate is a departure from other digital systems with fixed sampling rates. However, a more important stumbling block to potential compatibility with other digital systems is, according to the Center, the format of data. No standard exists for digital recording of audio, although such a standard does exist for data processing. "I would very much like to see everyone go to a simple standard format, but I don't think that it's going to happen right away," Moorer said.

The compatibility obstacle has been overcome in a number of cases already, Moorer added. The Stanford-developed software has been sent to a handful of other research institutions in the U.S. as well as in Europe and converted to the format used by the other centers. Moorer said that conversion "hasn't been a particularly difficult job in these instances."

Signal information that occupies 14 bits is stored in 18 bit-blocks (bytes). "Every time you do subsequent processing, you want to keep some extra bits around to prevent any run off error — processing error," explained Moorer. This reserve capacity is to insure error-free processing and preserve integrity of signals.

Samples are stored in packets of 4,000 bytes. Depending on the chosen sample rate, that represents approximately one-fifth second of program material. Because the software is designed for random access to data, packets are not necessarily stored

sequentially.

Most computer-based automated editing systems used currently at analog studios have a software instruction capacity of several hundred thousand bytes. By comparison, one minute of mono program material that has been recorded at a high sampling rate in any digital recording system would need more than a billion bytes just for storage. "If you start talking about 32 tracks at a 50 kHz sampling rate, the storage required is just stupendous," noted Moorer.

Program information is stored on what is called an "unformatted" disk that is used for simple playback. Editing and signal manipulation require transferring information from unformatted disks to a main disk. "It's a work disk versus a playback disk," explained Moorer. The unprocessed or unedited program material is preserved as is the new signal, which is also put in memory.

Because facilities and computer time are shared with Stanford's Artificial Intelligence Center, the digital research center is faced with several handicaps in its present operations. Recording fidelity is sacrificed because of constraints of sharing the structure. Also, recording and synthesis is done in mono to conserve computer storage capacity. The Center For Computer Research in Music and Acoustics uses less than one-fifth of the computer time available within Stanford's total computer facility, under time sharing arrangements. Using funds generated from CMC operations the digital music research center would move to a separate facility and upgrade its operations.

The following hardware components would be necessary to set up a Stanford-developed digital recording system: A completely debugged digital synthesizer which would cost approximately \$120,000. A minimum of \$250,000 in computer hardware of a buyer's choice would be needed to "drive" the system. Converters would also be necessary.

CMC suggests that a Stanford-like digital recording system with 32- or 48-track capability would be competitively priced "to comparable state-of-the-art analog equipment."

As Elliot Mazer put it, "... some people are building million, and million-and-a-half dollar facilities that are in their view, the complete state-of-the-art of what is available to them today. They could in a year-and-a-half to two years, spend the same amount of money and wind up with a digital studio that would get them everything that they have now ... plus."

SONY CREATES NEW DIGITAL AUDIO DIVISION; ANNOUNCES DIGITAL RECORDING STUDIO COMPONENTS

The family of digital audio products shown by Sony at the recent 'AES' convention in New York consists of their **PCM 1600**, a 16 bit PCM adapter now in production and available for immediate delivery. An all-digital mixer, the **DMX-800**. The **PCM-3200**, an all digital multi-track recorder. The **DRX-1000** digital reverberation unit, as well as a two channel A-D/D-A converter and an additional laser read audio disk playback system.

Statements by Mr. A. Morita, chairman of the board of Sony Corporation, and Michael

Schulhof, president of Sony Industries emphasized the importance Sony places on establishment of the new Digital Audio Division and the products introduced. Mr. Morita likened the digital audio product introductions to past Sony technical breakthroughs such as the World's first solid state videotape recorder in 1963. Mr. Schulhof pointed to Sony's dominance in the broadcast television market and predicted a parallel course for Sony in digital audio.

