ISSN0011-7145

THE SOUND ENGINEERING MAGAZINE

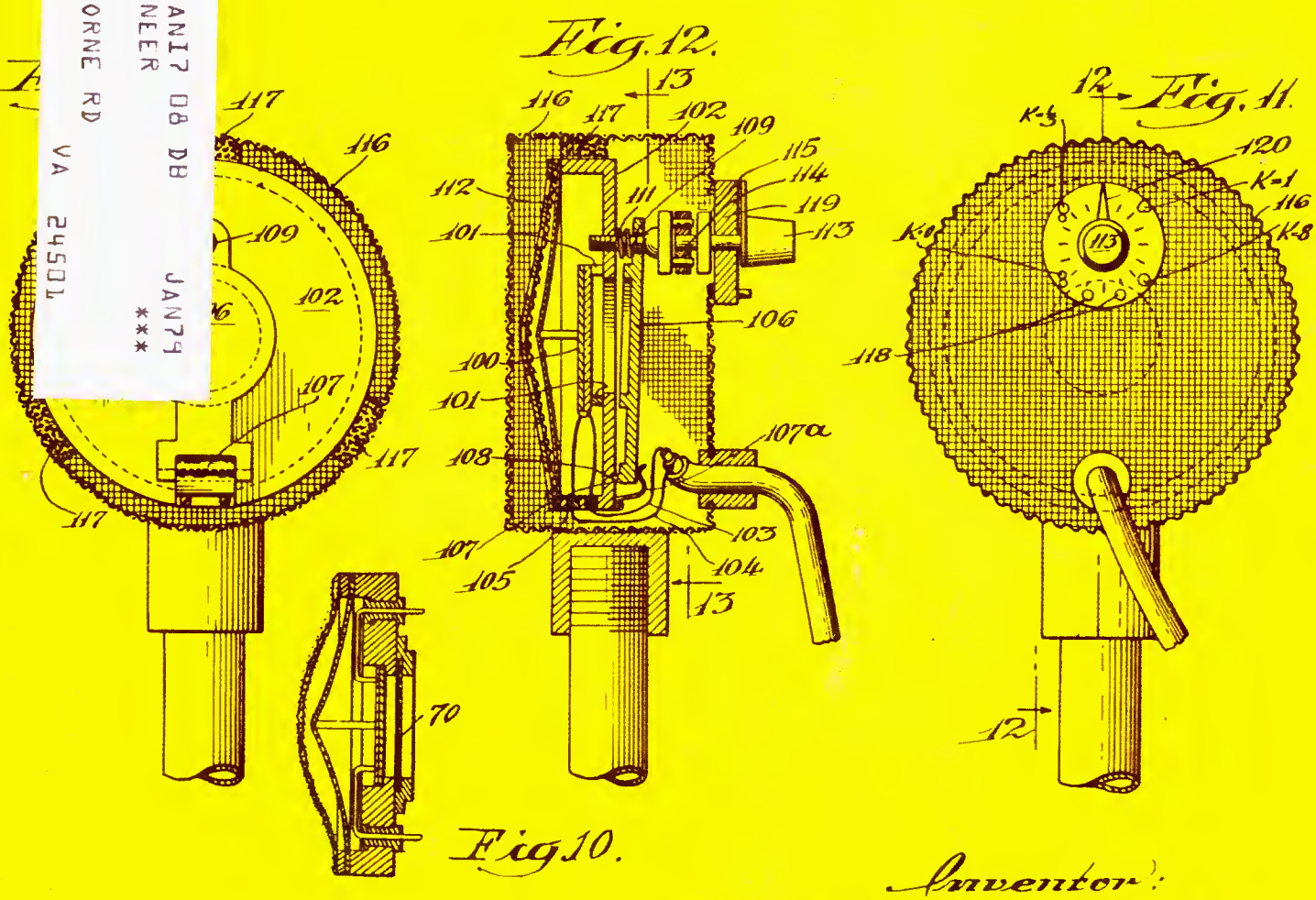
AUGUST 1978
$1.00

db

Dec

B. B. BAUER

2,305,598



Inventor:
Benjamin B. Bauer
By Dawson, Coms. & Booth
Attorneys

Today's performance requires the best in an audio test source. That's the new Sound Tech 1410A.

No question about it, the new Sound Tech 1410A is the finest audio test source available. It provides both sine wave (10 Hz - 110 kHz) and SMPTE intermodulation test outputs.

We classify it as an ultra-high-performance audio signal generator. Here's why:

Besides providing an ultra-pure test signal (typical distortion is **less than** .001% over most of audio range), the test signal is adjustable by precision output attenuators. And you have an exceptionally large output level range: from +26 dBm to −89.9 dBm in 0.1 dB steps. That +26 dBm can be a powerful help in line testing (no pun intended).

The output system on the 1410A is Sound Tech's special circuit. For minimum distortion, it has no output transformer, yet **it's both fully isolated and balanced.** That means **you can connect to any load: balanced or unbalanced, floating or grounded.**

INTERMODULATION TESTING

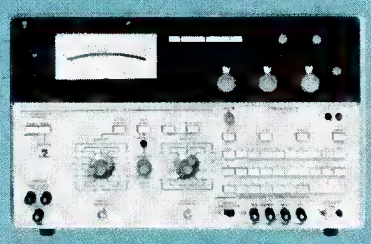
For intermodulation measurements, the 1410A provides the standard 60 Hz signal combined with a 7 kHz signal. You can vary the LF/HF ratio over a 100:1 range. The IM signal is provided from the same flexible output system discussed earlier.

With the high performance possible in today's audio systems, the 1410A (or its relative, the 1710 system) is what's needed for adequate testing.

CALL FOR DATA

Call Mike Hogue/Larry Maguire and get our literature on the industry's most advanced audio test source.

They can also arrange a demo for you almost instantly.



REMOTE TESTING

In broadcast work involving remote transmitters, you can test by using the 1410A with the Sound Tech 1710A Distortion Measurement System. With its ½ watt of audio power, the 1410A can be used, say, at the studio to test studio-transmitter links, amplifiers, etc., while the 1710A is measuring at the transmitter.

SOUND TECHNOLOGY

1400 DELL AVENUE
CAMPBELL, CALIFORNIA 95008
(408) 378-6540

In Don Mills, Ont., Canada: The Pringle Group

Circle 10 on Reader Service Card

Coming Next Month

• Next month, the NRBA (National Radio Broadcasters Association) holds its 1978 Convention at the Hyatt Regency Hotel in San Francisco (17-20 September). And, what better excuse do we need to pry into the subject of Audio and Broadcasting—or, if you prefer: Broadcast Audio?

We'll take a quick look at the NRBA itself, and then drop in on Bonneville Broadcast Consultants, whose task it is to prepare audio programming for its subscriber-stations. It's not quite the simple disc-to-tape duping operation that you might expect.

Getting that audio from here to there is also no routine operation. So, at McCurdy Radio, Cliff Rogers is working on a story about STL's (how many recording types know what they are?) And, from the National Public Radio Network, we hope to have some news about their use of satellite transmission systems.

Is the FCC finally going to do something about AM stereo and FM quad broadcasting? According to the grapevine, the beaurocratic wheels may move another few degress (perhaps by the time you read this, though not as we're writing it). In any case, we'll keep you posted in September.

And, we should also have some information about building your own broadcast console (well, why not?), using digital delay lines on live broadcasts, building a new station, and, when not to use noise reduction. Stay tuned.

About The Cover

• This is one of a number of patent drawings of cardioid designs for Shure Brothers, Inc. that were done for them by their young engineer Benjamin B. Bauer, the same Ben Bauer that has other patents in his name from not only Shure, but CBS Labs, later to be called CBS Technology. We've just learned that Ben has retired as v.p. and general manager of CBS Technology and is now president and director of research at Audio-Metric Laboratories, Inc. of Stamford, Connecticut. We expect the flow of patents to continue unabated. See page 32 for one of the latest patents, and page 37 for a look backwards.

db

THE SOUND ENGINEERING MAGAZINE

AUGUST 1978 VOLUME 12, NUMBER 8

is listed in **Current Contents: Engineering and Technology**

Larry Zide PUBLISHER
Bob Laurie ART DIRECTOR
Eloise Beach CIRCULATION MANAGER
Ann Russell ADVERTISING PRODUCTION
John M. Woram EDITOR
Hazel Krantz COPY EDITOR
Lydia Anderson BOOK SALES
Crescent Art Service GRAPHICS AND LAYOUT

db, the Sound Engineering Magazine is published monthly by Sagamore Publishing Company, Inc. Entire contents copyright © 1978 by Sagamore Publishing Co., Inc., 1120 Old Country Road, Plainview, L.I., N.Y. 11803. Telephone (516) 433 6530. db is published for those individuals and firms in professional audio-recording, broadcast, audio-visual, sound reinforcement, consultants, video recording, film sound, etc. Application should be made on the subscription form in the rear of each issue. Subscriptions are $7.00 per year ($14.00 per year outside U.S. Possessions, Canada and Mexico) in U.S. funds. Single copies are $1.00 each. Controlled circulation paid at Brattleboro, VT 05301. Editorial, Publishing, and Sales Offices: 1120 Old Country Road, Plainview, New York 11803. Postmaster: Form 3579 should be sent to above address.

db Calendar

SEPTEMBER

10-13 **Independent Background Music Operators Convention.** San Diego Hilton, Mission Bay (San Diego), Ca. Contact: Steve Jones, MUSI-CAL, 1608 Polmyrita Ave., Riverside, Ca. 92507.

11-13 **J.B.L. Sound Reinforcement Workshop.** Vancouver, Canada. Contact: Nina Stern, James B. Lansing Sound, Inc. 8500 Balboa Blvd., Northridge, Ca. 91329. (213) 893-8411.

New York Management Seminars. Contact: Heidi E. Kaplan, Dept. 14NR, New York Management Center, New York, N.Y. 10017. (212) 953-7262:

11-13 **Management of New Technology Projects.** Boston, Mass. N.Y.U.

14, 15 **New Products: A Systematic Approach.** Houston, Texas. N.Y.U.

21, 22 **Foreign Market Entry Strategies.** Chicago, Ill. Wharton School.

27-29 **Effective Communication for Engineers.** NYU. Chicago.

12-14 **Wescon Electronic Show & Convention.** Los Angeles. Convention Center & New Bonaventure Hotel. Contact: Electronic Conventions, Inc., 999 N. Sepulveda Blvd. El Segundo, Ca. 90245. (213) 772-2965. (800) 421-6816.

17-20 **National Radio Broadcasters' Association, Convention.** Hyatt Regency Embarcadero Hotel. San Francisco. Ca. Contact: N.R.B.A., Suite 500, 1705 De Sales St., N.W., Washington.

20-24 **Autumn Hi-Fi Show.** Cunard International Hotel. London. England. Contact: British Information Services, 845 Third Ave., New York, N.Y. 10022. (212) 752-8400.

25-29 **International Broadcasting Convention.** Wembley Conference Centre. London, England. Contact: British Information Services, see above.

18-20 **Wescon Electronic Show.** San Francisco, Ca. Brooks Hall & Civic Auditorium. Contact: Wescon 79, Suite 410, 999 N. Sepulveda Blvd., El Segundo, Ca. 90245. (213) 772-2965. (800) 421-6816.

index of advertisers

db sales offices

THE SOUND ENGINEERING MAGAZINE

New York
1120 Old Country Rd.
Plainview, N.Y. 11803 516-433-6530

Roy McDonald Associates, Inc.
Dallas
Stemmons Tower West, Suite 714
Dallas, Texas 75207 214-637-2444

Denver
3540 South Poplar St.
Denver, Colo. 80237 303-758-3325

Houston
3130 Southwest Freeway
Houston, Tex. 77006 713-529-6711

Los Angeles
500 S. Virgil, Suite 360
Los Angeles, Cal. 90020 213-381-6106

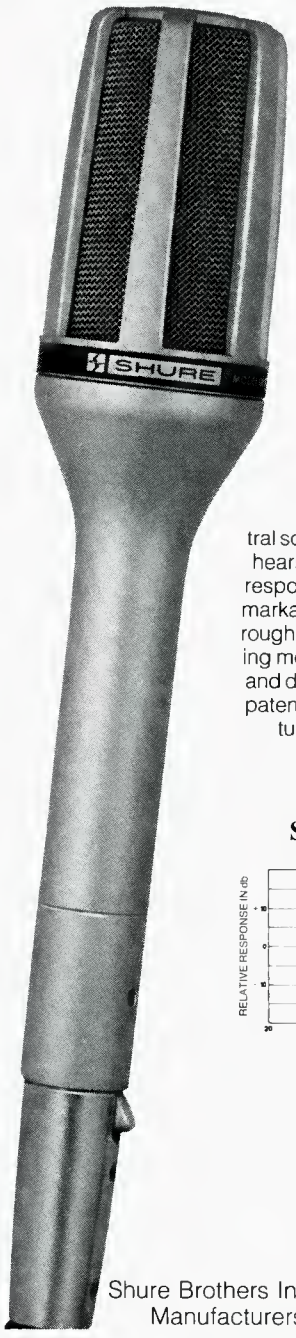
Portland
2035 S. W. 58th Ave.
Portland, Ore. 97221 503-292-8521

San Francisco
Suite 265, 5801 Christie Ave.
Emeryville, Cal. 94608 415-653-2122

Circle 15 on Reader Service Card

fact:
you can choose your microphone to enhance your sound system.

Shure makes microphones for every imaginable use.
Like musical instruments, each different type of Shure microphone has a distinctive "sound," or physical characteristic that optimizes it for particular applications, voices, or effects.
Take, for example, the Shure SM58 and SM59 microphones:

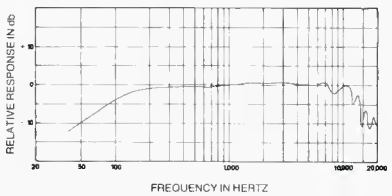


SM59

Mellow, smooth, silent...

The SM59 is a relatively new, dynamic cardioid microphone. Yet it is already widely accepted as a standard for distinguished studio productions. In fact, you'll often see it on TV . . . especially on musical shows where perfection of sound quality is a major consideration. This revolutionary cardioid microphone has an exceptionally flat frequency response and neutral sound that reproduces exactly what it hears. It's designed to give good bass response when miking at a distance. Remarkably rugged — it's built to shrug off rough handling. And, it is superb in rejecting mechanical stand noise such as floor and desk vibrations because of a unique, patented built-in shock mount. It also features a special hum-bucking coil for superior noise reduction!

Some like it essentially flat...

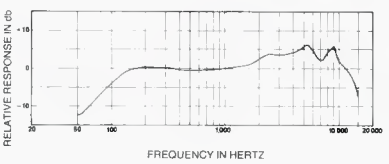


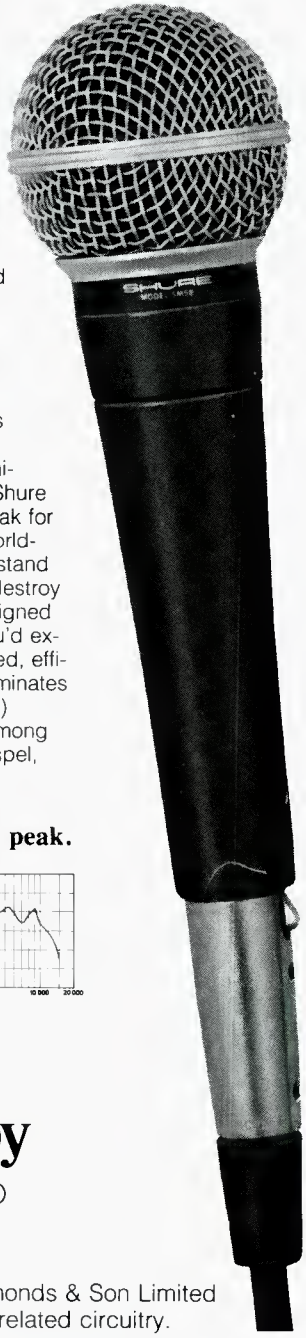
SM58

Crisp, bright "abuse proof"

Probably the most widely used on-stage, hand-held cardioid dynamic microphone. The SM58 dynamic microphone is preferred for its punch in live vocal applications . . . especially where close-up miking is important. It is THE world-standard professional stage microphone with the distinctive Shure upper mid-range presence peak for an intelligible, lively sound. World-renowned for its ability to withstand the kind of abuse that would destroy many other microphones. Designed to minimize the boominess you'd expect from close miking. Rugged, efficient spherical windscreen eliminates pops. Lightweight (15 ounces!) hand-sized. The first choice among rock, pop, R & B, country, gospel, and jazz vocalists.

...some like a "presence" peak.





professional microphones...by SHURE®

Shure Brothers Inc., 222 Hartrey Ave., Evanston, IL 60204, In Canada: A. C. Simmonds & Son Limited
Manufacturers of high fidelity components, microphones, sound systems and related circuitry.

Circle 17 on Reader Service Card

calendar (cont.)

OCTOBER

5-8 **High Fidelity Music Show,** New York City. Statler Hilton. Contact: Teresa Rogers, P.O. Box 67, New Hope, Va. 24469. (703) 363-5836.

5-8 **New York Management Seminars.** Contact: Heidi E. Kaplan, 14NR, New York Management Center, 360 Lexington Ave., New York, N.Y. 10017. (212) 953-7262.

5-6 **The Effective Engineering Manager.** New York City.

5-6 **Unlocking Creativity.** New Orleans.

23-24 **New Products:** A Systematic Approach. Chicago.

16-19 **Instrumentation-Automation Conference & Exhibit.** Philadelphia Civic Center. Contact: Instrument Society of America, 400 Stanwix St., Pittsburgh, Pa. 15222. (412) 281-3171.

16-18 **JBL Workshop,** Sound Reinforcement. Chicago. Contact: Nina Stern, James B Lansing Sound, Inc., 8500 Balboa Blvd., Northridge, Ca. 91329. (213) 893-8411.

17-19 **INTERNEPCON/UK** Metropole Exhibition Centre, Brighton, England. Contact: British Information Services, 845 Third Ave., New York, N.Y. 10022. (212) 752-8400.

18 **National Radio Broadcasters Association, Sales Manager Seminar.** The Welsh Company, Tulsa, Oklahoma. Contact: NRBA, Suite 500, 1705 De Sales St., N.W. Washington, D.C. 20036. (202) 466-2030.

29-11/2 **Society of Motion Picture & Television Engineers Conference,** New York City, Americana Hotel. Contact: SMPTE Conference, 862 Scarsdale Ave., Scarsdale, N.Y. 10583. (914) 472-6606.

The "better than" equalizer

crown EQ-2

The Crown EQ-2 is a ½-octave equalizer on octave centers with two channels, eleven bands per channel. ±15dB of boost/cut is available for each band. That's one reason why the EQ-2 is a better choice. But there's much more.

Adjustable center frequencies – The Crown EQ-2 is better than a parametric because you can control boost and cut for eleven-bands per channel with adjustable center frequency for all 22-bands. It cures many more room problems.

Simple set-up – The Crown EQ-2 is better than a ⅓-octave graphic because it's simpler to set up, yet provides full-range control. The EQ-2 can also be cascaded to create a 22-band, ½-octave mono equalizer.

Unique tone control – The Crown EQ-2 is better than other equalizers because of its unique tone control section. Shelving-type bass and treble controls with selectable hinge points reduce phase shift problems, since low and high frequency problems can be resolved before equalizing begins. This feature also permits quick reshaping of the response curve for different room populations without altering basic equalization.

Superb specifications – The Crown EQ-2 is "better than" because of a signal-to-noise ratio 90dB below rated output, and THD less than .01% at rated output.

Reliability – It's "better than" because it's Crown. That means reliability, ruggedness, and better value.

New RTA – It's also "better than" because Crown now manufactures a real time analyzer which, used in conjunction with EQ-2, makes the job of equalizing even easier.

Write or call today. We'll be glad to arrange a demonstration of both the EQ-2 and the new RTA at your convenience. Your systems deserve to be "better than."

crown

1718 W. Mishawaka Road, Elkhart, Indiana 46514

American innovation and technology...since 1951.

Circle 16 on Reader Service Card

PATRICK S. FINNEGAN

Audio Distortion

• The ideal audio system will pass all audio signals within its design bandpass without changes or modifications except those changes we desire. But this is a practical world, so inevitably some undesirable changes will occur, distortions which arise from a number of causes. This month we will discuss some of these distortion types and some of the reasons they occur.

FREQUENCY DISTORTION

The entire audio system should have a flat response curve within its design bandpass. If the response curve is irregular, the various frequency components of the signal will not receive equal amplification; frequency distortion is present.

Assuming the system has been properly designed and installed in the first place, the most common cause of frequency distortion is that one or more components of the system are falling or have failed, and a flat impedance across the bandpass no longer exists. Each frequency in the audio signal does not see the same impedance and thus cannot develop the same output voltage as does its neighbor. Operational problems can also create frequency distortion, and are most often due to carelessness—mismatching of units when making special arrangements, or modifications made to the system without thought given to the effects such modifications may have on the system bandpass.

HARMONIC DISTORTION

As the audio signal passes through the system, one or more circuits in the system may generate harmonics from the fundamental signals in the audio. Those harmonics which are in the system bandpass will be added to the audio signal. When the system creates harmonics in this manner, harmonic distortion is present. The harmonics which are added will change the wave shape of the original signals.

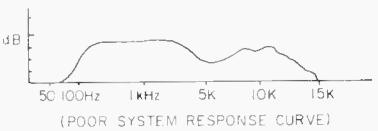
Non-linear operation of one or more stages in the system, or peak clipping, are the most common cause of harmonic distortion. Such conditions can very often be traced to some system component which is falling or has already failed. Whenever the part which failed can change the parameters of a stage, its operation will change, and most likely in a direction which causes non-linear operation or signal clipping. Power supplies or d.c. voltage dividing networks can easily change the parameters of one or several audio stages when components fail. But even though no change has occurred in stage parameters, operational problems can just as easily create the same conditions by overloading an amplifier with high signal levels, or accidently changing a setup control instead of the operating control.

PHASE DISTORTION

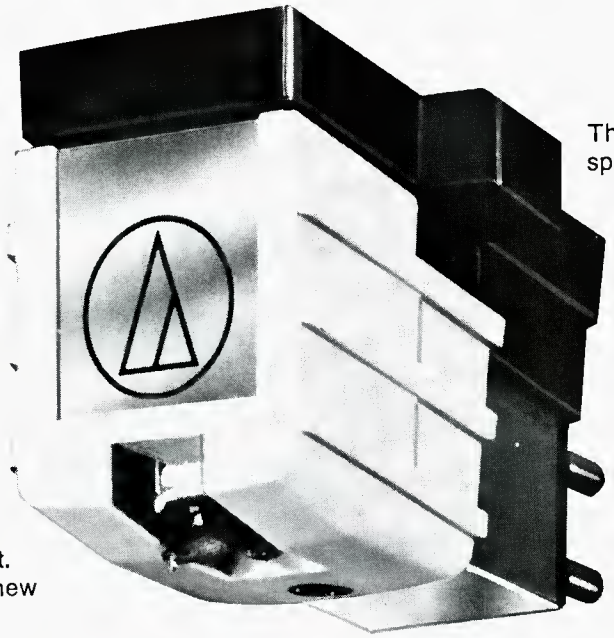
All frequency components of the audio signal should pass through the system without any one component caused to lead or lag other components of the signal. When these time relationships among the various signal frequency components have changed, phase distortion is present. Besides timing changes within the signal, the entire signal can be delayed in relationship to itself when sent over two separate circuit paths and then later added back together.

The rapid transition around filters and equalizers is a very common cause of phase distortion. So is mismatching of circuit impedances, and especially very long circuits such as telephone lines. Yet another common cause is feedback from output circuits to earlier stages of the system carrying the same signal. Operational problems which cause phase distortion are

Figure 1. A poor system response curve creates distortion because what comes out of the system is not the same as what went into it.



Audio-Technica rewrites the book on professional phono cartridges.



Introducing The Professionals

The new Audio-Technica ATP Series Dual Magnet™ Stereo Phono Cartridges

What do you really need from a professional phono cartridge? Impeccable quality. Reliability. Uniformity. And reasonable cost. The goals we've met with the new ATP Series cartridges.

The new ATP Series are flat, smooth, low distortion performers that will do your station, studio, disco, library, or commercial installation proud. They are also very tough... the next best thing to "bullet proof". Because we know that "needle drop" isn't just a way to pay for music or SFX. It's a fact of life!

Both ATP cartridges and styli are *uniformly* excellent. When you at last need to replace a stylus, you always get "like new" performance again, and again, and again.

Don't confuse the ATP Series with other "professional" cartridges that are merely modified home units. ATP units don't have to be treated with kid gloves. And yet we haven't sacrificed tracking ability to make them rugged.

The all-new ATP cartridges were specially developed for the working environment. Three models provide a choice of either spherical or elliptical styli. Each cartridge is hand-tuned for optimum performance, with stereo channels matched within 1.5 dB to eliminate balance problems.

All ATP cartridges feature tapered cantilever tubes that combine high strength with minimum moving mass. There's no problem with back cueing, and the brightly colored cantilever tip is readily visible so that you can spot an LP cut quickly and accurately.

ATP cartridges are priced from $25.00 suggested professional net. Write for complete specifications. Try the ATP Professionals on your own turntables. We know you'll be pleased with what you hear. From the thoughtful pros at Audio-Technica.

Upgrade your entire record-playing system with new ATP tone arms. Rugged and precise, like ATP cartridges. Professional in every respect. Model ATP-12T or ATP-16T just $120.00 suggested professional net.

audio-technica®

INNOVATION □ PRECISION □ INTEGRITY

AUDIO-TECHNICA U.S., INC., Dept. 88BD, 33 Shiawassee Avenue, Fairlawn, Ohio 44313 • In Canada: Superior Electronics, Inc.

very often caused by carelessness—for example, not observing the polarity on a patch plug when making temporary patchups in the patch bay. Turning the plug over will reverse the signal phase 180 degrees. Another mistake is not observing the correct polarity when attaching plugs to microphones, and then using two out-of-phase mics alongside each other on the same podium or set.

BYPRODUCTS

System conditions which create one form of distortion very often also create other forms. Consequently, there is very often more thn one form of distortion present at the same time. As though this were not enough to clutter and deteriorate the audio signal, byproducts may also be formed. One such byproduct is intermodulation distortion. This type of distortion occurs when non-linear operation of a stage or peak clipping of the signal is taking place. As the program audio passes through such a stage, a low frequency component of the audio will modulate a higher frequency audio component. The modulation process adds signal components to the original signal that are not harmonically related to the signal components creating them.

Figure 2. Harmonics will add back to the fundamental and change its wave shape.

OTHER CAUSES

Although faulty components, misadjustment or misoperation are the more usual causes of distortion in the audio signal, other conditions can develop that will also create distortion in some form.

Consider a common fault—a dirty jack or a loose connection. Oxidation can build up between the two contact points. This oxidation can soon become a very high resistance in series with the circuit and should effectively open the circuit. But the oxidation layer is very thin and two conductors separated by a very thin, high resistance also form a small value capacitor. So consequently, the signal will be coupled across the high resistance by capacity. The capacitor, however, will discriminate against the low frequency components of the signal and cause distortion.

CORRODED CONNECTIONS

Corrosion can develop when two dissimilar metals are connected together and current flows through the connection. Acids can also cause corrosion. Whatever the cause of the corrosion, such a connection can become a rectifier and clip the audio signal passing through it, or at least present a non-linear series circuit.

If there is a strong rf signal also present at that connection, rectification of the rf carrier may result so that modulation taken from the carrier is added to the original audio signal. Besides the other distortions of the audio signal, intermodulation distortion can occur.

RFI

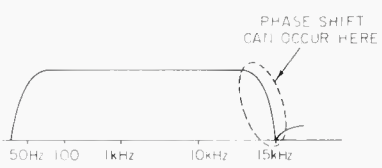
We are all aware of the problems that can develop when solid state audio units are in a strong rf field. The newer solid state units have "rf proofing" built into them. But that does not mean it will be effective in all cases, or remain effective.

A transistor is essentially two diodes placed back to back, so rectification of the rf signal can occur. If the rf signal is strong, enough d.c. voltage may be derived from the rectification that is added to the normal stage voltage. This can shift the operation of the stage so that it becomes non-linear and distorts the audio signal passing through it.

TURNTABLES

Distortion in music emanating from records can originate at the turntable itself. The point most susceptible to wear and damage is the delicate stylus. The diamond tip will wear away after much usage, and dropping the tone arm or scooting it across the record can knock the tip off altogether. Playing a record with such a badly worn or damaged stylus will produce a distorted audio output and also noise. Aside from producing poor quality audio, the grooves on that record can

Figure 3. The sharp transitions on a filter curve can cause phase distortion.



A JBL MONITOR KNOWS ITS PLACE.

A studio monitor is only a tool. It is not supposed to enhance, add to, subtract from, or in any way modify sound.

That's your job.

What a studio monitor is supposed to do is tell you precisely what's on tape. Because you have to know everything that's there. And everything that isn't. Before it's too late.

That's why JBL monitors are in thousands of recording and broadcast studios around the world. In fact, according to a national survey by Billboard Magazine, JBL's are in more recording studios than any other brand.

A JBL monitor plays what it's told. Nothing more. Nothing less. If that sounds good to you, contact your nearest JBL Professional Products Studio Equipment Supplier.

And put a JBL monitor in your place.

The 4301: Our newest 2-way monitor. Compact and efficient, for small broadcast control rooms and home studios. $168.

The 4311: The most popular monitor going. A compact, full-range 3-way. $333.

The 4315: An ultra-shallow 4-way, for maximum sound in minimum space. $783.

JBL studio monitors come in three other models, too. All fully compatible for accurate cross referencing.

JBL

GET IT ALL.

James B. Lansing Sound, Inc. / Professional Division, 8500 Balboa Boulevard Northridge, Calif

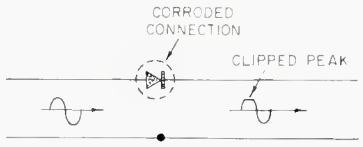


Figure 4. A corroded connection can become a rectifier in series with the audio and cause distortion.

be damaged by the faulty stylus so that when it is played with a good stylus, the results will still be noisy and distorted.

RUMBLE

Another source of distortion in turntables can be rumble. Rumble is a low-frequency mechanical vibration which may be due to mechanical resonances, worn bearings, a poor drive puck, or incorrect drive adjustments. The vibration is mechanically coupled to the stylus as the record is played, and is converted to an electrical signal by the cartridge in the tone arm. Preamplifiers often have a rumble filter built into them, but if the vibration is heavy enough or the filter not working properly, the rumble signal will be passed on into the audio circuits. If conditions are ripe in the preamp stages for intermodulation distortion to occur, this rumble signal can modulate one or more of the higher audio frequencies, introducing extraneous signals well up in the audible range.

OPERATIONAL FACTOR

Aisde from system component failure, a large number of distortion cases come from poor operational practices. Inattention to riding program signal levels is a very common failing, especially with announcers and disc jockeys who operate their own board. Too much reliance is placed on AGC amplifiers and limiters to do the entire job of level control. Most signal level processors (that have been set up properly) will do an excellent job of level control, as long as the input signal is kept within their range. But many gain control devices are well down the chain, so there is ample opportunity for stage overload long before the signal gets to the gain control device.

MICROPHONES

The correct type of microphone as well as correct technique for a given pickup situation is important to good audio. By the same token, an incorrect mic or the wrong technique in using a microphone can result in distortion in the audio. A typical case which can cause distortion is created when an announcer insists on giving a high level delivery into a microphone which is almost touching his lips, although the microphone is not designed for close talking. The resulting audio will probably sound very bassy, muffled, and overloaded from the strong volume of air movement on the diaphram. An environment which requires special selection and technique is a noisy gymnasium during a sporting event. An improper mic and technique in this situation will either result in the announcer not being heard over the crowd noise, or the audio will be so distorted as to be unintelligible.

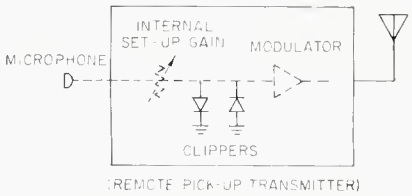


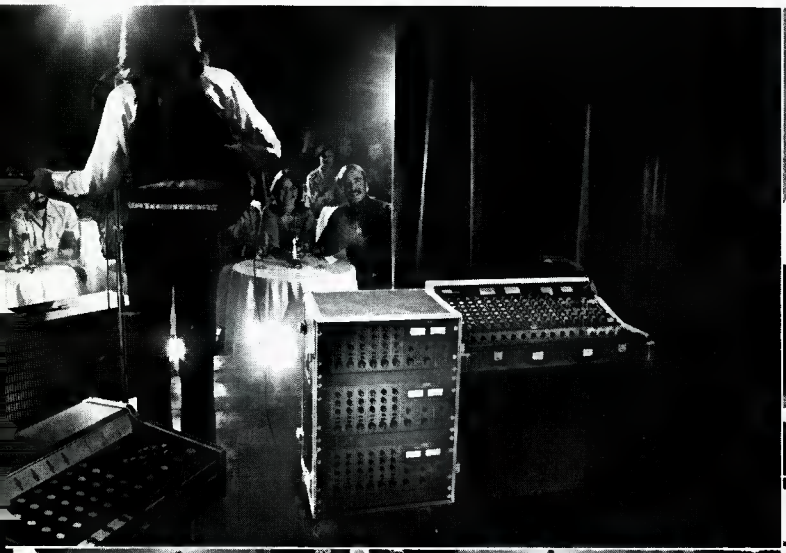
Figure 5. Speech clippers in remote pickup transmitters will clip strong audio signals and cause distortion.

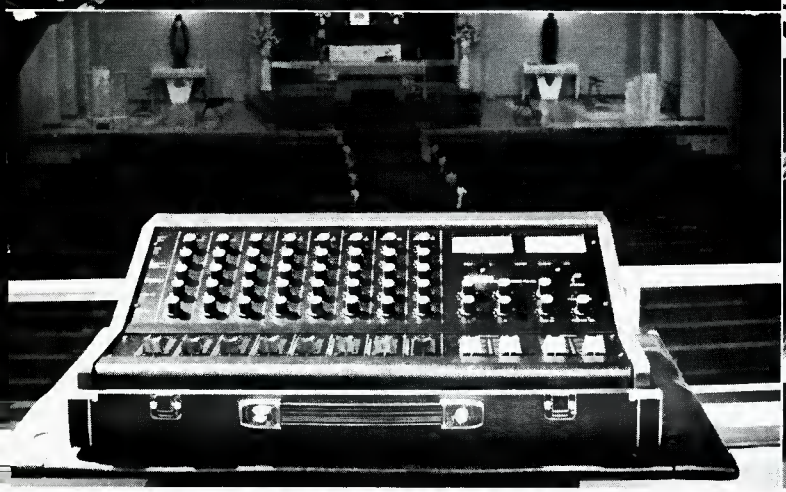
Microphone technique is very important in the small transmitters for remote pickup use. The transmitters have speech clippers built into them that will clip the audio signal above a given level to prevent overmodulation of the transmitter. Besides that, the gain controls are usually set-up controls located inside the transmitter. Unless the announcer develops the correct distance and delivery for his normal voice, the results may be distorted audio caused by the clippers lopping of the peaks (or more) of strong input audio signals.

RECAP

Most audio systems introduce some degree of distortion into the signal. The closer to the ideal, the better sounding the audio, but distortion problems will develop from time to time. It is easier to find most causes if we can distinguish which type of distortion we are dealing with. Poor operating practices are often more difficult to correct than are faulty components. But all cases of component distortion are not easy to detect. In some cases, finding an elusive component that is failing can be a very tedious job. ■

Yamaha's PM Series. A mixer to match every job.





No matter what the application, or how tough the job, there's a Yamaha PM Series professional sound mixer that can handle it.

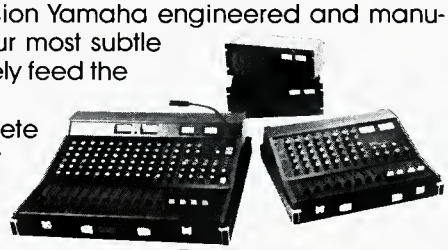
Think of the Yamaha PM mixers as business machines that insure your sound. The PM-170 and PM-180 are ideal as prime mixers for small clubs, discos, schools and the like. Or they're excellent submixers to extend the capability of larger consoles.

The Yamaha PM-430 and PM-700 are the portable heavyweights. They have the specs, power and flexibility to mix well in moderate to major events and concerts, broadcast production and recording studio applications.

Each PM mixer can be used as a complete sound system controller. Or they can be combined to solve your most complex reinforcement and production problems.

And all your mixes are well under control with balanced, transformer-isolated inputs* and +24dBm (12.3 volts RMS) **stereo** outputs for no-hum sound over long distances. Precision Yamaha engineered and manufactured long-throw, smooth-flow, dB-calibrated faders respond to your most subtle adjustments. And foldback and monitor functions that help you precisely feed the right mix to the right performer or technician.

Send six dollars, and we'll rush you an operating manual complete with schematics on our PM Series. (Please, certified check or money order only. No cash or personal checks.) Or better yet, see your Yamaha dealer and match a Yamaha PM mixer to your job.



*PM-170 uses unbalanced inputs, ideal as a keyboard mixer.

Yamaha International Corporation, Musical Instrument / Combo Division,
6600 Orangethorpe Avenue, Buena Park, CA 90620. Write: P.O. Box 600, Buena Park, CA 90622.

YAMAHA

Circle 29 on Reader Service Card

NORMAN S. CROWHURST

db Theory & Practice

Taking Loudspeaker Responses

• A periodic question asks about equipment for taking loudspeaker response curves. I have discussed this before, but the question keeps coming up. So if some of you think you've read this all before, maybe you have, but newcomers still want to know.

It is logical, since we can take the responses of amplifiers and all of the electronic links in the chain, to want to know how to take the responses of transducers, such as microphones, which convert sound from acoustic to electrical information, and of loudspeakers, which convert it back from electrical to acoustic.

The electronic links in the chain are far simpler than the acoustic elements. And even the electronic links appear to have some intangibles, as we find any time we get musicians and engineers into a discussion.

Back in the early days, when audiophiles first began to seek fidelity in reproduction, and the moving coil loudspeaker was still a new invention, the obvious thing was frequency response—whether all the frequencies of the original sound were reproduced in their correct proportions. It was realized fairly soon that the acoustics of a room influenced the measured result, so the next step was the *anechoic room* as a measurement device.