The PCM-1600 is a two-channel PCM processor for use with Sony's broadcast-model U-Matic videocassette recorders and editing equipment. Using this system, it is possible for a studio to record a stereo master or sub-master with better than 90 dB dynamic range, distortion less than 0.05% over the entire audio spectrum and at all levels up to the limits of the PCM-1600's wide dynamic range. Wow and flutter are immeasurable, being functions not of the mechanical irregularities of a tape transport but controlled by the precision of a quartz sampling-rate clock. There is no tape hiss or print-through.

U-Matic recorders are widely available, reasonably priced, and compact. Electronic editing for U-Matic tapes has been available for some time. Editing and dubbing can be performed in a direct digital-to-digital mode through a video editing console, ensuring no quality deterioration through generation after generation. Using this system, separate takes can be reassembled in any order without signal quality loss (and without the end-to-end pitch changes that can plague analog recorders).

As with other digital recording systems, duplicate masters can be produced with no

generation loss.

An advanced error-correcting code has been developed to ensure that missing information is automatically detected and replaced, eliminating the drop-out problem.

The PCM-1600 also has facilities for synchronization with videotape recorders and other PCM audio units, for synchronized high-fidelity cine or video soundtracks, or for multi-channel use. Using two video recorders and a video editor, the PCM-1600 also allows independent pitch and depth control when cutting records.

Important specifications: Using 16-bit linear quantization, the sampling frequency is 44,056 Hz, allowing approximately six 16-bit words to be recorded on each video horizontal scan line, for a transmission rate of 3.5795 megabits/second.

The remainder of Sony's digital audio line was shown as prototype equipment, to more fully investigate additional user requirements.

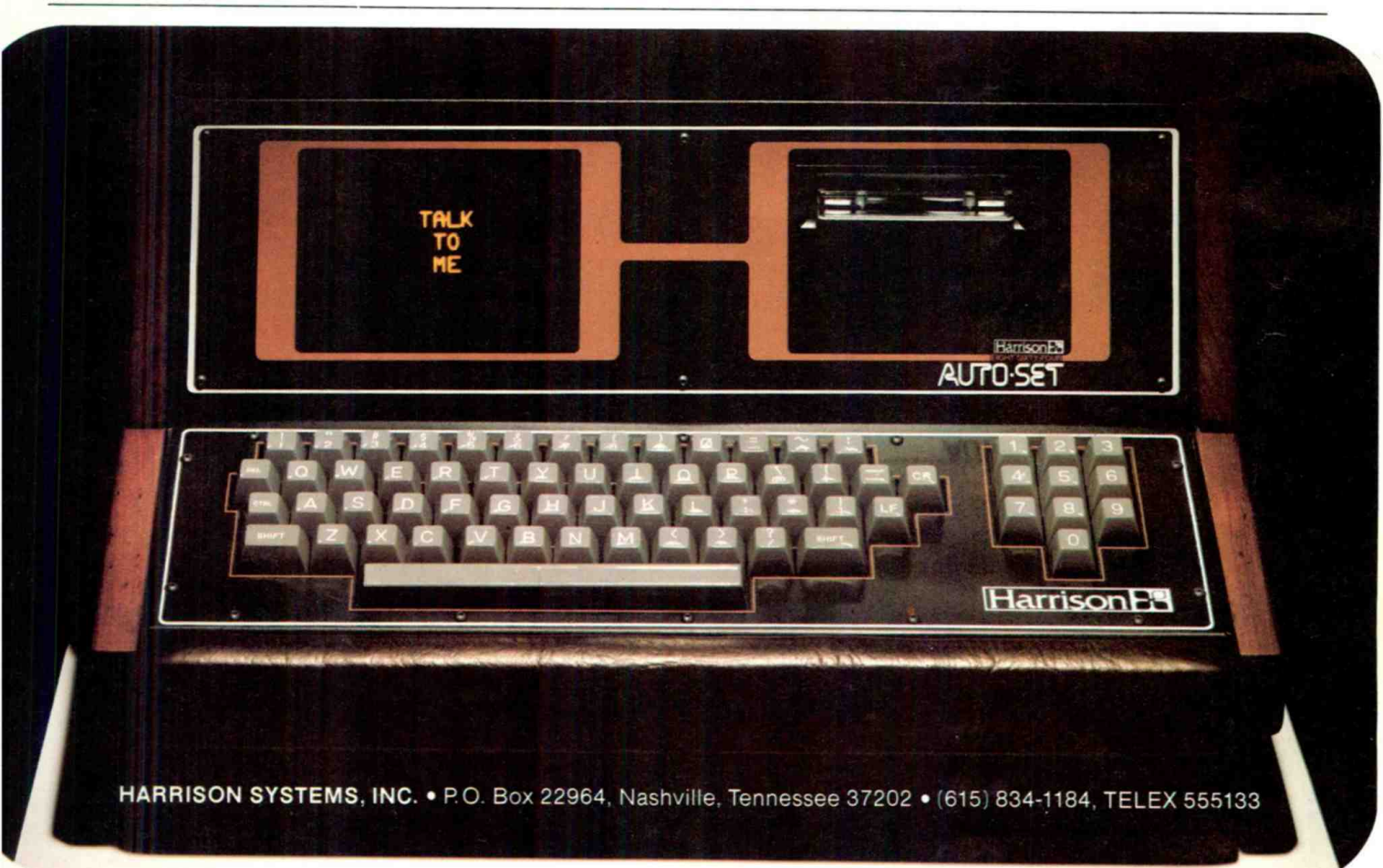
The PCM-3200 Series Multitrack Digital Recorders are to be available in models with 4 to 48 digital channels, plus analog and SMPTE time-code tracks. The decks provide for reliable electronic editing, are comparable in size to conventional studio recorders, and incorporate SMPTE time-code tracks for electronic editing and multi-deck synchronization. Both digital and analog input and output connections are provided, for interfacing with both existing analog equipment and the new generation of digital audio systems. Published performance specifications for the 16-bit encoded system include: Dynamic Range of over 90 dB, distortion better than 0.05% at all frequencies from 20 to 20,000 Hz, and