If you have ever tried to measure a frequency response in an ordinary room, you know why the room's influence is significant. You feed the loudspeaker with a slowly swept frequency from an oscillator, or from a test record, put a high quality, calibrated microphone in front of it, and record the result on a dB *versus* frequency chart.

The result is a zig-zag line that goes up and down pretty violently as the frequency gets higher. If you move the microphone an inch or two, the zig-zags will be totally different although the general contour, formed by drawing an average line through them, will be much the same. But doing that smacks of "doctoring" the result, a practice which was frowned on by audiophiles long before government got into the "truth in advertising" business.

It was quickly realized that the zig zags were due to standing wave patterns associated with the liveness of the room and that the general contour was due to the response of the loudspeaker itself. But how could you separate them once they were on paper?

WARBLE-TONE OSCILLATOR

One device that was used extensively for a while was a "warble-tone" oscillator. Standing waves build up at a particular fixed, or nearly fixed, frequency. If the frequency is changing, standing waves do not have time to build up. So warbling the oscillator frequency up and down a few cycles, quite fast, took out most of the zig zags and drew the average curve for you without your having to interpolate it by hand.

But the problem that occurred when measuring by hand still existed; if the loudspeaker itself had a fairly sharp resonance, or anti-resonance (hole), the warble tone would "smooth it out," in just about the same way as testing the frequency by hand. We had to have a way to separate what the loud-

when cost is more important than price

Value conscious recording engineers specify the Studer B67 because it outperforms its competitors on the criteria that matter most to the discriminating recordist:

- Studer state-of-the-art performance
- Long service life with low failure rate
- Speed and ease of user maintenance

If you've ever had to scrub a session because of a faulty recorder, you'll understand why we talk about total cost rather than price. Write to us for complete information on the superiority of the Studer B67 recorder. We'll show you why it's your wisest tape recorder investment.

Circle 32 on Reader Service Card

STUDER

Studer Revox America, Inc., 1819 Broadway, Nashville, Tenn. 37203 / (615) 329-9576 • In Canada: Studer Revox Canada, Ltd.

speaker itself did from the effect of the room.

Thus was born the anechoic room. An anechoic room absorbs all frequencies above the lowest, which—if the anechoic room is of adequate size, are down where there would be little problem with standing waves in the average room—and just records the response of the loudspeaker as if it were in open air, or very nearly so.

Of course, taking the response actually in open air, with the unit pointing at the sky to avoid reflections is one way to do it. The only problem is that you pick up the sounds of passing traffic, aircraft, birds, and maybe the neighbors having an argument. The anechoic room also excludes all extraneous sounds and records only the sounds you feed into the loudspeaker.

Admittedly, developing the anechoic room was a tremendous step forward. But, as some put it, you do not listen to a loudspeaker in an anechoic room. What difference could that make? Surely, if the response was close to perfect in an anechoic room, anything an ordinary live room would do to the reproduction would be inconsequential since it would be characteristic of that room and would affect any loudspeaker in the same way.

That was what a lot of people thought for a long while. But gradually those who studied such matters more critically had to admit there was some other factor that this method was missing. Perhaps a big step toward realizing what it was occurred when someone had the bright idea of concentrating all of the resonance effects of the transducer into one big resonance—like about 30 dB high—and then correcting it with an electrical equalizer.

The response in an anechoic room, with its equalizer in circuit, was close to perfect. But on comparing this loudspeaker with another of more conventional design that was also close to perfect, on ordinary reproduction in an average room there was a very pronounced difference; you could still hear that accumulated resonance in the first speaker, particularly any time a note near to its frequency was reproduced. The sound was definitely "pingy."

TRANSIENT RESPONSE

Thus we began to get a handle on something that had been spoken of quite a bit by now, but about which nobody really knew anything: *transient response.* We realized now that frequency response is not everything.

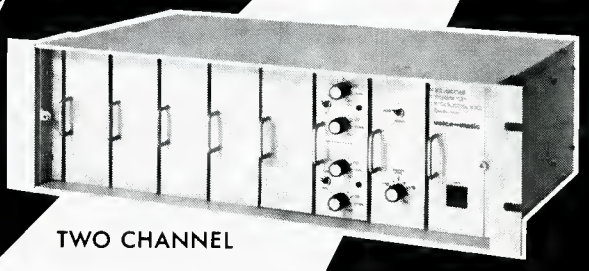
Possibly, for research purposes—that is, finding out how to build bet-

NEW! from IRP
Voice-matic Microphone Mixer

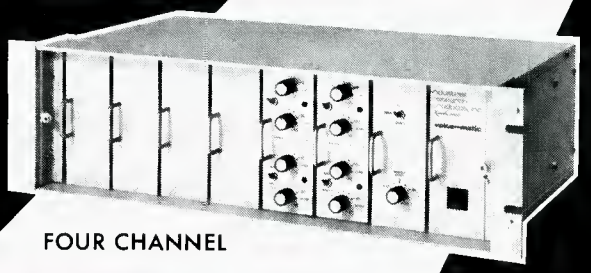
When two, four, six up to twelve microphones are used simultaneously in a sound system, the Voice-matic Mixer gives state-of-the-art control of the sound. The modular design makes possible selection of channels for the small conference room that requires only two microphones—or a large system where many channels are required—and everything in between.

By using a system that limits the number of open microphone channels to only those in use, background noise and reverberant sound are held to the lowest possible levels. This sophisticated system also assures maximum house gain before annoying "howl" caused by feedback. The result: improved sound clarity and overall system quality.

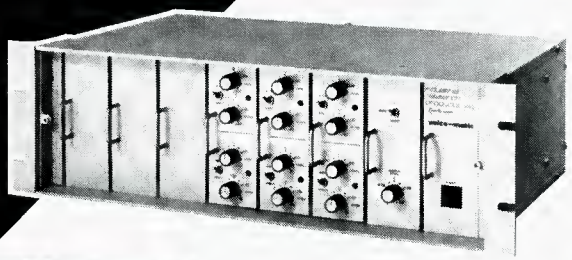
The new IRP Voice-matic system is illustrated and described in Data Sheet DE-4013. A copy is yours for the asking.



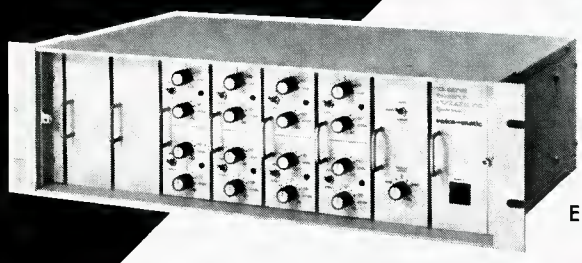
TWO CHANNEL



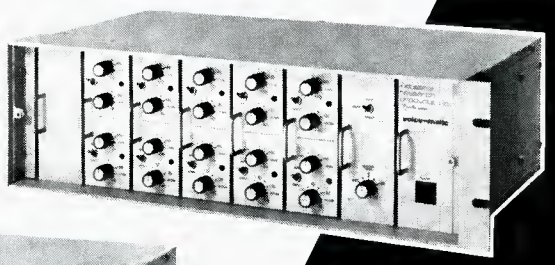
FOUR CHANNEL



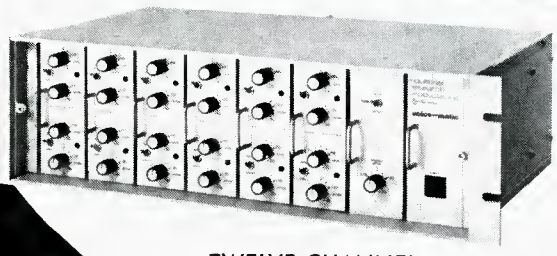
SIX CHANNEL



EIGHT CHANNEL



TEN CHANNEL



TWELVE CHANNEL

YOU NEED THESE IMPORTANT FEATURES

- Sophisticated circuitry suppresses feedback "howl".
- Dynamic Threshold Sensing (DTS) eliminates gating common to VOX systems.
- Adjustable attenuation for active or inactive channels.
- Low noise. Wide dynamic range. Transformer balanced inputs.
- Modular design—2 to 12 microphone inputs—allows economical selection of inputs.
- Multiple chassis may be tandem connected if additional inputs are needed.
- Second fully mixed output for tape recording, off-premise transmission, etc.
- Front panel channel status LED's.
- Flexibility is provided by many options giving a custom-made system for each installation.

INDUSTRIAL RESEARCH PRODUCTS, INC.
321 BOND ST. • ELK GROVE VILLAGE, ILL. 60007 U.S.A.
Telephone: 312/439-3600
A Knowles COMPANY

Circle 37 on Reader Service Card

ter loudspeakers—the anechoic room is a most valuable tool. But for judging the performance of loudspeakers in a real life environment, there are other factors besides those I have mentioned. What are they?

Foremost, we must consider the way the loudspeaker and the room in which it reproduces interact. Perhaps the best way to point this up is to think of the extremes in room type—the very live, and the quite dead. The average recreation room, with wood-paneled walls, tile floor, plaster ceiling, and very little soft furnishings, is very live. A room with heavy carpeting, little exposed wall surface, lots of soft furnishing, a good acoustic tile ceiling, is much more dead.

In the dead room, most often, you hear the loudspeaker(s), quite definitely. There are no reflections to confuse you. Even though a combination of sound from two or more units may give you a good stereo illusion, you are still conscious of exactly where the loudspeakers are located.

DIFFERENT SPEAKERS FOR DIFFERENT ENVIRONMENTS

In the live room, the sound bounces around a lot. And as I have commented before, you get best results in such a room by choosing loudspeakers and their placement in such a way as to trade on these reflections, rather than fighting them. So we have now reached the point of realizing that different loudspeakers suit different room environments: there is no universal "best choice" of loudspeaker, for anywhere—whatever some salesmen may say to the contrary.

So our initial question is now reduced to one of determining this kind of choice objectively rather than subjectively. What you want to measure is not output but response: how the whole thing responds to output. How can you do that?

SEA SHELLS AND COLORED NOISE

Perhaps the idea for this came from the old fiction about a sea shell bringing you the sound of the sea, wherever you may be. Perhaps it was more scientific than that. But you know, when you hold a sea shell to your ear, you hear something an audiophile recognizes as "colored noise," that occurs because the cavities in the shell pick up and emphasize those colors in ambient noise that is present everywhere. Try the sea shell in an anechoic room, and it won't work!

So you feed, preferably pink noise, into your loudspeaker system, and then listen to it with a microphone, or several microphones, in the room where you have the loudspeaker system installed, analyzing what the microphone hears. What's "pink noise?"

First, *white noise* is sound due to random events, which can be analyzed into a frequency spectrum at so much energy per cycle of the spectrum. Thus, the octave between 1,000 and 2,000 hertz contains ten times as much noise energy as the octave between 100 and 200 hertz, with white noise. Pink noise "corrects" that, because our hearing faculty looks at frequency on a logarithmic scale, as if each octave occupies an equal spread.

The difference between "noise" and rhythmic or periodic sound is that tones of any specific frequency have a regular repetition rate. Noise is a succession of discrete events, each an entity in itself, occurring at random intervals and consisting of random amplitudes. There is nothing regular about noise, although averaging over a period of time reveals patterns.

Because frequency is a measure that corresponds to a reciprocal of time interval, noise can be frequency-analyzed. The frequency so measured is

not actually present in the noise, but represents a band of intervals which correspond with a band of frequencies—the frequency band used for measurement can be made as sharp as may be desired.

Of course, the sharper you make the frequency band, the smaller the band of random periods it will contain, and thus the smaller the proportion of the total energy will appear within that band. So in a sense, maybe, using frequency analysis of noise has similarities to using a warble-tone oscillator, which employs a band of frequencies that sweeps instead of a single frequency that changes slowly by itself.

But will the noise measurement method produce the same result as a warble-tone oscillator? Although they are similar, they are not the same. For one thing, a warble-tone oscillator, at any instant, consists of a sine waveform of specific frequency. If you pick one specific frequency, of zero bandwidth, it won't show up in noise. You need a bandwidth in which you can find measurable noise.

WHICH METHOD TO USE

Which is best? Neither is perfect, because neither is an accurate representation of any form of reproduced sound, except its own. Some electronic organ and synthesizer sounds are produced by taking a noise generator and filtering it, while others use tone generators of one kind or another to generate frequencies. Their sounds are quite different.

What this shows is that the world of acoustics is as complex as any other part of our world. There are no simple answers. But understanding inter-relationships can always be a help toward understanding what is happening.

So what equipment do I need to measure loudspeaker response, asks some reader. Without more information about why he wants to measure it, I cannot give a ready answer. Does he want to check the manufacturer's specs? If so, maybe he should duplicate the manufacturer's method of measuring, whatever that is. Does he want to find a better way to make loudspeakers? Then perhaps he should explore all methods, and endeavor to correlate the results achieved with various units.

Does he just want to find the best installation for a specific job? Even then, perhaps the best method depends to some extent on the kind of job—what sort of environment it represents. Is he looking for really high fidelity, or perhaps for maximum intelligibility—which gets into a whole new story. ■

MARTIN DICKSTEIN

db Sound With Images

Visual Communications Congress

• A couple of months ago, I talked about the Association for Multi-Image conference, at which a loose leaf book called *The Experience* was distributed, and I discussed the book itself to some extent. This meeting was only one part of the Visual Communications Congress sponsored by United Business Publications, Inc., one of twelve major conferences that took place during the 4-day convention at which there were also 120 exhibits.

The overall topic was *Explore New Avenues of Visual Communications,* and it was the hope of the Congress to . . ."provide a forum for contacts between producers of films, video and television programs, photographic campaigns, graphic presentations and multimedia . . . and that the interaction will provide an enrichment of ideas, an opportunity to explore new avenues of visual media."

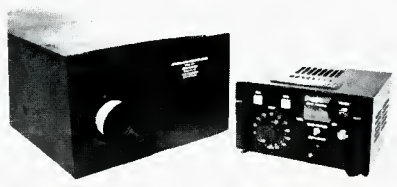
This was the first annual Visual Communications Congress (VCC)—(here we go with acronyms again). It was expected that 10,000 visitors, including communications managers, media specialists and general management involved with communications techniques and materials, would attend. From the look of the crowds at the seminars and exhibits, they were not too far off..

PHOTOGRAPHY

On the first day, the N.Y. Industrial Photographic Conference (Industrial Photographers Association of N.Y.—IPANY) ran the whole day. Among the sessions, some of the topics were *Is Photography Alive and Well in Business and Industry?* which discussed the growth of industrial photography; *The Black Box Syndrome,* in which a visual presentation was given on "the same old product shot"; *Photography as a Tool of Science; What you Should Know About Photography for A-V;* and a free-for-all session on the technical end of the subject of industrial photography.

Simultaneously, and also taking al-

One of AZP's systems with carousel in box, with a zoom lens in front. The control box has a 3-position switch for zooming, a pot to regulate the speed of the zoom, and a meter to show the zoom position, and forward/reverse slide controls.



most a full day, there was a meeting of the International Industrial Television Association (ITVA). The subject, *Eye On The Future*, covered seminars on *Beyond Your Video Program, Field Production, Animation and Graphic Design*, and workshops on *Media Management and Engineering Dialogue*. Subjects discussed included the advantage of an integrated multi-media approach, producing a package in-house versus using an outside supplier, pre-production planning for graphic design, tapping in-house resources, computer and electronically generated animation and graphics for t.v., and the advantages of field production.

Then there was also a meeting sponsored by the Association of National Advertisers (ANA) at which a report was given on *How To Select an Audio Visual Producer* from a sponsor's viewpoint.

The next three days were just as full, with a conference by the Information Film Producers of America (IFPA) on the subject *Future Shock: AV's Impact on Business and Industry*, including sessions on *Dull Meetings Are a Thing of the Past*, and *Times Have Changed . . . Now, How You Say It is More Important Than What You Say*—one focalized by the National Audio-Visual Association (NAVA); another by the National Academy of TV Arts and Sciences (NATAS), at which they presented the 1978 National Daytime Emmy Awards. Another session was run by the International Tape Association (ITA) on *International Video Networks*.

EXHIBITS

At the exhibits, there were a few firsts. For the first time, the City of New York had a booth; the Office of Economic Development had two a/v presentations on location shooting in N.Y.'s film studios.

Another first was a setup presented by D. O. Industries. They introduced a front projection screen with a viewing angle of 160 degrees and a washable silver surface. The name of the screen is *Navilux* and it is said to have an image brilliant enough to be used either in daylight or with room lights on. Its rounded lenticular surface can be used for either regular or video projection. Images are as bright at the corners as they are at the center. It is constructed with a mounting yoke that is adjustable for tripod or tabletop viewing, or for permanent installation. Comparison tests have shown that the new screen is about "18 times brighter than conventional screens across full viewing angles." The screen

comes in three sizes: 40 x 40 in., 40 x 60 in., and 50 x 70 in. Costs go from $169.00 up.

Among the other exhibitors was Al Stahl Animated, who specialize in producing 16mm films from still photography. Through the use of computerized camera moves, focus and exposure, a film can be produced from slides, type, cartoons, cutouts, and live action. The technique employs zooms, pans, wipes, split-screens, dissolves and stop-motion. You supply all art work and a sound track and get a film back. This can even be done for a multi-media slide show.

Advent was there with their 3-gun, 2-piece large screen video projector. Indications are that they are now in the process of developing a one-piece unit, although previously they have specialized in two-piece sets.

Arion had an array of programming devices for multi-image presentations. They have a line of fader units for greater slide capacity, more rapid slide accessibility, and more, as well as better, effects, with each module of the Model 904, containing its own memory circuitry.

Audio Visual Workshop, a rental, sales, and programming outfit, handles the AVI Show Saver I which contains a back-up lamp within its carousel housing for immediate transfer of source in the event the regular projection lamp blows during a presentation. It's all done with a mirror.

SLIDE ZOOM

Still in the A's, AZP had its slide zoom lens to show. It was another first—the first time the general a/v field had a chance to see the AZP method for zooming 35mm slides. The system consists of a zoom lens positioned in front of the carousel projector, using a 4 in. normal lens. A control box, which could be located as far away as 150 feet from the projector, regulates the zooming action (speed and direction) as well as the slide action. The 10-to-1 zoom offers a 60 x 60 image at an 80 ft. projection distance. How about brightness, you ask? A novel light-controlling feature of the zoom system is the ability to dim or increase the light, depending on zoom direction, to keep total illumination the same at any size image. The image also stays in focus during zooming. There is also a 6:1 zoom lens available. The system had been in use primarily in planetaria and museums, but now with some recent developments to improve brightness, it is believed to have application in the general a/v field.

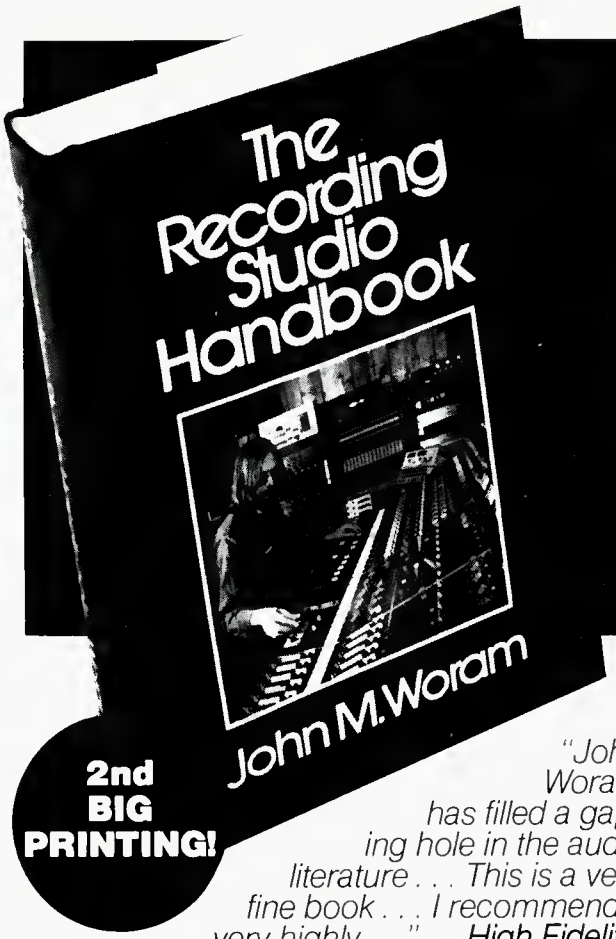
Creative Exchange showed its Cover-Alls (a trade mark name). These frosted plastic covers are made of 10 mil, long lasting, flexible, heavy material and are shaped to cover slide projectors with or without lens, as well as other a/v equipment. They can also be made to order, and can even include a logo.

Diamond showed its line of "Imagician" programmers, dissolves, and memory units. D'San showed its Spin-reel unit which can be used to run a spool of slide projector remote control cable from 20 to 100 feet, or a telephone extension cable up to 200 feet at the rate of 150 feet/min. with the reel support bracket.

Entré self-contained programmer/dissolve units were in the display by Oregon Images, and Electrosonic Systems showed its line of slide projector control, dissolve and programmer units.

Fairchild displayed its Synchro-Slide 35 (another trade mark name) unit which is capable of front or rear screen projection, using a film/sound cartridge, and the Synchromatic 110, a portable projection system using a special format developed by Fairchild which uses a binary optical code appearing between picture areas that can be cross checked electronically with signals on the audio tape for perfect synchronization every time. With a rapid frame advance rate of three frames per second, the unit is capable of producing simulated animation.

There's a whole lot more, but the rest of the alphabet will have to wait till next time. It's not easy to tell you about four days, twelve conferences, and 120 exhibitors in this small corner all at one time. ■



From the publishers of db

An in-depth manual covering every important aspect of recording technology!

2nd BIG PRINTING!

"John Woram has filled a gaping hole in the audio literature . . . This is a very fine book . . . I recommend it very highly . . ." — High Fidelity.

And the Journal of the Audio Enginering Society said: ". . . a very useful guide for anyone seriously concerned with the magnetic recording of sound."

The Recording Studio Handbook

by John Woram

The technique of creative sound recording has never been more complex than it is today. The proliferation of new devices and techniques require the recording engineer to operate on a level of creativity somewhere between that of a technical superman and a virtuoso knob-twirler. This is a difficult and challenging road. But John Woram's book charts the way.

The Recording Studio Handbook is an indispensable guide. It is the audio industry's first complete handbook that deals with every important aspect of recording technology.

Here are the eighteen chapters:

- **The Decibel**
- **Sound**
- **Microphone Design**
- **Microphone Technique**
- **Loudspeakers**
- **Echo and Reverberation**
- **Equalizers**
- **Compressors, Limiters and Expanders**
- **Flanging and Phasing**
- **Tape and Tape Recorder Fundamentals**
- **Magnetic Recording Tape**
- **The Tape Recorder**
- **Tape Recorder Alignment**
- **Noise and Noise Reduction Principles**
- **Studio Noise Reduction Systems**
- **The Modern Recording Studio Console**
- **The Recording Session**
- **The Mixdown Session**

This hard cover text has been selected by several universities for their audio training programs. With 496 pages and hundreds of illustrations, photographs and drawings, it is an absolutely indispensable tool for anyone interested in the current state of the recording art.

Use the coupon at the right to order your copy of *The Recording Studio Handbook*. The price is only $35.00, and there's a 15-day money-back guarantee.

SAGAMORE PUBLISHING COMPANY, INC.
1120 Old Country Road, Plainview, N.Y. 11803

Yes! Please send_____copies of THE RECORDING STUDIO HANDBOOK at $35.00 each. On 15-day approval.

Name_____

Address_____

City/State/Zip_____

Total payment enclosed $_____
(In N.Y.S. add appropriate sales tax)

Please charge my ☐Master Charge
☐BankAmericard/Visa

Account #_____ Exp. date_____

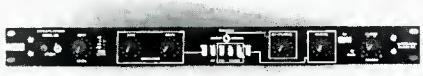
Signature_____
(charges not valid unless signed)

Outside U.S.A. add $2.00 for postage

db New Products & Services

AUDIO EFFECTS

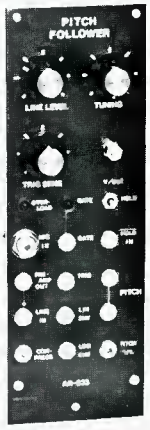
● Another variation of audio variations is called Freq-E-Flanging, produced by a device called the Dynaflanger, which performs a frequency analysis on an incoming program signal and continuously varies the control voltage on its delay line in accordance with the program and the panel control settings. A dynamics tracking switch determines whether the control voltage increases or decreases with an increase in frequency of the program, while another switch sets a CV decay rate to suit the program material. When used for non-dynamic flanging, one control permits the user to set or vary the control voltage manually. Flange phasing/depth is fully variable in all operating modes. The unit will accept input levels from +18 dB above to 40 dB below a reference of 0.775 volts. Claimed residual output noise is −78 dBm for the delayed signal and below −90 dBm for the direct signal.



Mfr: MicMix Audio Products, Inc.
Price: $895.00.
Circle 50 on Reader Service Card

INTERFACE

● Interface between external sources, such as voice, single-note instruments, and tape recorders, and most synthesizers is achieved with AR-333 Pitch and Envelope Follower electric module. A one octave change of input signal produces a one-volt change in pitch control output for controlling V.C. oscillator frequency, filter frequency, etc. Linear and logarithmic envelope follower outputs permit control of synthesizer functions. A front panel trim-pot adjusts the tracking sensitivity of the pitch control output and permits use of the module with different synthesizers without retrimming oscillators. Also on the front panel is a tuning control for adjusting oscillator frequency which allows tuning to the pitch of other instruments and a retriggering sensitivity control for picking up accents.



Mfr: Aries Music, Inc.
Price: Kit: $349, Assembled: $499.
Circle 51 on Reader Service Card

MIC BOOM ATTACHMENTS

● Three microphone booms, designated Porta Series, adapt to various pickup situations. Model PB-1 is 31 in. long. Model PB-1X is adjustable from 31 in. to 50 in. Both models include a tapered counterweight for precise positioning. Lightweight Model PB-2X telescopes from 21 in. to 40 in., is useful for audience participation or as a short horizontal extension to a mic stand. All of the booms have die-cast zinc swivels equipped with oversized hardware. The chrome-plated steel tubing terminates in ⅝ in. male thread or adaptor for use with all standard microphone holders.

Mfr: Atlas Sound
Circle 52 on Reader Service Card

ELECTROSTATIC HEADPHONES

● Sintered bronze cover plates are notable on the ET1000 listening system. The featherweight (less than 14 oz.) padded-headband and cushioned earphone unit reproduces frequencies of 10-25,000 Hz. It's equipped with its own power pack.

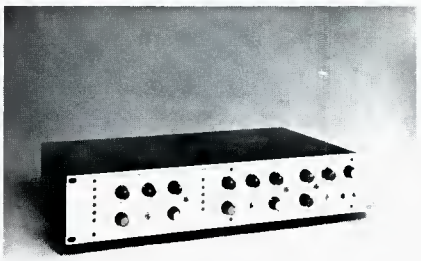
Mfr: Beyer Dynamic (Hammond Industries)
Price: $280.
Circle 53 on Reader Service Card

BROADCAST TROUBLE-MONITOR

• Monitoring medium-frequency broadcasts, this a.m. radio receiver emits an audible alarm for carrier failure and/or modulation failure. The device covers pre-selected broadcasts; the frequency can be varied by exchanging a circuit board containing a crystal and other tuning components on a plug. The solid state unit uses gate-protected f.e.t.'s, a meter which monitors either percentage modulation (positive or negative) from 0-125 per cent on the lower scale or line level from −20 to +3 vu on the upper scale, a choice of biased diode detector or phase locked synchronous demodulator, and a carrier level meter which gives the correct input signal level when used with automatic gain control or direct reading of carrier variations when used with manual mode. Other features are an active 10 kHz notch filter, an 18 dB per octave low pass filter, test points for routine monitoring, and an automatic telephone dialer activated in the event of broadcast failure and connected to the appropriate emergency station. The manufacturer of this item, an Australian firm, is looking for U.S. distributors.

Mfr: General Electronic Developments
Circle 54 on Reader Service Card

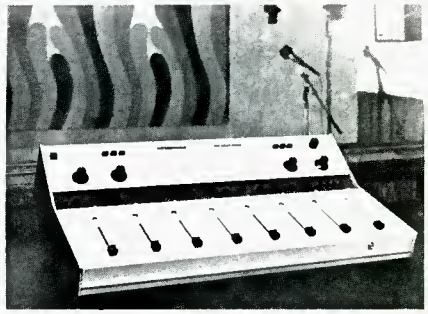
ANALOG-TIME PROCESSOR



• Enhancing studio production, the DN36 Analog-Time Processor is a 19 in. dual-channel multi-effect device with a frequency response of 20-15 kHz and claimed distortion of less than 0.2 per cent. Among the effects possible are phasing, flanging, reverb, doppler shift. Using an external ramp generator, the unit can also provide harmonizing. A cassette demo tape included describes how to achieve the effects.

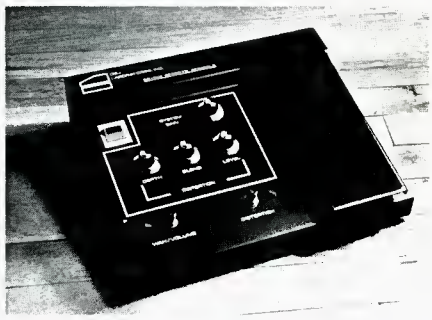
Mfr: Klark-Teknik
(Hammond Industries)
Price: $1,499.
Circle 55 on Reader Service Card

AUDIO CONSOLES



● Five basic units are available in the B-1000 series of audio consoles, including the following possibilities: 8-channel mono and stereo with rotary attenuators with 18 inputs; 8-channel mono or stereo with vertical attenuators wih 18 inputs; 5-channel stereo with 10 inputs and a vertical attenuator. All models contain mu-metal input transformers, type G-10 printed circuit board material, flat cable computer type wiring harnesses and inter-connecting cables, gold plated contacts on p.c. board connectors, tantalum capacitors, hybrid monitor amplifier with 15 watts output mono, 30 watts for stereo. Frequency response, ± 0.5 dB, is 30-15,000 Hz. The program amplifier output level is +8 dBm nominal, +28 dBm maximum.
Mfr: McMartin Industries, Inc.
Circle 56 on Reader Service Card

EFFECTS CONSOLE

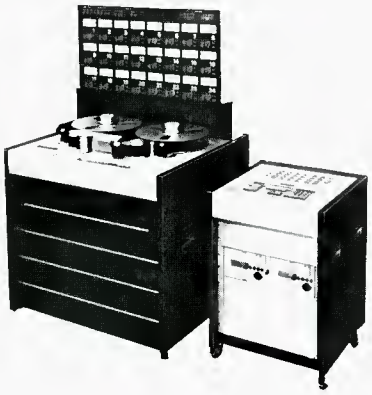


● Distortion, wah, and volume modes may be tinkered with on the EC-301 solid state effects console to produce a variety of interpretations. Distortion effects range from a "soft tube" effect to extreme sustain, achieved by presetting depth and output level, as well as blending undistorted signal. The wah circuit produces a wide range filtering, emphasizing both base and treble harmonics. Wah and distortion can be mixed through using the system gain and distortion level controls. Volume circuitry routs the output signal through an additional stage which is controlled by the pedal, eliminating possible noise generation due to a worn potentiometer. The console features front panel mounted controls, steel chassis, electronic switching, l.e.d. function indicators, and an electronically regulated power supply.
Mfr: DBJ Laboratories, Inc.
Circle 57 on Reader Service Card

EQUALIZER-REVERB

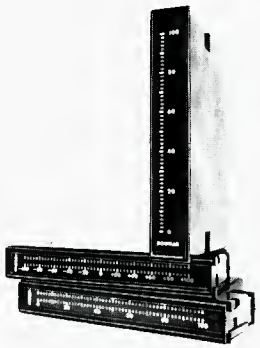
● A combination of functions are possible with R100 series equalizer-reverb system. In addition to its reverberation qualities, the device can be used as a preamp for guitars and other musical instruments, plugging straight into a power amp. The line and reverb signals can be routed through or can bypass the four band equalizer which features center-variable frequency control. Separate gain controls are possible for input, line, reverb, and output signals. The system is rack mountable.
Mfr: Intersound Inc.
Circle 58 on Reader Service Card

MULTICHANNEL RECORDER



• Packed with sophisticated electronics, top level A 800 recorder can combine with the manufacturer's Tape Lock 2000 System. Gadgetry includes: micro processor controlled transport; built-in Autolocator and Varispeed control; 14 in. reel capability; brushless d.c. spooling motors with high torque, permitting rapid tape handling; controlled winding speed; phase-corrected playback and record electronics; micro processor-controlled audio, bias, and erase switching for electronic editing; electronics mode control system with special features for easy alignment and service; NAB/CCIR selectable, electronically switched; electronic remote control.
Mfr: Studer International
Circle 59 on Reader Service Card

ANALOG PANEL METER



• The bar graph display on the APM-100 panel meter can be lit from zero to full scale in 2.5 μsec. with one per cent accuracy. The display includes point-to-bar-to-point flashing, plus overrange or underrange indicators. The solid-state meter has a 100k ohm input impedance. The device can be stacked vertically or horizontally, is equipped with electrical connection studs on the back. Zero and full scale adjustments can be made through screwdriver slots.
Mfr: Bowmar/ALI
Circle 61 on Reader Service Card

1/6-OCTAVE EQUALIZERS

• Model 4300 has a one-sixth octave resolution from 40 Hz through 894 Hz and one-third octave resolution from 1000 Hz through 16 kHz. The adjustment range is ± 10 dB, using Mil-Spec rotary controls. Optionally available plug-in low-level crossover networks facilitate either bi-amp or tri-amp outputs to the power amplifiers. Also available are one-sixth octave real time analyzers.
Mfr: White Instruments, Inc.
Circle 60 on Reader Service Card

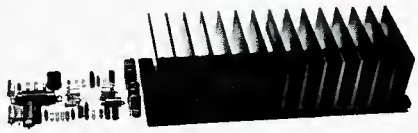
POWER AMPLIFIER

● Off/on switching done with a Class D, pulse width modulating circuitry powered by the newsworthy V f.e.t., capable of handling the necessary 500 kHz signal, has made possible a remarkably lightweight (22 lbs.) yet efficient power amplifier, TA-N88. Weight reduction has been achieved through the elimination of heat sinks, made unnecessary through the energy saving property of the switching, which converts the input signal into pulse signal on/off information, a process that does not create heat buildup. Driving at 250 watts per channel, the TA-N88 still handles peak loads with negligible distortion. Voltage variation in the device has been reduced to claimed one per cent or less through the use of a Pulse-Locked power supply, an important consideration for on-location applications when a d.c. battery power supply and power inverter must be used.
Mfr: SONY
Price: $1,000.00.
Circle 62 on Reader Service Card

STEREO TRANSDUCER SYSTEM

● Specifically designed to improve the performance of EMT echo plates, line level stereo transducer system, FS-200LL increases the output level of the manufacturer's previous FS-200 system by 24 dB. Included are two three-dimensional transducers and an a.c. powered preamplifier with both individual and mixed channel outputs.
Mfr: FRAP
Price: $750.00.
Circle 63 on Reader Service Card

POWER AMPLIFIER



● Economical d.c. Model 701 power amplifier has a maximum continuous power output of 80 watts delivered to a load. Frequency response is within ± 0.1 dB, d.c. to 20 kHz, into 8 ohms, within ± 0.3 dB; d.c. to 20 kHz, into 4 ohms. Claimed thd is less than 0.02 of one percent, d.c. to 20 kHz at full output and claimed intermodulation distortion is less than 0.1 per cent at full output. Signal-to-noise ratio is better than 100 dB below full output, unweighted, 20 Hz to 20 kHz. Slewing rate is not less than 10V per μsec. Input impedance is 10k ohms and output impedance is less than 0.01 ohms below 200 Hz.
Mfr: Spectra Sonics
Price: $89.00.
Circle 64 on Reader Service Card

db New Literature

WIRE AND CABLE

An Engineering Guide for use by electrical and electronic circuit designers covers construction details as well as containing a glossary, cable design formulas, and a temperature conversion chart. Mfr: Brand-Rex Company, WC-78, P.O. Box 498, Willimantic, Conn. 06226.

MICROPHONES

An English translation of "MICROPHONES," a handbook written by Dr. Gerhart Boré, Georg Neumann GmbH, translated by Stephen F. Temmer, 74 pages of practical information from the chief physicist of the Neumann Company of W. Germany, is available for one dollar to cover postage and handling. Source: Gotham Audio Corp., 741 Washington St., New York, N.Y. 10014.

OHMMETERS

A four-page, two-color bulletin illustrates and describes DLRO digital low resistance ohmmeters for measurements from 1 microhm to 20 ohms. Mfr: James G. Biddle Co., Bulletin 24-lb. Township Line and Jolly Rds., Plymouth Meeting, Pa. 19462.

POTENTIOMETERS

150 pages cover a line of potentiometers, trimming potentiometers, digital, and concentric turn-counting dials, as well as miniature rotary switches. Mfr: Spectrol Electronics, Corp., P.O. Box 1220, City of Industry, Ca. 91745.

INPUT/OUTPUT SWITCHES

This bulletin describes a series of eight Crydom a.c. and d.c. input and output solid state switches. Mfr: International Rectifier, Semiconductor Division, 233 Kansas St., El Segundo, Ca. 90245.

BIG UGLY GUITAR PLUG

The "Big Ugly" guitar plug stars in this bulletin, #333. Mfr: Switchcraft, 5555 N. Elston Ave., Chicago, Ill. 60630.

DIGITAL/AUDIO HEADS

Digital and audio magnetic heads and magnetic card readers are the subject of an engineering data sheet. Mfr: Michigan Magnetics, Vermontville, Mi. 49096.

LOUDSPEAKER CABINET REFLECTION EFFECTS

A report on loudspeaker cabinets by James M. Kates, of Teledyne Acoustic Research at the 1977 New York AES Convention is available, Preprint #1278. Source: Audio Engineering Society, Room 449, 60 E. 42nd St., New York, N.Y. 10017.

TRUTH IN LISTENING

The truth in this respect resides in loudspeakers, described in a catalog. Mfr. Teledyne Acoustic Research, 10 American Dr. Norwood, Mass. 02062.