frequency response flat within +0.5, -1.0dB from 20-20,000 Hz. Crosstalk is better than -90 dB, and wow and flutter are immeasurable.

Tape speed is 22.5 ips, permitting 40 minutes of recording time on a 10-inch reel. Production versions, however, will run at 15 ips, for playing time of 60 and 120 minutes. The PCM-3224 is a 24-channel machine, using one-inch tape; the 16-channel version (PCM-3216) will also use one-inch tape. Two-inch tape will be used by the 32- and 48-channel versions, half-inch tape for the 8-channel version and quarter-inch tape for the 2- and 4-channel models.

Sony explains that the number of tracks is greater than the number of channels, as the format uses two tracks per channel to allow 3-phase modulation, plus two analog audio tracks and one SMPTE time code track. Fast forward and rewind times are two minutes or less for 10-inch reels.

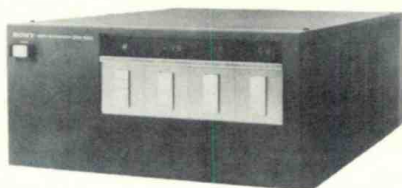
The encoding format employs 16 bit linear quantization, at switch selectable sampling frequencies of 44.056 or 50.35 kHz, for compatibility with other digital equipment (including video-based recorders). The packing density is 3072 bits per inch, or 20480 flux reversals/inch. Three-phase-modulated recording provides higher recording density, hence tape economy, even though the system requires the use of two tracks per channel for proper redundancy. Interleaving, and modified crossword error-correction code effectively corrects dropout errors up to 3840 bits (or more than one-inch) in length. For code errors beyond the system's correcting ability, interpolation is carried out after error detection.



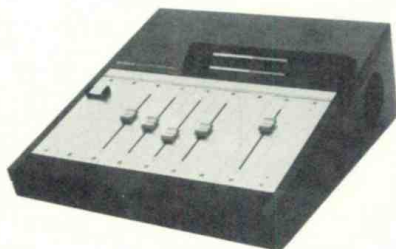
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PCM-3200



DRX-1000



DMX-800



PCM-1600

DMX-800 Digital Audio Mixer: Mixing down from multi-track digital masters to two-channel digital submasters has heretofore meant converting the signal from digital to analog for use with conventional mixers and consoles, then re-converting it to digital or making an analog mixdown tape, with some loss in quality as a result. The Sony DMX-800 has been designed specifically to mix 16-bit, professional-quality digital signals in real time, with no analog process involved.

Operation and appearance of the mixer are quite conventional. There are the usual slide-type fader controls, echo (send and receive) facilities for use with Sony's DRX-1000 digital reverb unit, and analog-type peak program level displays, plus instantaneous digital overflow indicators. The level displays are 280-element plasma (bar-graph) displays rather than conventional meters, having no physical inertia to prevent true peak reading (peaks are registered instantly, but the display's decline from each peak is delayed slightly so the human eye will have a chance to see it), and can be grouped more closely together in multi-channel arrays, for easier visual scanning.

The mixer has eight input and two output channels. It is designed to mix 16-bit linear quantized digital signals, as used by all other Sony digital studio equipment, and can be synchronized with either internal or external sampling-rate clocks. The internal clock offers switch-selectable sampling rates of 44,056 and 50,350 Hz; maximum external clock rate is 56 kHz. The mixer can also be used with conventional analog equipment, interfaced via an A/D/D-A converter such as the newly announced Sony ADA-1601.

Sony plans to develop more sophisticated digital mixers with more than 8-channel input/output, up to 48 channels. The primary purpose for displaying the 8-channel mixer was to investigate customer requirements, including equalization specifications.

DRX-1000 Digital Reverberation Device: Designed for direct connection to 16-bit digital audio systems the DRX-1000 can

also be used in analog systems, with the addition of Sony's companion **DAD-1601 A/D/D-A Converter**.

A built-in microcomputer allows front-panel programming of any of four reverberation modes. Reverberation mode selection is stored in a non-volatile memory, which retains its contents even when the system's power switch is off. The DRX-1000 accepts digital signals directly, and adds reverberation digitally; there are no analog-digital conversions, unless the delay unit is linked to conventional analog studio systems by an external converter.

The DRX-1000 offers a range of initial delay times from 0 to 100 milliseconds, with reverberation times that range from 0-20 seconds. Up to 90 dB of input-level attenuation is available if required.

The use of digital techniques allows a signal-to-noise ratio of 90 dB, distortion levels of 0.05%, and frequency response that is flat from within plus or minus 3 dB to 20,000 Hz, even at minimum delay and reverberation-time settings.

Manager of Sony's Digital Audio Products Division is **C. Roger Pryor**, who is located at:

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**3M ANNOUNCES DIGITAL
RECORDING REFINEMENTS:
DIGITAL EDITING SYSTEM
AND DISK LATHE PREVIEW
UNIT — CONSOLE BEING
DEVELOPED**

The new digital equipment developments, and announcement that deliveries of the first 32-channel, two-unit mastering systems have begun, according to a statement by **Marshall Hatfield**, vice president of 3M's Mincom Division, verify the company's commitment to the goal of making superior quality digital

sound ultimately extend from microphone to speaker. Hatfield also noted that preliminary work on a studio console had begun.

While acknowledging that there has been some industry discussion surrounding standardization, presently delayed at the request of the AES while it attempts to determine legal status of such discussions, 3M's **Bob Brown**, marketing director for the equipment division, said 3M feels it must proceed into the market in behalf of the studios and the technology. He observed that, in all probability, it will be the day-to-day successful use of systems that will determine what standards studios will accept, rather than an arbitrary decision at this point.