MONITORING LOUDSPEAKERS

More information for the speaker shopper is contained in Volume 3, #1, bulletin detailing the development, design, and use of loudspeakers, especially Model 105, a three drive unit on casters which uncannily resembles *Star Wars'* R2 D2. Mfr: KEF Electronics Ltd., Tovil Maidstone ME-156QP, England.

MICROPHONE CABLES

Microphone cables and microphone multicable systems in 12 colors are described in this brochure. Mfr: Wireworks, Box 3600, Hillside, N.J. 07205.

CHILDREN'S FILM SERIES

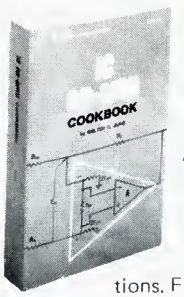
An introductory videocassette gives a flavor of "Calliope," a film series for the 4-14 age range recently completed by UA Columbia Cablevision in conjunction with the Learning Corporation of America, which will be available via satellite in September. Source: Devlin Productions Inc., 150 W. 55th St., New York, N.Y. 10019.

HEATHKIT

The latest Heath catalog of do-it-yourself projects contains 104 pages of their standard and some new items. Mfr: Heath Company, Benton Harbor, Mich. 49022.

SEMICONDUCTOR REFERENCE

A 144-page handbook, including cross-reference/replacement listings and application notes promotes Archer Semiconductors. Source: $1.95, Radio Shack, 1400 One Tandy Center, Ft. Worth, Texas 76102.



What's cooking?

IC Op-Amp Cookbook by Walter G. Jung. Explains basic theory of the IC op amp in a down-to-earth manner. Includes over 250 practical circuit applications. Fully illustrated and designed for all interested in modern linear IC design techniques. Covers general operating procedures, such as offset nulling, frequency compensation, and protection against abuses and failures; signal-processing circuits; audio circuits including low-level preamps, active filters and equalization circuits, power-booster stages up to 100 watts, and a variety of other specialized circuits. Includes unique devices that cannot be categorized with standard types—programmable op amps, operational transductance amplifiers, quad current-differencing amplifiers, etc. **$12.95**

SAGAMORE PUBLISHING CO, INC.
1120 Old Country Road,
Plainview, N.Y. 11803

Please send__copies of **IC Op-Amp Cookbook** at $12.95. N.Y.S. residents add 8% sales tax.

Name _____

Address _____

City _____

State/Zip _____

Editorial

WELL, we *were* going to try to say a few words this month about other transducers, but . . .

One of our problems, when we start talking about microphones (as we did last month), is, how do we *stop* talking about them? For instance, J. Howard Smith discussed the Sound Field Microphone, developed in conjunction with the Ambisonics system of recording.

Ambisonics? Just in case you were wondering what Ambisonics are (is?), so were we. So we looked up John Borwick—our trusty spy in old England—and asked him to compare his notes with publisher Larry Zide. They did, and we start off this month with; **From England: The Ambisonics System.** Hopefully, the article will bring at least a little discomfort to those who think that "multi-track mono" is the only thing that's happening these days.

And from *New* England (Connecticut that is), Benjamin B. Bauer brings us up to date on **The Ghent Microphone,** yet another alternative to multi-miking everything. Like the Ambisonics system, surely Bauer's Ghent Microphone (so-called in honor of the city in which he conceived its design), will not obsolete everything that has gone before, but that's as it should be. It's yet another tool for the knowledgable recording engineer, and should find applications beyond its primary purpose of recording SQ-encoded programs. It merits the attention of anyone looking for something more than a forest of cardioid microphones.

Speaking of which, we understand you've been taking your cardioid microphones pretty much for granted, haven't you? Well, why not?—everyone else does, including us. So, for an appreciation of the early research work that went into the development of the modern cardioid microphone, take a look at **A Backward Glance at Cardioid Microphones.** Do you know who started it all? We're not saying here, but read the article and find out.

Finally, we wrap-up the subject of microphones (for the time-being at least), with our **Directory of Electret Condenser Microphones.** As Robert Schulein showed us last month, the electret is now a fully-professional device, and so we thought we should take a quick glance at what's available at the moment. No doubt our list will need updating by the time you read it.

Oh well, you can't stop technology, and if you need more convincing on that subject, please refer to **The 60th Audio Engineering Society Convention: Part II,** where we find that even the so-called semi-professional hardware is getting more and more sophisticated. By the way, there will be still more new technology at the 61st A.E.S. convention, scheduled for 3-6 November, at New York City's Waldorf-Astoria Hotel. In addition to the exhibits, there will be technical sessions devoted to the following subjects; Audio In Broadcasting, Audio In Medicine, Audio Measurements And Instrumentation, Digital Techniques, Disc Recording and Reproduction, Electronic Music, Magnetic Recording, Signal Processing, Sound Reinforcement and Architectural Acoustics, Subjective Judgments Of Audio, and Transducers.

We hope to see you there. Or, perhaps at the 62nd convention, which will be held in Belgium, at the Brussels/Sheraton Hotel. The dates are 13-16 March, 1979.

JOHN BORWICK & LARRY ZIDE

From England: The Ambisonics System

Space age technology applied to surround sound.

WHAT have moon shots got to do with personal calculators? At first glance, the answer may appear to be "nothing," but think again. Years ago, calculators of any degree of sophistication were cumbersome, complex and costly, and the moon was very far away. Then, not so very long ago, scientists and engineers launched an all-out effort to get a man on the moon (and off again, of course).

Fortunes were spent, new technologies were developed, and the rest is history. But, future historians may find that the wonder of a man on the moon has become almost incidental, compared to the spin-off wonders of space-age technology back here on earth. Now calculators are neither cumbersome nor costly, thanks to the space-age high technology that has become accessible to industry.

IMPROVING AUDIO

The same technology eventually finds its way into the recording studio, as an automated console, or perhaps later on as a production model digital tape recorder. In fact, even the black art of microphone placement shows signs of being influenced by technology. And here, some of the spin-off wonders may be traced back to—of all things—quadriphonic sound!

IS QUAD DEAD?

If you have begun to believe the rumors and "expert" pronouncements that quad is dead, you should note the intriguing research going on all over the world, as scientists probe the mysteries of the hearing mechanism. In one research laboratory, engineers have succeeded in creating the effect of voices approaching the listener and whispering in his ear. Or, seemingly, a plane flies overhead while loudspeakers remain firmly anchored on the ground. Elsewhere, one may hear sounds in the rear, yet there are only two speakers in use, and they are up front.

Clearly then, there is very much more to audio than the two channel stereo system of today, and we are only beginning to comprehend what may be possible in the future. We shall find out soon enough whether "the future" means four channel, six channel, or *n* channels. But for now, we should realize that two channels do not create the ultimate listening experience.

AMBISONICS

In England, the team of Peter Fellgett, Michael Ger-

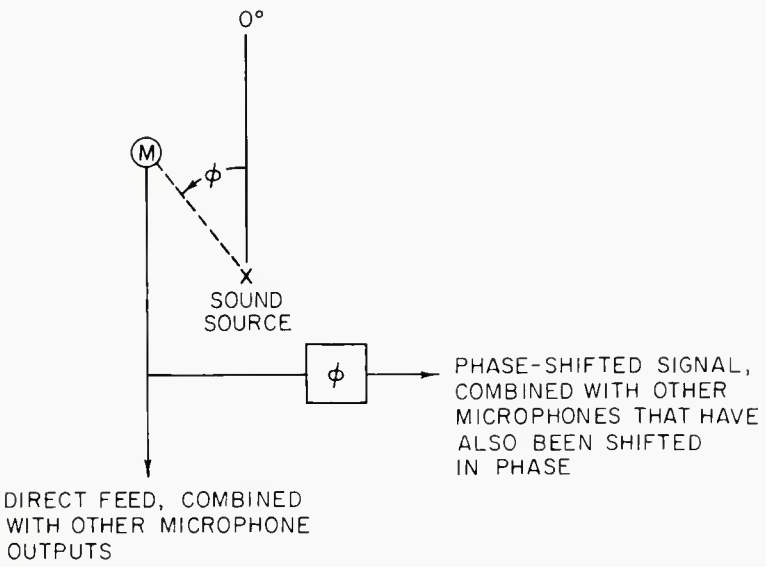


Figure 1. The phase angle is equivalent to that of the angular position of the microphone relative to the sound source.

zon, and John Wright have been as critical as anyone of the conventional approaches to surround sound. They don't even like the word "quadriphony," and have employed higher mathematics to support their contention that existing four channel systems are inherently unsatisfactory. Whether single microphones are panned pairwise between four loudspeakers, or crossed-coincident pairs are used, these Ambisonics men claim that sounds will cling to the individual speakers, with very imprecise imaging everywhere else.

They obviously have a point. If you listen to stereo with your two loudspeakers spaced so wide apart that they subtend an angle of ninety degrees at your head (rather than the recommended sixty degrees), a tendency for the "hole in the middle" effect definitely sets in. It is much worse then, considering the brain's relative inability to locate sounds at the side and back, to sit at the center of a square of speakers. Then, each pair of speakers subtends an angle of ninety degrees to your ears, and normal panpotting, or even Blumlein microphone pairs, will at best present a variable sense of location overall. We need some more subtle encoding philosophy—one that will work for rectangular speaker layouts, lengthwise or cross-wise, as well as for the square configuration.

The Ambisonics research program, going back over five years, has addressed itself to this need. In part, it has been financed by the National Research and Development Council (NRDC), with NRDC joining Ambisonics in representations before the American Federal Communications Commission and others.

In the Ambisonics system, a number of microphones are used, with their outputs simply combined to produce a mono sum signal, *W*. In addition, the output of each microphone is also fed through an all-pass phase shift network. The phase angle is equivalent to that of the angular position of the microphone itself, with respect to the sound source, as seen in FIGURE 1. The phase-shifted outputs are combined in one or more additional channels (X, Y, Z) for later processing.

THE SOUND FIELD MICROPHONE

In the Sound Field microphone, especially developed with Ambisonics in mind, the angular relationships between the system's four transducers are quite complex. (See last month's issue of **db** for more information about The Sound Field Microphone—Ed.) Michael Gerzon, of the Mathematical Institute of Oxford, did most of the mathematical work on the design, employing what is known as "kernel" algebra. This form of higher mathematics allows the designer to take into account the fact that although sounds may come from an infinite number, or a continuum, of directions, these sounds must be stored and reproduced over a finite number of channels. If budget and space were of no concern, six channels might be preferred, although realistically four will do the job quite nicely.

Gerzon acknowledges that the system's success owes a lot to the early work of Alan Dower Blumlein. In his 1931 patent, Blumlein observes that the outputs of two omni-directional microphones may be combined through matrices. One combination yields L + R, while another gives L − R. If L − R is combined with L + R, we are left with a left-channel signal. If L − R is combined subtractively (− L + R) with L + R, we get a right-channel signal.

From here, it is a very long way through Gerzon's kernel algebra and on to the complete Ambisonics system. But, starting from first principles, the Ambisonics team has set its target on nothing less than recording and

reproducing the total sound field, to give the listener the impression of really being there—and not only if he sits in a particular part of his living room. It worries them that most of the quadriphonic systems—with the possible exception of the little-known UMX—are incompatible with each other, and are not designed to march forward into higher realms of directional reproduction in three dimensions. They have therefore specified that the ideal surround sound system must meet the following criteria:

1. It will leave room for both minor and major developments in the state-of-the-art, without risk of becoming incompatible or obsolete.
2. It will reproduce the desired directional effects with any reasonable room layout of speakers.
3. It will reproduce these effects without the aid of variomatrixing and other fatigue-inducing trickery.
4. It will be capable of accepting existing quad material, to give as good—if not better—decoding.
5. It will easily handle any recording philosophy pursued by either pop or classical producers.
6. It will be tolerant of normal inaccuracies in studio processing, recording chains, and consumer equipment.
7. It will be capable of high quality transmission over all media, including disc, cassettes, radio and video formats.
8. It will reproduce well on conventional stereo and mono systems.
9. It will permit the option of inexpensive decoders, as well as state-of-the-art devices.

FROM TWO CHANNEL TO "PERIPHONY"

At the heart of the Ambisonics scheme is a hierarchy of increasingly more ambitious reproducing methods:

1. A 2-channel matrix version, capable of disc and radio transmission by present-day broadcasting methods.
2. A "2½" channel sub-carrier version, with the third channel having a restricted bandwidth of, say, 6 kHz and/or a reduced level.
3. A 3-channel version, giving further enhanced directional reproduction over the 360 degree horizontal plane.
4. A 4-channel "Periphony" version, to convey full-sphere reproduction in all planes (possibly with six speakers).

The four tracks of information supplied by the Ambisonics "black box" are not the four compass-point signals beloved by other quad theorists (L_f, R_f, L_b, R_b). Instead, the kernel mathematics derives first-order directivity patterns in all three planes of sound surrounding the microphone. Therefore, the four signals are proportional to the total sound field pressure (omni-directional), plus the three components of pressure-gradient (left-to-right, front-to-back, up-to-down). Such an approach to recording makes some changes in control room thinking necessary, but it can produce a master tape of great flexibility for future developments.

TWO CHANNEL AMBISONICS, AND THE FUTURE

While remaining starry-eyed about the eventual wide acceptance of all-direction periphonic reproduction, the NRDC scheme realizes the pragmatic need to interface with today's comparatively limited audio scene. Though using only part of the total Ambisonics capability, NRDC has been demonstrating a 2-channel version of the system, given the code name "45J." They have also gained considerable leverage by joining in collaborative ventures with Britain's two radio organizations—the British Broadcasting Corporation and the Independent Broadcasting Authority.

All three bodies are desperately trying to persuade the European Broadcasting Union (EBU) to accept 45J or one of its variants as an international standard. And they are very much afraid that, in America, the FCC will preempt this by sanctioning SQ, QS or whatever (as a finale to their protracted deliberations). This, NRDC feels, would have the effect of forcing the world to standardize on what they would regard as a less-than-ideal system.

OTHER BBC WORK

The BBC Research Department has pursued a somewhat different line of development in search of a conventional matrix quad system which would avoid some of the compatibility anomalies heard on mono and stereo receivers when earlier designs of matrix quad are used. Their "Matrix H" was used to encode a series of concerts, as well as numerous jazz programs and special quadriphonic plays and documentaries. As it happens, Matrix H has more in common with Regular Matrix (a bit like Sansui's QS) than CBS's SQ. Accordingly, Sansui rushed out a modification to their QS decoder, tailored to the needs of Matrix H. The broadcasts were a brave attempt at quadriphony, at least as good as many SQ, QS and CD-4 records.

However, heard in stereo or mono, the BBC-encoded broadcasts were noticeably less clear and precise in their sound picture. This was deemed due to a fairly large phase-angle error at center-front; halfway through the broadcast series, the angle was reduced somewhat for the sake of compatibility. And now comes the cruncher—BBC Matrix H was then close enough to the NRDC's two-channel 45J version of the Ambisonics system for the two groups of engineers to get together and plan further improvements, centered about an "HJ" encoder. These plans are progressing, and extensive broadcast tests of HJ should be announced shortly.

These experimental broadcasts will also be recorded, using the full four channel capability of the Ambisonics B-format system. The tapes should be available for future re-broadcasts or the production of records.

It has recently been reported that the giant Japanese record manufacturer, Nippon Columbia, is working in close cooperation with the NRDC group, so it is clear we have not heard the last of surround sound by any means. It is interesting that broadcasters seem keener to experiment than record companies—at least outside of the USA. But perhaps economic considerations, and the poor image created by early quadriphonic records have cooled the ardor of those record companies who previously supported quad. And this would also explain the apparent lack of interest by the uncommitted disc companies, such as Decca, Phonogram and DGG.

But whatever the fate of surround sound, or quad if you like, it is becoming increasingly apparent that the next few years should see some impressive advances in the state of the recording art. And Ambisonics is but one of several exciting new concepts that should eventually make our conventional two channel format a thing of the past. ■

BENJAMIN B. BAUER

The Ghent Microphone System

Using a combination of 100 degrees and two 80 degree side pickups, the system employs both stereo and matrixed quad.

MICROPHONE TECHNIQUE for sound pickup in a studio is well established: one microphone (or more) is provided near each performer or group of performers and the outputs are recorded on individual tracks of multi-channel tape. Later, the producer mixes the individual tracks onto a two- or four-channel master tape. Because of the ease of editing and the possibility of adding special effects, this "proximate" multi-microphone technique is almost universally used, especially for popular music.

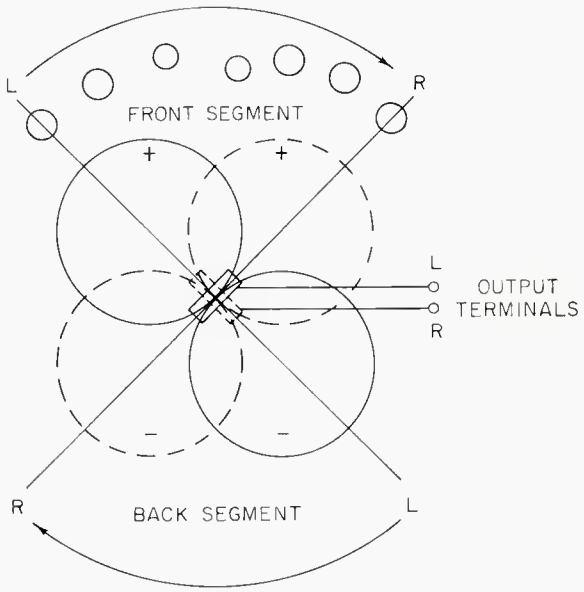
However, there is another, less-frequently-used microphone technique which is most useful in natural settings such as live opera, an orchestral performance in a concert hall, and religious music played in a cathedral. Here, the preservation of the natural hall reverberation, and/or the natural position or motion of the performers, is paramount. In these cases, it is convenient to pick up the performance with an array of microphones clustered around one point in space. Such is the *cross-gradient* microphone system proposed by Alan Dower Blumlein in the early thirties, or the so-called M-S microphone system attributed to Lauridsen and Steinhausen in the fifties. And now, a new "spatial" microphone array is available for this purpose—the CBS Ghent Microphone System, which offers a number of advantages compared with the earlier schemes.

Prior to discussing the details of the Ghent Microphone System, let's briefly review the operation of the older crossed-gradient and M-S systems.

THE CROSSED-GRADIENT SYSTEM

In the cross-gradient system, two velocity transducers are closely placed together and oriented at 90 degrees with respect to each other. The performance is depicted by two crossed figure-eight polar sensitivity patterns, as shown in FIGURE 1. The crossed-gradient system has two useful sound pickup zones comprising the front and the back 90 degree segments. Since in a live pickup situation, as in a concert hall, it is necessary to minimize the audience noise—coughing, etc.—the rear zone is not, as a rule, utilized. The microphone is placed high above the floor and tipped forward, to direct the front quadrant toward the stage and the back quadrant away from the audience. The side quadrant sounds are reproduced anti-phase, which does not lead either to good stereo or good mono sound because the anti-phase signals sound "phasey" in the former mode and are cancelled in the latter. Thus, in a traditional long, rectangular hall, where strong lateral eigentones (resonance frequencies, caused by the room's surfaces—Ed.) are present, the cross gradient microphone causes problems. It can, however, be used successfully in locations which do not exhibit strong lateral reverberant modes—in a semi-circular hall, for example, or in a relatively dead studio, if care is taken to avoid placing the performers in the side quad-

Figure 1. Polar patterns for Blumlein's "Crossed-Gradient" Microphone System.