As to the announcements of other companies preparing to enter the studio market with digital recording equipment, Brown said that this was anticipated and welcomed. It's recognition of the superior sound quality that digital can offer, and



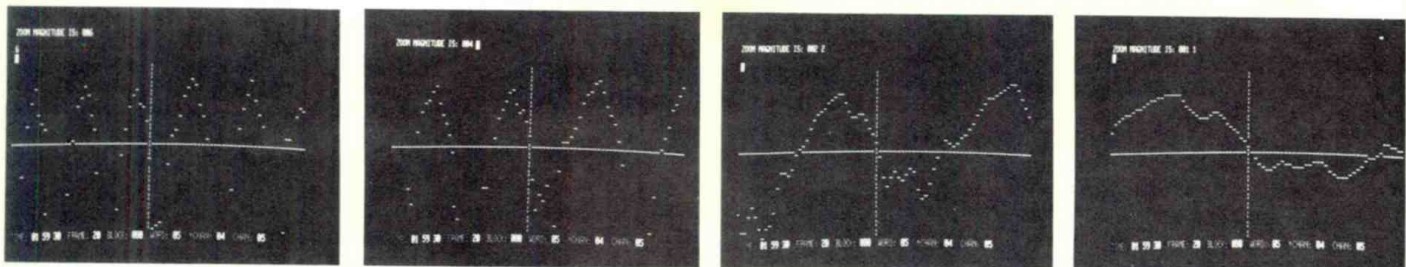
Artist's conception of 3M electronic digital editing system.

confirms Hatfield's prediction made a year ago that this technology will revolutionize sound recording.

Regarding 3M's mastering systems, some small changes have been made in the data and parity deployment of signals on tape in the interests of improving punch-in and editing capabilities. The system also will incorporate new styling of equipment to be produced starting in mid-year 1979.

The disc lathe preview unit is an accessory that delays a set of digital signals from the master recorder while analog signals proceed to a conventional lathe controller that optimizes the spacing (pitch) between disk grooves. Because the delayed signals stay in the digital domain through this additional process, their integrity is maintained until the end of the delay, resulting in equivalent quality to the original recorder output.

The unit consists of a random access memory (RAM), time generator and digital-to-analog converters. Signal delay is adjustable up to 1.3 seconds. The unit can either be incorporated into the master recorder or made available as a self-contained, stand-alone unit for optional use in the disk cutting room, remote from the recorder.



Sequence illustrates zoom feature of 3M's digital editing system. Visual representations of sound amplitude on the video screen may be decreased or increased in magnitudes of enlargement to facilitate coarse and fine visual identification of appropriate edit points. Sequences here zoom from resolution of six (upper left) down to one (lower right), where each point on the display represents an individual 20 microsecond sample.

The most significant announcement made by 3M is of a programmable electronic digital editing system for use with 3M's multi-channel digital mastering system. This development, an early prototype of which was demonstrated with simulated recorder signals at the AES meeting, was engineered jointly with Inter-technology Exchange (ITX), Ltd., of Hollywood, a research and manufacturing firm with expertise in studio design. Availability of the system probably will be in the fourth quarter of next year.

According to **Bob Youngquist**, research manager of Mincom, and **Don Davis**, manager of digital systems development of ITX, the editing console consists of a video screen, a teletypewriter keyboard augmented with special function keys and remote controls for the 32-channel pre-mix and 2/4 track master recorders.

An operator working with the system would select the rough location point for an edit by listening, but with the 3M system, he would

then be able to further refine the appropriate location by observing enlarged visual representations of the sound amplitude on the video screen. The display first shows 40 samples on either side of the tentative point selected by listening. But, for a broader perspective, a zoom function will permit observation of much more. Recorded time codes control the precise definition of edit points, while enabling microprocessor control of execution with accuracy within 20 microseconds (one 50,000th of a second).

Insert editing (the inserting of new material in a previously recorded section of a multi-track tape) involves keyboard definition of punch-in and punch-out points, the execution under microprocessor control in one tape pass. This procedure also allows assembly of a master track from multiple tracks of the same performance, provided the takes are recorded in sync on the same tape; it uses only one multi-track recorder.