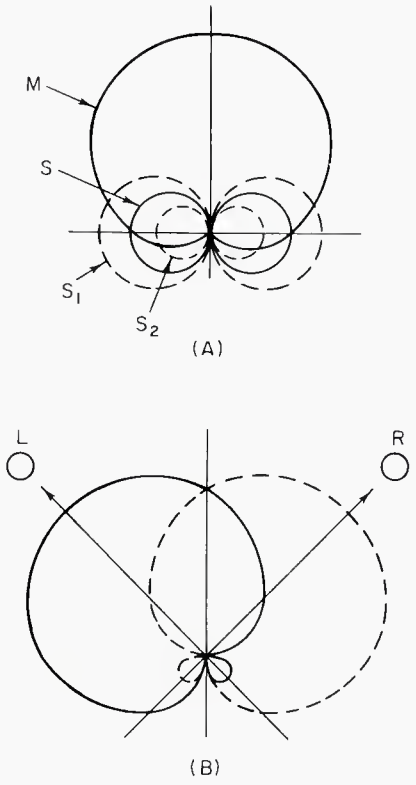


Figure 2. Polar patterns for the M-S Microphone System.

rants. Under these conditions the crossed-gradient microphone can produce excellent stereo sound.

THE M-S SYSTEM

The M-S microphone, shown in FIGURE 2A, uses a "middle" cardioid microphone, M, facing toward the group to be recorded. The output of a "side-oriented" velocity microphone, S, is both added and subtracted to the M output. The summed output produces a right-oriented limaçon, R, while the differenced output produces a left-oriented limaçon, L, as shown in FIGURE 2B. By adjusting the gain of the velocity microphone, S, relative to the cardioid unit (as shown by the broken-line patterns in FIGURE 2A), a variety of patterns may be obtained. When the two output channels are combined, a front-oriented cardioid pattern is created, resulting in reasonably good mono compatibility, although the loudness balance of the directional signals is somewhat altered.

The above M-S microphone configuration has the advantage of operational flexibility and the avoidance of antiphase pickup. It has the disadvantage of being unable to provide good channel separation over a relatively narrow front-angle—say a quadrant or so—often resulting in center-heavy performance. Other M-S microphone arrangements have been tried in an effort to overcome this problem. One of them, for example, consists of two axially-adjustable limaçon microphones equipped with electrically adjustable polar patterns to provide a variety of directional parameters.

GHENT MICROPHONE SYSTEM

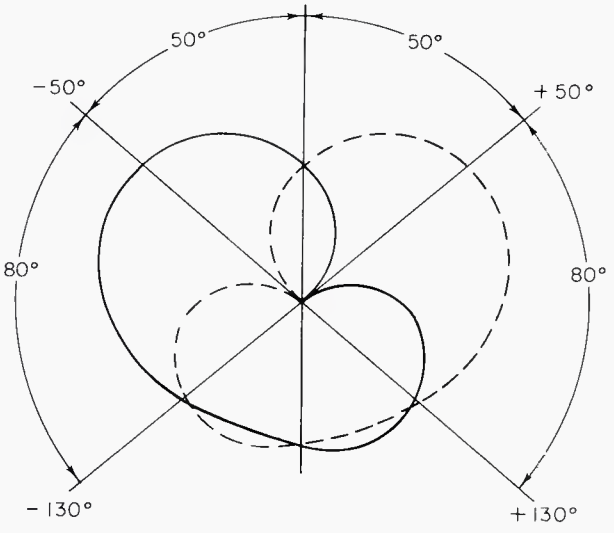
In the conventional stereo mode, the Ghent Microphone System (whose polar patterns are shown in FIGURE 3) picks up the sounds arriving over a 100 degree front angle. The sounds arriving over two 80 degree side segments are encoded in the SQ quadriphonic matrix mode. Thus, the Ghent System serves the dual purpose of picking up the stage sounds in stereo, and the ambiance in surround-sound quad. And, because these sounds are picked up from a single point in space, the actors in, say, a dramatic presentation, or an outdoor street scene, are able to move freely around the frontal 260 degree angle, being automatically properly encoded for stereo or surround-sound quad reproduction depending on their axial location. Exemplary quadro, stereo, and mono-compatible performance is thereby obtained.

While still experimental in nature, the Ghent Microphone System has already been successfully employed in a number of applications. It was used with the BBC Orchestra at the Royal Albert Hall in London, the New York Symphony at Avery Fisher Hall, and the Detroit Orchestra in Michigan. The 1977 season of the Filarmonica de las Americas at the Palacio de Bellas Artes in Mexico City was broadcast using the Ghent System.

A significant advantage the Ghent System shares with the crossed-gradient system is its excellent ±50 degree front-oriented stereo pickup area, which meets the requirements both of stereo and the SQ quadriphonic system specifications. At the ±50 degree positions, a 46 dB channel separation is available, with in-phase center-front sound pickup mode. The 80 degree angular side areas, important in a traditional concert hall, encode the lateral reverberation in the SQ mode, resulting in a broad reverberant energy display when listening either in the stereo or quad modes. The stereo or quad energy pickup is uniform within 0.6 dB all around the compass

The back quadrant retraces the front three-quadrant space, and, therefore is used only in special circumstances. Thus, in order to minimize audience sounds, the Ghent microphone usually is placed quite high above the stage and is oriented downward toward the orchestra, with the back quadrant facing away from the audience, as with the crossed-gradient system. The direct orchestral pickup versus the audience pickup is helped by the relatively "flat" profile

Figure 3. Polar patterns for the SQ Ghent Microphone System.



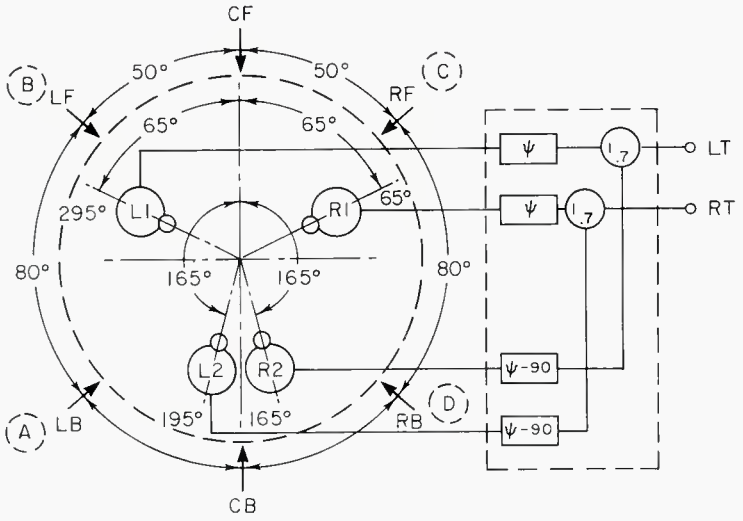


Figure 4. Schematic principle of the Ghent Microphone System.

polar pattern of the Ghent microphone, which follows the super-cardioid law, $0.3+0.7 \cos \theta$.

Directional sounds arriving at ± 130 degrees azimuth from the center front result in output signals which are equal and in phase-quadrature (90 degree ø shift—Ed.)—the left channel output leading for the sounds arriving at −130 degrees and the right channel output leading for sounds arriving at +130 degrees. This is precisely the signal organization required by the SQ code for the left-back and right-back channels, respectively. Played back through an SQ decoder, these signals are decoded in the appropriate left-back and right-back loudspeakers. In the stereo mode they are "folded" and reproduced near to, and at either side, of center. Therefore, as an option, the Ghent System may be placed right in the middle of the orchestra, resulting in good stereo distribution of the instruments in the stereo mode and in a surround-sound display in the quadriphonic mode.

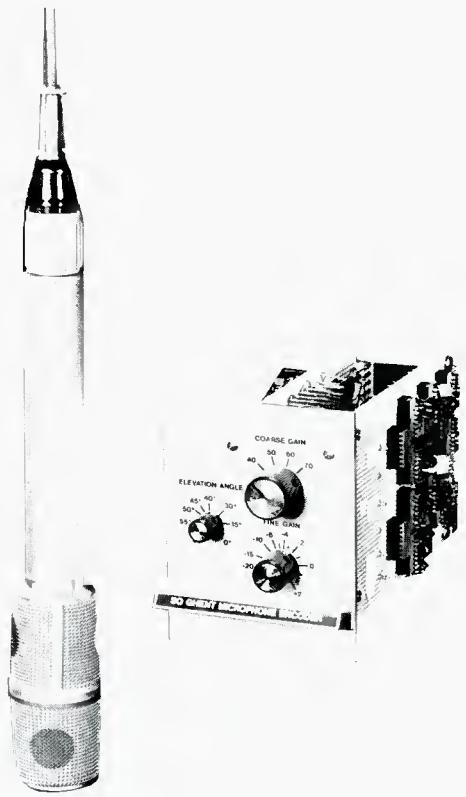
DESIGN DETAILS

The performance achieved with the Ghent Microphone System requires a rather unorthodox microphone confiuration. As shown in FIGURE 4, the microphone array consists of four limaçon-pattern transducers with polar response defined by the equation, $0.3 + 0.7 \cos \theta$, where θ is the angle respecting the axis of maximum sensitivity of each transducer. The four transducers are oriented in space as shown in the left-hand side of the figure, with the two front elements, L1 and R1, being positioned at ±65 degrees, and the two back elements, L2 and R2, being positioned at ±165 degrees, with respect to the 0 degree center-front direction. The four elements actually are vertically coaxial, i.e., the origins of the patterns fall on top of each other. In FIGURE 4 they are shown separated from the center only for clarity.

To complete the Ghent System, a special encoder is needed, shown at the right-hand side enclosed by the broken-line rectangle. The encoder consists of phase-shift networks which are identical to those normally used in a conventional SQ encoder. Specifically, the networks labeled ψ connected to the front transducers have a phase shift which is linear with the log of frequency; those labeled ψ-90 degrees also have a similar phase shift function which, however, is displaced from the first one by −90 degrees (lagging) at all frequencies. The latter networks are connected to the back transducers, and their outputs are multiplied by 0.7 and summed to the outputs of the opposite front transducer's networks to form the combined signs, LT and RT.

The Ghent systems deployed in field tests have been constructed by using basic QM-69 Neumann microphones

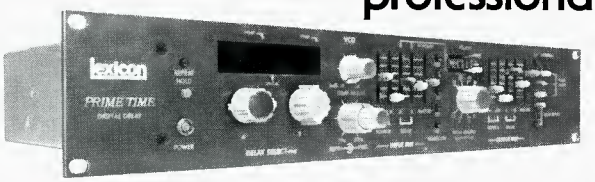
Figure 5. The Neumann QM-69 microphone and the special adapter used for the Ghent system.



Prime Time™

Digital Delay Processor

professional quality delay plus special effects



Lexicon's new Model 93 "Prime Time" digital delay processor gives recording studios and entertainers an easy-to-use professional quality time delay with special effects and convenient mixing all at a price you can afford. It combines a degree of flexibility and versatility never before offered in equipment of full professional quality.

- Two delay outputs independently adjustable from 0 to 256 ms
- Complete mixing for delay and reverb processing, freeing up main console channels and tape tracks
- Integral VCO for special effects like vibrato, doppler pitch shift, flanging and automatic double and triple tracking
- Long delay special effects — up to 2 seconds
- All dynamic functions can be footswitch controlled
- 90 dB dynamic range, total distortion below 0.08% at all delay settings

lexicon Lexicon, Inc., 60 Turner Street
Waltham, MA 02154 (617) 891-6790

Export: Gotham Export Corporation, New York, New York

Circle 38 on Reader Service Card

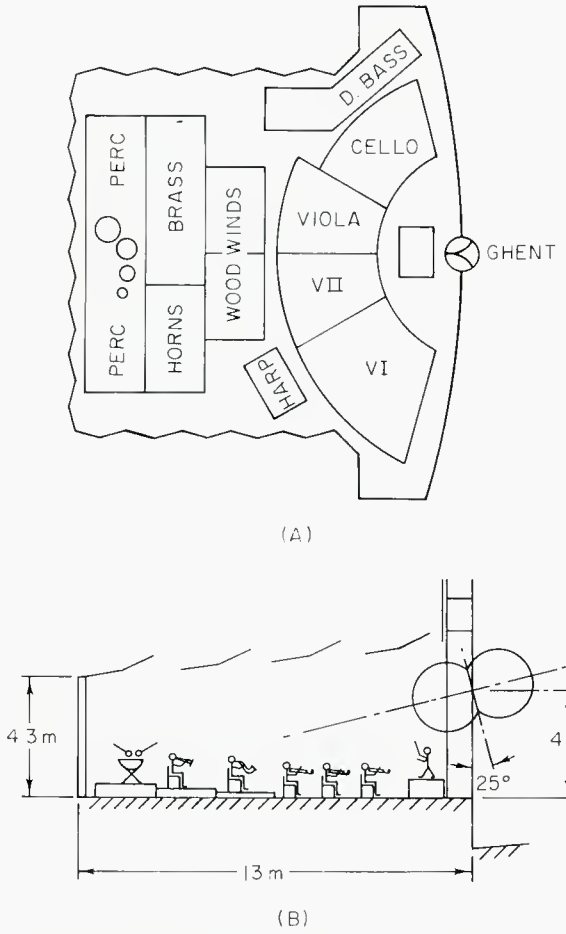


Figure 6. Microphone arrangement for conventional stereo or ambiance quad recording.

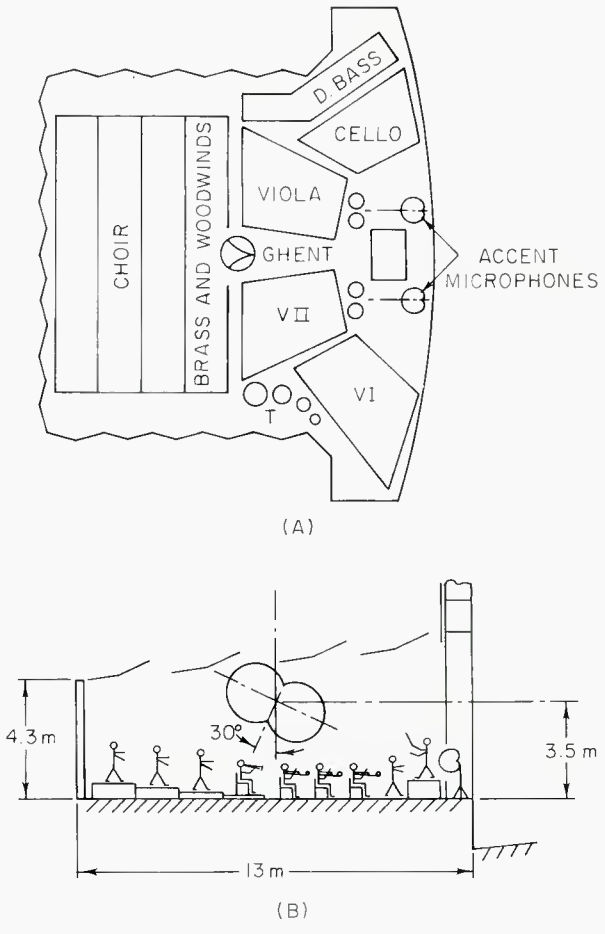


Figure 7. One microphone arrangement for stereo-compatible surround-sound recording.

suitably matrixed to produce the four limaçon patterns shown in FIGURE 4. The QM-69 Neumann microphone, together with the system's special adapter, is shown in FIGURE 5.

To illustrate the most common method of using the Ghent Microphone System, a cross-sectional elevation and plan view of the arrangement used for broadcasting a conventional symphonic performance from the Palacio de Bellas Artes in Mexico City is shown in FIGURE 6. A more adventuresome variation, used with Mozart's *Requiem*, which features a 60-voice choir, is shown in FIGURE 7. Here, the microphone is placed in the middle of the orchestra facing the conductor, inclined to favor the strings and to attenuate the sound of the strong choral group. With the provision of two accent microphones used to pick up the soloists, a well balanced surround-sound performance was obtained, albeit it was necessary to reverse the microphone outputs left for right in order to retain the proper perspective on reproduction.[6] This latter method of sound pickup gave such favorable results that it was used in all the 1978 summer season's symphonic performances broadcast from Bellas Artes.

CONCLUSION

In conclusion, the ongoing experiments with the Ghent Microphone System have shown it to be a powerful tool for the recording engineer. It picks up the orchestral sound with the precision of the Blumlein crossed-gradient microphone, but has the advantage of eliminating the latter's antiphase zones and of encoding the ambiance in a natural SQ quadriphonic mode. It provides an added flexibility for surround-sound orchestral and dramatic performances. It is easily installed and offers a balanced sound transmission for the broadcaster who often is unable to expend much experimental effort for a live broadcasting setup.

Experimental results to date have made it amply evident that the Ghent Microphone System is bound to become an important tool in the practicing audio engineer's bag of tricks. ■

REFERENCES

1. B. B. Bauer, "Quadraphony, Spatial High Fidelity and Compatibility," IEEE Transactions on Broadcasting, Vol. BC-23, pp. 76-84 (Sept. 1977).
2. B. B. Bauer, D. W. Gravereaux, A. J. Gust, "A Compatible Stereo-Quadraphonic (SQ) Record System," J. Audio Eng. Soc., vol. 19, pp. 638-646 (Sept. 1971).
3. B. B. Bauer, G. A. Budelman, D. W. Gravereaux, "Recording Techniques for SQ Matrix Quadraphonic Discs," J. Audio Eng. Soc., vol. 21, pp. 19-26 (Jan/Feb 1973).
4. B. B. Bauer, R. G. Allen, G. A. Budelman, D. W. Gravereaux, "Quadraphonic Matrix Perspective—Advances in SQ Encoding and Decoding Technology," J. Audio Eng. Soc., vol. 21, pp. 342-350 (June 1973).
5. B. B. Bauer, L. A. Abbagnaro, D. W. Gravereaux, and T. J. Marshall, "The Ghent Microphone System for SQ™ Quadraphonic Recording and Broadcasting," J. Audio Eng. Soc., vol. 26, pp. 2-11 (Jan/Feb 1978).
6. B. B. Bauer, G. Cota, "Quadraphonic Broadcasting of the Filarmonica de las Americas in Mexico," J. Audio Eng. Soc., vol. 26, pp. 356-360 (May 1978).

JOHN M. WORAM

A Backward Glance at Cardioid Microphones

The road to single-directional response was strewn with obstacles, and possibilities.

IS THERE a recording or broadcast engineer anywhere in this world who does not use cardioid microphones? Probably not. In fact, there are those who will use nothing *but* cardioids. For, so popular is this handy "problem-solver" that some have forgotten the many virtues of other types. But, that's another story, and perhaps another article.

THE FIRST CARDIOIDS

It seems that the cardioid microphone has been around forever, and it has long since been taken for granted by most mixers in search of a chart-busting sound. Yet, the cardioid principle is not yet fifty years old—it's a relative newcomer when compared to its omni-directional predecessor, which has been with us now for more than 100 years.

Last month, in the *Sound Field Microphone,* J. Howard Smith pointed out that the earliest cardioids ". . . con-

tained two transducers whose outputs were combined within the microphone housing; one was omni-directional (usually a moving-coil)—the other, bi-directional (typically, a ribbon element.)"