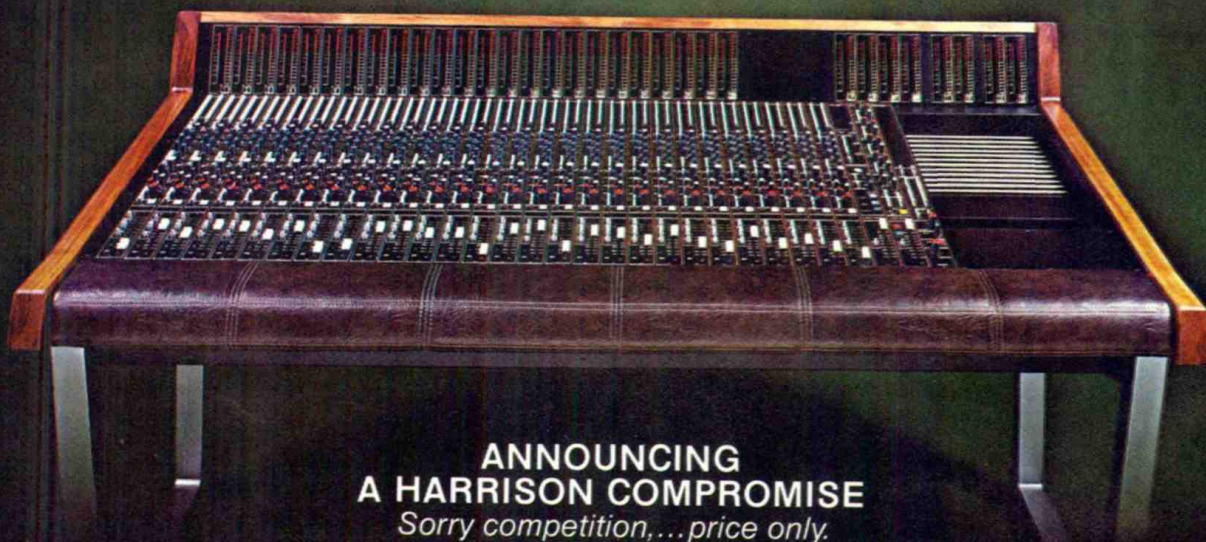
Assembly editing, analogous to cut-and-

splice editing in traditional recording, allows out-of-sequence building of a final multi-track version through interim transfer from the 32-track recorder at a different tape location. This assembly is accomplished, three tracks at a time, by transfer under editing system control after the sequences and edit points are defined. Edited masters of any required degree of complexity may be assembled. The source material is unaltered and the final product not compromised by physical splices.

While the creative capabilities are said to be greatly expanded by the system's sophistication, set-up sequences are interactive; the system leads the operator through the appropriate steps, asking for human decisions at each step. An operator may preview the effect of the finished edit before committing the system to execute the actual copying.

The digital editing system and disk lathe preview unit will be available under a lease/rental arrangement, as is the mastering system. □ □ □