Two transducers? Now when was the last time anyone saw such a microphone in day-to-day usage? Apparently, a better way was discovered, for today the two-transducer cardioid microphone is pretty much a museum piece. People may still debate the relative merits of moving coils, ribbons and condensers (electret or otherwise), but there isn't much to argue about when it comes to selecting the optimum number of transducers. We all seem to agree; that number is ONE.

Note that the dual-diaphragm microphone is not the same beast as a two-transducer device. Today's popular dual-diaphragm microphones permit the user to select a variety of polar patterns. Yesterday's two-transducer microphones produced a single polar pattern only. (As a further confusion factor, a few of these featured a switching system that *also* produced several polar patterns, but that's still another story.)

Most of us don't spend too much time worrying about how to coax today's single diaphragm microphone into ignoring sounds from the rear. It just does it, and that's all there is to that. Nothing to it, right?

Wrong. It's quite a complex procedure. (Ask any microphone designer.) And it turns out that it all began when a young engineer, just out of college, filed a patent application describing a method of "Conversion of Wave Motion Into Electrical Energy." (U.S. Patent 2,237,298) In the application, filed in 1938, the inventor states his objective." . . . *to obtain an instrument with unidirectional sensitivity pattern . . . using one transducer element only.*"

The application is quickly followed by four more, each supplementing the first, and contributing still more information. All five were granted patent status, proving that the young engineer had done his homework. And he's been doing it ever since, as you'll find out in this month's story about **The Ghent Microphone.** For our inventor is none other than Benjamin B. Bauer, now vice president and general manager of the CBS Technology Center. Along the way from then till now, Mr. Bauer has managed to accumulate some 65 other patents; that is, one about every six months. (Well, doesn't everyone?)

THE RIBBON MICROPHONE

According to Bauer, it was the invention of the ribbon microphone that helped point the way towards the (two-transducer) cardioid microphone. Within a single housing, one ribbon would be suspended freely, producing a bi-directional polar response. A second ribbon would produce an omni-directional pattern when one of its sides faced into a sealed enclosure. The summation produced the polar equation, $0.5\ (1 + \cos\theta)$, better known to all as a cardioid pattern.

Later, a still more directional pattern was created when the bi-directional ribbon element was combined with a moving coil omni-directional transducer, giving the equation $(0.25 + 0.75 \cos\theta)$, which we call the hyper-cardioid pattern. (For still more equations, see last month's application note on **Plotting Polar Patterns,** which includes the equations given here.)

SAUSAGE MICROPHONES?

These two-transducer microphones were no doubt a far cry from the earliest single transducer microphones designed by J. P. Reis in the middle of the nineteenth century. Reis' microphone used a stretched sausage skin as a diaphragm, and it is reported that although such devices could transmit various single-frequency tones, vocal transmissions were quite unintelligible.

THE "UNIPHASE" SYSTEM

In trying to get a cardioid characteristic from a single diaphragm, Bauer developed the "Uniphase" system, coining the term from the words "uni-directional" and "phase." In other words, the uni-directional response was derived by acoustic phase shifts—and therefore, cancellations—of rear-originating sounds. Then, as now, system performance was not uniform across the entire bandwidth. In fact, Bauer has noted that a popular single-transducer uni-directional microphone of the late 1930's tended toward an omni-directional characteristic at frequencies above 4 kHz. However, at this point the microphone's own casing became an obstruction to the higher frequencies (that is, to smaller wavelengths), and diffraction effects helped to preserve the cardioid characteristic somewhat. This may help to explain why even today the high-frequency response of some omni-directional microphones falls off a bit in the rear. The microphone gets in its own way, acting as an obstruction to high frequencies.

MODERN CARDIOID MICROPHONES

Of course, technology marches on, and perhaps the performance of the latest generation of single-transducer cardioid microphones may even surpass the early expectations of the inventor of "Number 1," not that many years ago.

A complete study of the Bauer patents is pretty heavy reading, but we thought our readers would be interested in this brief backward glance—a tribute to the man who has the distinction of having had the first, and—with the Ghent Microphone—the latest, word to say on the subject of microphones. Until tomorrow, of course.

In the meantime, a review of Bauer's patents should be required reading for anyone who places two cardioid microphones back-to-back and wonders where all the leakage is coming from. As noted, the math gets a bit heavy at times, but the early pages provide a little food for thought. For instance:

"Unidirectional operation has previously been obtained in both transmitting and receiving transducers through a combination of a unit having a nondirectional (circular) polar sensitivity pattern with one having a bidirectional (cosine-law) polar sensitivity pattern. A combination of two such units causes the resulting polar sensitivity pattern to be unidirectional (cardioid) in shape, and it has been applied extensively in the past to transmitting antennas, microphone apparatus, etc. For this latter application, one of the units is commonly made to operate on the pressure component of the sound wave (pressure transducer) and the other upon the pressure-difference of the sound wave (velocity transducer). Addition or cancellation of the voltages generated in each unit occurs, depending upon whether the incidence of sound is from the front (0° inci-

dence) or from the rear (180° incidence) of the instrument. Obviously, the voltages generated by both units for the 180° incidence should be substantially equal and opposite in phase throughout the frequency range in which cancellation is desired, which because of inherent differences in construction and operating principle is a difficult thing to obtain in microphones operating upon dissimilar components of the sound wave.

"An important object of my invention is . . . to obtain an instrument with unidirectional sensitivity pattern by the action of wave effects at two points in a sound wave, using one transducer element only.

"My invention is principally applicable to production and reception of sound waves in air, although it will become apparent to those skilled in the art that it may be equally applicable to wave phenomena in other media. The transducer element or elements employed may be either of the reversible type, such as piezoelectric crystal, moving coil, moving armature or condenser type, or of the non-reversible type such as, for example, the carbon-type. The theory set forth herein is applicable to receiving apparatus, such as loudspeakers, as well as to transmitting apparatus such as microphones. If transducers of the reversible type are employed, one instrument could serve interchangeably, both as a transmitter and as a receiver."

As occurs with many other early patents describing fundamental principles, future microphone designers may find themselves referring to Bauer's work. For example, one of the patents describes second-order directional patterns (again, see last month's application note) which are created through subtractive combinations of first-order patterns. Bauer has observed that this approach has so far found little commercial application, but it is quite likely to crop up again, in future designs.

For those who would like to dig further, the patent numbers and brief descriptions follow. For those who are not inclined towards the mathematics of the microphone, just keep in mind that when two (or more) microphone outputs are combined, be prepared for the unexpected. Unless you've done your homework too.

THE PATENTS (all titled, "Conversion of Wave Motion into Electrical Energy")

2,237,298	April 8, 1941	The basic work, describing the design of various cardioid phase shift microphones.
2,305,596	Dec. 22, 1942	Shows how to obtain different polar patterns by adjusting the phase-shift elements.
2,305,597	Dec. 22, 1942	Describes modified phase-shift configurations.
2,305,598	Dec. 22, 1942	Shows means for external adjustment of directional properties.
2,305,599	Dec. 22, 1942	Second-order directional patterns.

■

Directory of Electret Microphones

THERE WAS A TIME when the condenser microphone was pretty much in the "for-professionals-only" category. Though widely admired for its illusive "condenser sound," the condenser was expensive, complex and fragile. It required an accessory power supply and a special cable. Naturally, these were not interchangeable, so switching microphones in mid-session could be somewhat of a hassle.

Over the years, a variety of developments have made the condenser microphone a little more approachable. Solid-state electronics and phantom powering have been a big help. Gone are the nuisances of individual power supplies lying about the studio floor, and multi-conductor cables between the supplies and the microphones.

But perhaps electret technology has done the most to bring the condenser microphone within financial reach of just about everyone. Here then is a round-up of the electret condenser market. Our list is by no means complete, but we hope it is thorough enough to give the reader an appreciation of the wide variety of electret condenser microphones now available.

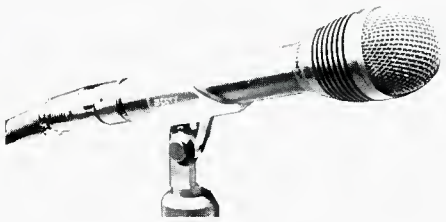
THE DIRECTORY

Model	Polar Pattern	Impedance	Sensitivity	Price	Additional Information
AKG					
SE-5E	(Powering Module)	200	—	$ 60.00	uses 5.6V battery
CAPSULES FOR SE-5E					
CE-1	cardioid	—	−48 dBm	45.00	with integral windscreen
CE-2	omni	—	−48 dBm	45.00	as above
CE-5	cardioid	—	−48 dBm	55.00	as above
CE-8	shotgun	—	−42 dBm	85.00	as above
CE-10	omni	—	−50 dBm	85.00	lavalier microphone
SYSTEMS					
C-501E	cardioid	200	−48 dBm	119.00	includes SE-5E, CE-1 stand adapter, and windscreen
C-505E	cardioid	200	−48 dBm	129.00	includes SE-5E, CE-5, stand adapter, and windscreen
C-510E	omni	200	−50 dBm	145.00	includes SE-5E, CE-10

Model	Polar Pattern	Imped-ance	Sensi-tivity	Price	Additional Information
AUDIO-TECHNICA					
AT-801	omni	600	−48 dBm	60.00	uses AA (UM3) battery
AT-803S	omni	600	−57 dBm	80.00	lapel mic, with belt-clip powering module
AT-805S	omni	600	−57 dBm	50.00	lapel or lavalier, with battery (1.3V) enclosed
AT-811	cardioid	600	−54 dMm	80.00	uses AA (UM3) battery
AT-813	cardioid	600	−58 dBm	95.00	uses AA (UM3) battery
ELECTRO-VOICE					
PE-15	preamp only	150	—	162.00	requires battery or phantom powering
SE-15	preamp only	250	—	288.00	as above
CAPSULES FOR PE-15 AND SE-15					
CH-15E	hyper-cardioid	—	−40 dBm	138.00	accessory windscreen included
CO-15E	omni	—	−49 dB	102.00	accessory windscreen included
CS-15E	cardioid	—	−45 dB	84.00	accessory windscreen included
CL-42E	cardiline	—	−33 dB	297.00	accessory windscreen included
SYSTEMS					
CH-15S	hyper-cardioid	250	−40 dB	486.00	includes shock-mount
CO-15P	omni	150	−49 dB	252.00	
CS-15P	cardioid	150	−45 dB	234.00	direct replacement for CS-15 microphone
CL-42S	cardiline	250	−33 dB	630.00	includes shock mount and handle
MICROPHONES					
CS-15	cardioid	150	−45 dB	225.00	
CO-85	omni	150	−56 dB	156.00	lapel or tie tack microphone
CO-90	omni	150	−57 dB	111.00	lapel or lavalier, with belt-clip powering module
CO-90E	omni	150		75.00	powering module not supplied
1776	cardioid	150	−57 db	—	uses 4.5V battery
1777	cardioid	150	−54 dB	—	uses 4.5V battery, or phantom powering

Model	Polar Pattern	Imped-ance	Sensi-tivity	Price	Additional Information
NAKAMICHI					
CM-300	preamp only	200	—	—	price includes one CP-1, one CP-2, windscreen, cable and 9.1V battery
CAPSULES FOR CM-300					
CP-1	cardioid	—	−56 dB	—	included with CM-300
CP-2	omni	—	−56 dB	—	included with CM-300
CP-3	omni	—	−54 dB	—	improved high frequency response
CP-4	shotgun	—	−56 dB	—	includes windscreen
SYSTEMS					
CM-300x3		—		—	three complete CM-300 sets, in carrying case
SENNHEISER					
K-1	(powering module)	15k	—	101.00	unbalanced output, uses 5.6V battery
K-2U	(powering module)	200	—	101.00	balanced output, uses 5.6V battery
CAPSULES FOR K-1 AND K-2U					
ME-20	omni	—	−49 dB	71.00	
ME-40	super-cardioid	—	−49 dB	100.00	
ME-80	shotgun	—	−45 dB	140.00	
SYSTEMS					
MKE-201	omni	15k	−56 dB	172.00	unbalanced output
MKE-202	omni	200	−49 dB	172.00	balanced output
MKE-401	super-cardioid	15k	−56 dB	201.00	unbalanced output
MKE-402	super-cardioid	200	−45 dB	201.00	balanced output
MKE-801	shotgun	15k	−53 dB	241.00	unbalanced output
MKE-802	shotgun	200	−49 dB	241.00	balanced output
MKE-2002	two omni's	1.5k	−59 dB	403.00	for binaural recording, includes plastic dummy head, battery power supply and carrying case

Model	Polar Pattern	Imped-ance	Sensi-tivity	Price	Additional Information
SHURE					
SM-81	cardioid	150	−64 dB	—	for simplex (phantom) powering
SONY					
ECM-56F	cardioid	200	—	230.00	external power system
ECM-65F	cardioid	200	—	220.00	phantom powering
ECM-64P	omni	200	—	220.00	phantom power or battery



FURTHER NOTES AND COMMENT

Note that in several cases these microphones are available in two or three sections: a powering module, a preamplifier, and a capsule.

Powering modules contain both a battery and the required preamplifier. Preamplifiers do not contain a battery, and so need an external power supply. This may be either a battery or a phantom power supply. (Note that Shure Brothers prefers the term *simplex* to *phantom*).

Where a selection of capsules is listed, these screw into the powering module (or preamplifier). Thus, the user may quickly change from one polar pattern to another without needing a separate power module/preamplifier for each. Obviously, a collection of complete systems is preferable, but when the budget is tight, this feature can help to stretch the pennies somewhat.

Remember, this directory is merely a quick glance of what's available. For complete information on the microphones and their accessories (which are often extensive), contact the manufacturers. And tell them **db** sent you! Here's where to find them.

AKG Acoustics
91 McKee Drive
Mahwah, New Jersey 07430
(201) 529-5900

Audio-Technica, Inc.
33 Shiawassee Avenue
Fairlawn, Ohio 44313
(216) 836-0246

Electro-Voice, Inc.
600 Cecil Street
Buchanan, Michigan 49107
(616) 695-6831

Nakamichi Research, Inc.
220 Westbury Avenue
Carle Place, New York 11514
(516) 333-5440

Sennheiser Electronic Corp.
10 West 37th Street
New York, N.Y. 10018
(212) 239-0190

Shure Brothers, Inc.
222 Hartrey Avenue
Evanston, Illinois 60204
(312) 866-2200

Sony Corp. of America
9 W. 57th Street
New York, N.Y. 10019
(212) 371-5800 ■

JOHN M. WORAM

The 60th Audio Engineering Society Convention—Part II

Semi-Pro can get pretty fancy.

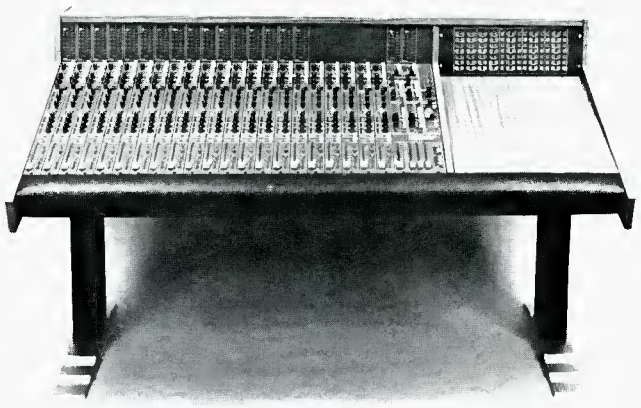
LAST MONTH, our report of the 60th A.E.S. convention began with a look at the latest in digital tape recorders. For the professional recording studio, surely these represent the ultimate in sophistication, even though the price tags (when and if) are at least 3 dB above the threshold of pain.

But possibly there are one or two readers out there who are not quite ready for this kind of expenditure. In fact, even the price tags on more conventional pro grear can get a little scary. What then, about the so-called "semi-pro" gear?

DEFINING THE SEMI-PRO

The term "semi-professional" has been loosely draped over an incredibly vast amount of equipment that does not quite measure up to "professional" standards. Fortunately, this need not mean that the equipment is therefore inferior. For example, tape recorder output levels on semi-pro machines are apt to be some 10 dB lower than on pro gear. Such machines may not be able to drive Dolby "A" systems, though they do a fine job with the dbx semi-pro (those words, again) systems.

Sound Workshop's new 1600 Series, automation-ready for about $10,000, or fully equipped for $60,000+.



Interconnecting plugs are apt to be RCA phono or quarter-inch phone plugs. If you drop a pro and a semi-pro machine off the back of a truck, the semi-pro may suffer more damage. And, a tape made on a semi-pro deck may not play back on a pro machine, due to track format differences. But then, a pro tape won't play back on a semi-pro machine for that matter.

With all that out of the way, it's a good bet that most high quality semi-pro gear measures up quite well against their professional counterparts. And, the price is right.

SEMI-PRO CONSOLES

Barely a decade ago, consoles were strictly for pros. The price tags alone saw to that. Then, TEAC/Tascam introduced the famous Model 10 for less than $2,000. In our own backyard, Sound Workshop introduced its 1280 series, and at this last show, the company demonstrated its Series 1600 modular automated console. Automated! Good Lord, these semi-pros don't seem to know when to stop, do they?

The console is available in configurations from 12 x 8 up to 36 x 32, with or without the automation. If you get it without, the automation may be added by inserting a VCA automation control card into each input module, and purchasing Sound Workshop's Automation Processor. With this equipment installed, the system provides automated level control and channel muting, and is compatible with MCI's automation system.

That last point may be one of the consoles' most interesting features. It allows the basement studio to prepare tapes (automated, no less) that may be played back in the big time pro studio downtown. It also means that the fully-automated pro studio can add a second room at a fraction of the cost of their "Studio A." Prices on the 1600 series start at $10,000, and can go beyond $60k, depending . . .

From Uni-Sync, Inc., the Trouper I stereo output module with expander module on the left.

From the other side of the country, Audio Concepts showed its $14,500 Concept I console, with 16 inputs, 8 outputs, three-band equalization, and all the usual goodies.

And, in Westlake Village, California, Trouper I has gone stereo. Not the latest craze in C.B. radio, the Troupers are a series of live music mixing consoles from Uni-Sync, Inc. Formerly available just in mono, the Trouper I Stereo Output Control Module is an 8-in/2-out board for sound reinforcement applications. A plug-in expander module

The PMS-1 metering panel, also from Uni-Sync.

adds ten more inputs and costs $838. The Output Control Module costs $898. Both units feature professional three-pin plugs on all microphones inputs, with quarter-inch phone jacks elsewhere. The Output Control Module contains two built-in spring reverbs.

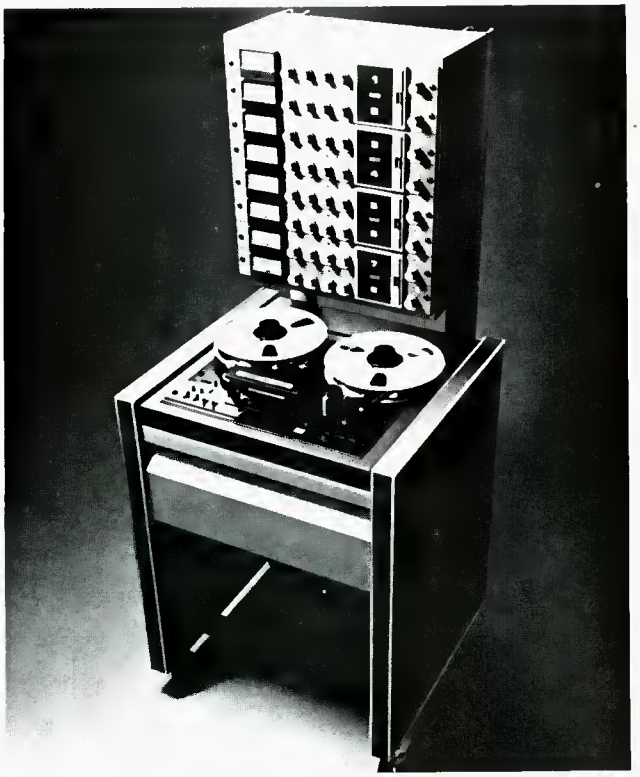
Uni-Sync also showed an interesting rack-mount two channel metering panel, which uses twelve l.e.d.'s per channel. The green, yellow and red l.e.d.'s on the PMS-1 read out percentages (10% to 100%) of maximum power output. A rear-mounted calibration potentiometer sets the 100 per cent level at up to 200 watts. And the price looks good too: $149.