GREEN BACK

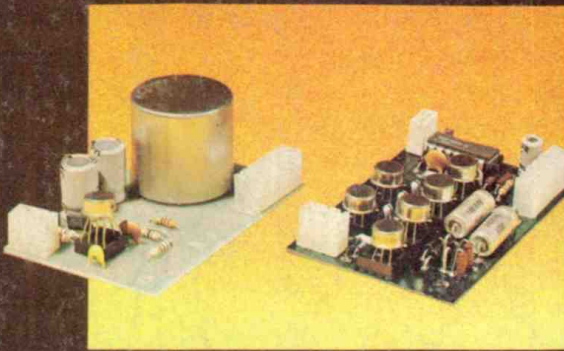


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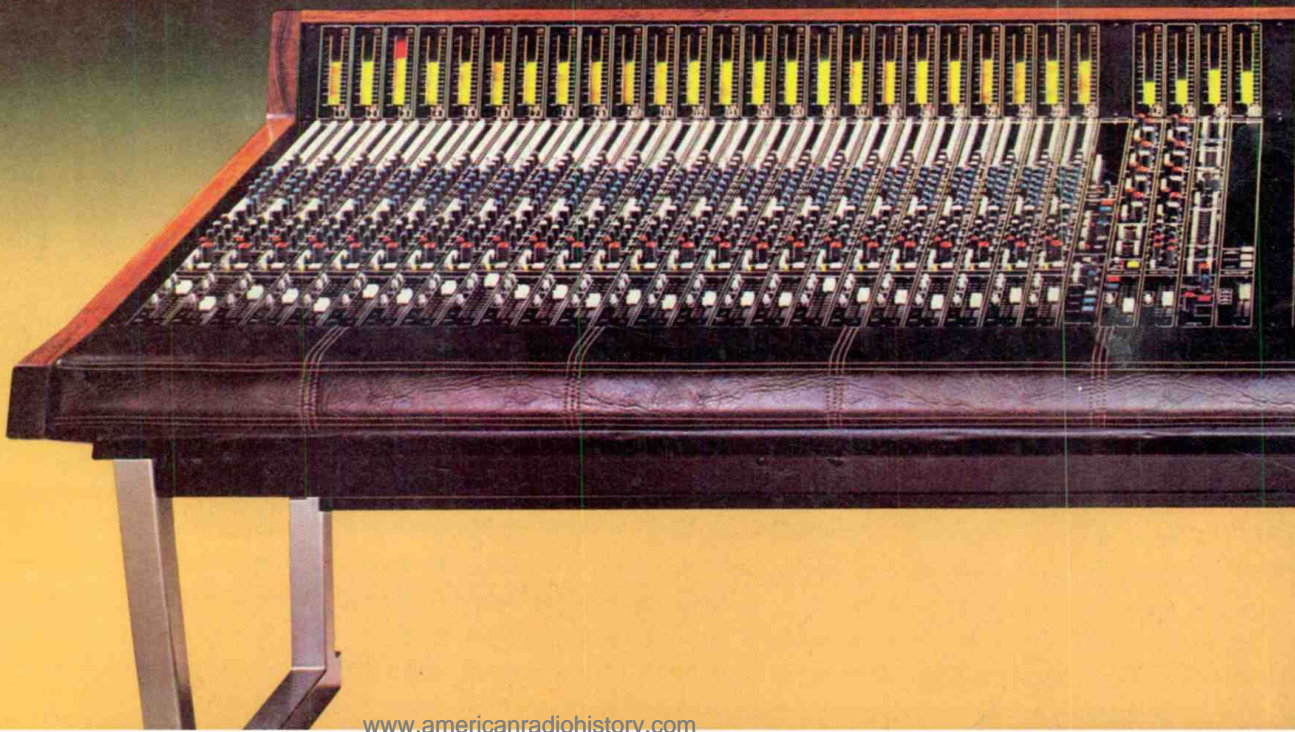
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NEW Proprietary Transformerless Microphone Preamplifier is available at no extra cost in all 32C series consoles. Opening up a new world of sonic experience, it's a difference you can hear. Contact your Harrison distributor for a demonstration. For those who would prefer, the traditional transformer mike pre-amp continues to be available.

NEW 4832C Master Recording Console. 48 I/O module positions with VCA grouping and AUTOSET are ideal for mixing from two locked 24 track recorders. 48 I/O modules also allow effective split operation. Record on one group of modules and monitor on another group. Master modules may be placed in the center for easy access.

NEW 4432C Master Recording Console. A compact, light weight Harrison made especially for remote recording and any other weight or space sensitive application. Utilizing the standard 32C series modules, the Harrison 4432C does not include wood trim or patch bays. It does come with all normal patch points terminated in quick connect splice blocks for easy connection of full external patching. All "normalled" patch points are looped with jumpers on splice blocks so that full patching need not be installed for operation. A new compact aluminum frame and efficient wire routing keep weight extremely low for a full 44 X 32 console. The 4432C is ideal for studio applications where it is desired to customize patching and cabinetry.



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