Coming back to consoles once again, TEAC has added the Model 15 to its Tascam series of boards. With 24-in, and 8 mixing busses, the console sells for $9,500. The provisional spec. sheet notes that the Model 15 offers the expanded facilities needed for Tascam's eight and sixteen track tape recorders. In fact, the first sixteen inputs are mic/line/tape, while 17-24 are mic/line/off. Presumably, the first sixteen would be used to monitor the output of a sixteen track recorder. As for recording on tracks 9-16, there must be a way, but the spec. sheet doesn't say much on this. Check with TEAC for more details.

SEMI-PRO RECORDERS AND EQUALIZERS

The semi-pro who seeks pro compatibility apparently has a friend at Otari. At the A.E.S. 60th, the company introduced the MX-7800 full-function one-inch eight track tape recorder. With a price tag of $8,695, the MX-7800 offers 15 and 30 in./sec tape speed, three heads, +4 dBm balanced outputs, d.c. capstan servo with varispeed, and throws in microphone inputs as well. There's also a built-in oscillator (700 Hz and 15 kHz) for making quick level and bias checks.

Otari full-function remote control for MX-7800 one-inch 8-track recorder includes synchronous reproduce and varispeed coarse and fine controls.



Otari MX-7800 full-function one inch 8-track recorder.

As options, the CT-706 provides full remote control functions for the MX-7800, and the CT-501 adds remote tape timing, plus return-to-zero function.

TEAC enters the equalizer field with the GE-20, a $350 two-channel 10-band graphic equalizer, with center frequencies at one-octave intervals, from 31.5 Hz to 16 kHz. Each band may be boosted or cut by up to 12 dB.

TEST GEAR—FOR PROFESSIONALS AND OTHERS

Why the sudden interest in test equipment? There was a time when such esoterica was all but invisible on the exhibit floor. Convention-goers were more interested in the latest "whiz-bang boxes," super consoles and such. But then people began realizing that all that super-sophisticated hardware would require a little more attention than just plugging it in and turning it on. And so, test gear was discovered. Actually, it was re-discovered. It had been there all along, but hadn't been getting the attention it deserved. Now, people are getting more test gear-conscious, and manufacturers are responding with enthusiasm.

Ivie Electronics began operations several years ago in a mobile home, surrounded by 9½ acres of cherry orchard. They must have done something right, for there are now 30,000 square feet of rock, block and glass standing on that orchard. No doubt, cherry picking has suffered some, but the company now enjoys spacious R&D areas, plus large anechoic and reverberant chambers. Try putting *that* in your mobile home!

One of Ivie's latest products is the IE-17A Microprocessor Audio Analyzer, an accessory to the IE-30A Audio

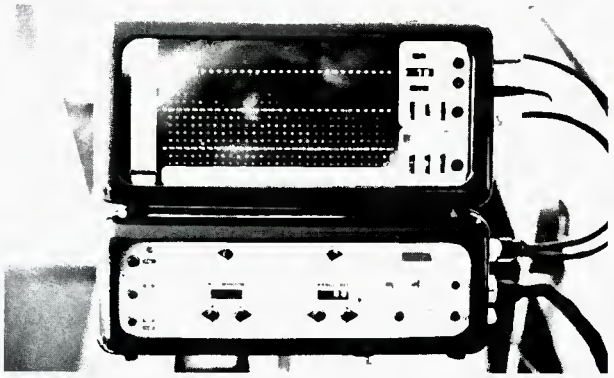
Analysis System. The IE-30A may be used as a one-third octave real time analyzer, or as a sound level meter with A, C or flat weighting. The spectrum analyzer section utilizes a 480 l.e.d. matrix display, and there are two memories for storing and/or accumulating data.

The IE-17A accessory extends the versatility of the IE-30A by permitting the measurement of reverberation time in one-third or full octave bands. RT_{60} can be measured over the range from 10 milliseconds to 99.99 seconds. In addition, the combination allows the user to study time-delay spectrometry events, acoustic absorption coefficients, articulation losses and various other measurements that are a function of time. If that's not enough to keep you out of mischief, the IE-17A contains the interface required for transferring screen patterns from the IE-30A l.e.d. display to an X-Y or strip chart recorder. The IE-30A is $2,800, and the IE-17A costs $995.

If you haven't got a strip chart recorder lying about, get in touch with the Neutrik Products Division of Philips Audio Video Systems Corp. and ask about the 3201 Audiotracer, which records amplitude *vs.* frequency (or time), using a heated pen writing on thermo-sensitive paper. Paper speed is continuously adjustable up to 25mm/sec. The Audiotracer carries a suggested professional user net price of $1,695.

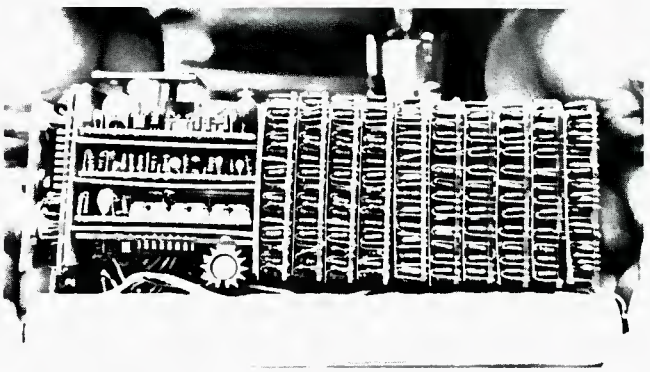
Amber Electro Design Ltd. has added a distortion plotting system as an accessory to its Model 4400A Audio Test Set. The Model 4405 permits measurement of total harmonic distortion and sweep plots of harmonic or inter-modulation distortion *vs.* frequency.

Via the Audio Test Set, these plots may be displayed on an oscilloscope. An optional accessory (for the test set) allows hard copy plots to be made on any X-Y recorder.

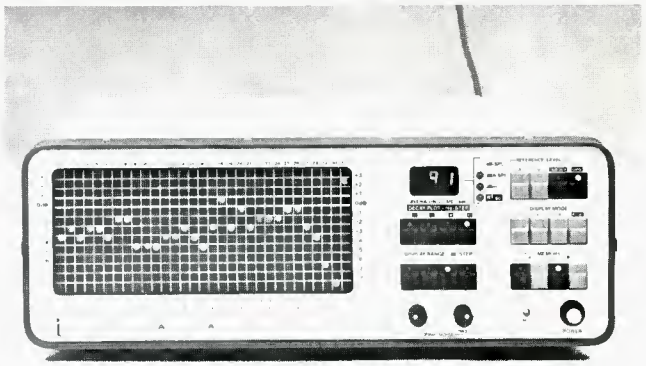


The Ivie IE-30A Audio Analysis System, with the IE-17A Microprocessor Audio Analyzer below it.

The compact electronics package inside Ivie's Audio Analysis System.



Amber's new Model 4405 Distortion Plotting System sits on top of the versatile 4400A Audio Test Set.



Inovonics Model 500 Acoustic Analyzer offers spectrum analysis and sound level measurements.

* * *

Inovonics Inc.—best known for its compressors and tape recorder electronics—introduced the Model 500 Acoustic Analyzer. A 13 x 31 l.e.d. matrix is used to display SPL in thirty one-third octave bands, or reverberation times up to 9.99 seconds. Rear panel connectors are provided for oscilloscope feeds, and there is a digital I/O interface connector available for three-dimensional displays of amplitude *vs.* frequency *vs.* time. The Model 500 also has a digital read-out for SPL measurements (dB or dBA) or line levels from —60 to +39 dBm. It's yours for $2,750.

What with microprocessor analyzers and digital I/O interfaces, how much longer will it be until the test gear interfaces directly with the recording equipment, and continuously monitors the performance (of the equipment, not the musicians)? Any guesses? ■

db Classified

Closing date is the fifteenth of the second month preceding the date of issue.
Send copies to: Classified Ad Dept.
db THE SOUND ENGINEERING MAGAZINE
1120 Old Country Road, Plainview, New York 11803

Minimum order accepted $10.00.
Rates: 50¢ a word.
Boxed Ads: $25.00 per column inch.
db Box Number: $1.00 per issue.

Frequency Discounts: 3 times,10%; 6 times,20%; 12 times,33%.

ALL CLASSIFIED ADS MUST BE PREPAID.
FREQUENCY DISCOUNT ADVERTISEMENTS ARE TO BE PREPAID IN ADVANCE.

FOR SALE

(continued)

FOR SALE

CANADIANS!
SEMI-PRO MULTITRACK RECORDING HEADQUARTERS FOR: TEAC/TASCAM, Soundcraft, Sennheiser, BGW, Altec, Lexicon, dbx, Bi Amp, Beyer, R.S.D., Tapco, and more.
Richard's Music Shop Inc.
6078 Sherbrooke W.
Montreal, Canada H4A 1Y1
(514) 487-9911

TEST RECORD for equalizing stereo systems. Helps you sell equalizers and installation services. Pink noise in ⅓ octave bands, type QR-2011-1 @ $20. Used with precision sound level meter or B & K 2219S. **B&K Instruments, Inc., 5111 W. 164th St., Cleveland, Ohio 44142.**

DISCOUNT PRICES on fresh name-brand tape. Check our prices in bulk, reels, boxes, carts, and cassettes. **P.B.P., 4100 West Kennedy Blvd., Tampa, Fla. 33609. (813) 877-7125.**

CROWN INTERNATIONAL. Complete repair, overhaul, and rebuilding service for current and early model tape recorders. Reconditioned recorders in stock. Used recorders purchased. **Techniarts, 8555 Fenton St., Silver Spring, Md. 20910. (301) 585-1118.**

MODERN RECORDING TECHNIQUE, by Robert E. Runstein. The only book covering all aspects of multi-track pop music recording from microphones through disc cutting. For engineers, producers, and musicians. $10.50 prepaid. **Robert E. Runstein, 1105 Massachusetts Ave., #4E, Cambridge, Mass. 02138.**

STAGE / STUDIO / BROADCAST audio systems: AKG, Allison Research, Amber, Amco., A.P.I., Audiotronics, Beyer, Cannon, dbx, E-V, Eventide Clockworks, Ivie, JBL, Lexicon, MicMix, MRL, MXR, Nagra, Neotek, Neumann, Nortronics, Orban/Parasound, Orange County, Otari, Pultec, Robins, Russco, Scully, Sennheiser, Sescom, Shure, Sony, Soundcraft, Speck, Switchcraft, Spectra Sonics, 3M, Tascam, Technics, White, UREI plus many more. For further information on these and other specialty items from our factory operations contact: **Midwest Sound Co., 4346 W. 63rd St., Chicago, Ill. 60629. (312) 767-7272.**

NAGY SHEAR-TYPE TAPE SPLICERS

FOR CASSETTE ¼ & ½ IN. TAPES
- **HAND-CRAFTED**
- **FIELD PROVEN**
- **FAST, ACCURATE**
- **SELF-SHARPENING**

NRPD Box 289 McLean, Va. 22101

AMPEX, NAGRA professional sales and service. ATR 100's in stock for immediate delivery. **Techniarts, 8555 Fenton St., Silver Spring, Md. 20910. (301) 585-1118.**

MAGNECORD 1024-42RX/remote; Revox A-77 1302/remote/rack, $550. **James Ebbert, 770 Holly Rd., Wayne, Pa. 19087. (215) 687-3609.**

MINI-STUDIO package systems from $2,599, using pro-recording equipment from Revox, Otari, Lamb Labs, Trident, Beyer. Write for full details of offers to **Entertainment Sound Services, Inc., 78 N. Franklin Ave., Hempstead, N.Y. 11550. (516) 538-2220.**

TAPCO and Electro-Voice, mixers, equalizers, amps, mics, and loudspeakers. Write for low mail order prices. **Sonix Co., P.O. Box 58, Indian Head, Md. 20640.**

NAB ALUMINUM FLANGES. We manufacture 8", 10½", and 14". Also large flanges and special reels to order. Stock delivery of assembly screws & nuts & most aluminum audio, video, & computer reels. For pricing, call or write **Records Reserve Corp., 56 Harvester Ave., Batavia, N.Y. 14020. (716) 343-2600.**

SERVICEMEN—Cleaners, lubricants, adhesives, belts for all electronic repairs. Rek-O-Cut belts, $7. Write for free catalog. **Projector-Recorder Belt Corp., Whitewater, WI 53190. Tel: 1-800-558-9572.**

INTERFACE 200 series, 8 x 2 board; Ducan sliders; brand new; list price, $2,000, yours for $1,250. Hewlett-Packard/Altec 8050A real time analyzer, $2,000. Demo UREI equipment; 1176-LN limiter; 527 equalizer; other assorted pieces. Make offer. **Ro-Cel Electronics, Inc., 731 Butler St., Pittsburgh, Pa. 15223. (412) 781-2327, Don.**

CORNERS, HANDLES, latest pro audio and disco equipment at big savings. Price list FREE. Catalog, $1.00. **Stillwater, Box 31012, Dallas, Texas 75231.**

AMPEX, SCULLY, OTARI, all major professional audio lines. Top dollar trade-ins. 15 minutes George Washington Bridge. **Professional Audio Video Corporation, 342 Main St., Paterson, N.J. 07505. (201) 523-3333.**

HIGH IMPEDANCE headsets, $14.95. 300Ω or 10,000Ω units available. Please specify. Headsets come with one year factory warranty. **Scott Phillips Electronics, 92 Beacon St., Lawrence, Mass. 01843.**

FOR SALE: One Neve 8016a multi-track recording and remix console with 24 inputs; one Neve BCM 10-2 console; one Neve 2254a compressor/limiter; one Neve 2254e compressor/limiter; one Ampex MM-1000 16-track record/playback machine; one Studer B62 2-track record/playback machine; one Ampex MR 70/2 2-track record/playback; one Ampex MR 70/4, 4-track record/playback; one UREI Cooper time cube; two UREI LA/3A limiters; two UREI 1176 LN limiters; one UREI 527 graphic equalizer (1/3 octave); one Pultec EQP 1A3; one Pultec MEQ5; one Multi-track parametric equalizer; one Eventide PS 101 phaser. MICROPHONES: Two Neumann U87; one Neumann U47 f.e.t.; one AKG D 1000E; one AKG C 12A; one AKG C 24 stereo; three AKG D 224E; two Electro-Voice RE15; one Electro-Voice RE 20; one Schoeps CMT 541; two Schoeps CMT 54; two Schoeps CMT 56; two Beyer M 160; two Beyer M 500; one Beyer M 360; one Beyer M 69 NC; one Beyer M 88 NC; two Beyer M 201 NC; one EMT 140 mono chamber; one EMT 140 TS stereo chamber; 2 Furman PQ-3 equalizers (parametric); two Furman TX-2 crossovers. MISC. Three MacIntosh MC75 power amps; one MacIntosh MC 240 power amp; one MacIntosh MC 275 power amp; two Phase Linear 400 power amps; eight Beyer DT 100, 100-ohm earphones; eight custom 4-channel earphone mixers on heavy duty music stands; two JBL 4350 monitor speakers; two JBL 4325 monitor speakers, each containing two LE15B's, 1 2440, 1 075, 1 1200 Hz passive over, 1 7000 Hz passive crossover; two JBL 4325 cabinets containing two LE15B woofers only; two JBL LE15B woofers; 2 JBL 2215A woofers; two Krohn-Hite band pass filters; six Beyer ST 212 booms, 7'6" tall, 6' reach; ten Beyer ST 210-2 booms on stands; three Keith Monks booms 8' tall, 10' reach; assorted cables, direct boxes, snakes, mult boxes. **Call Sid Goldstein, Parasound, Inc. (415) 673-4544.**

AMPEX TAPE. ¼ in. and wide widths in stock. **Techniarts, 8555 Fenton St., Silver Spring, Md. 20910. (301) 585-1118.**

AMPEX 351 Record/playback electronics; Ampex MX35 mixer; Philips EL6911/01 tape delay unit; Sony EV-320 1 in. VTR with video color pack CLP-1B (both used approx. 15 hours); JBL 5306 mixer; Magnecord 748 half-track stereo; Stancil/Hoffman 16-track 2 in. tape transport with new play head only, in console, no electronics; 16 x 2 mixer, faders and panners only, no electronics. **(215) 338-1682.**

TASCAM Model 10, 12-in/4-out, accessories; Sony TC8-54 4-channel; associated equipment. **Steve Kurtz, 2421 Mapleview, Kalamazoo, Mi. 49002. (616) 323-9410.**

HAECO CSG-2 compatible stereo generator, new condition, $1,700. Used Westrex 1574D cutter amps, $400 each. Pultec MH-4 mixer, $125. HAECO LX-1 crossover, $600. Fairchild 670 stereo limiter, $650. **Frankford/Wayne Recording, 134 N. 12th St., Philadelphia, Pa. 19107. (215) 561-1794.**

WEST COAST engineers/producers: Bay Area sixteen-track; fully equipped with tube Neumanns, Schoeps, etc., EMT; DDL's (2); acoustic chamber; Dolby A; Spectrosonics; Scully; Ampex. Free flight for out-of-towners. **Tewksbury. (415) 232-7933.**

7 x 7 STEREO routing switcher. Any input or multiple outputs. All electronic switching, digital control and memory, l.e.d. status board. **Audio Products Company, 1038 Fourth St., Rensselaer, N.Y. 12144.**

PROFESSIONAL AUDIO COMPONENTS: AKG mics; Badap 1; Crown; dbx; Delta-Lab; Eventide; Frazier; Gauss; GLI; Ivie; Malatchi; MasterRoom ; Neumann mics; Otari; Pentagon; RTR; Sennheiser mics; Switchcraft; Tascam; Uni-Sync; and UREI. These products are on demo in our showroom and in stock for immediate delivery. Our shipping is insured and prepaid. **Barclay Recording & Electronics, 233 E. Lancaster Ave., Wynnewood, Pa. 19096. (215) 667-3048 or 649-2965.**

SALE: FAIRCHILD #523 lathe, Grampian mono feedback cutter, Jagenburg Colletta automatic cassette labeler. **(212) 753-9888.**

FOR SALE, large Moog synthesizer. All components, 2 keyboards, ribbon controller, 2 sequential controllers. Excellent condition. **Scott-Textor Productions, 220 E. 54th St., New York, N.Y. 10022. (212) 688-4330.**

A PROFESSIONAL 6-input stereo mixer for under $300.00! Tone, cue, echo panpot, linear fader, vu meters. Innovative European design. Sole American distributor. Write: **ICB(C), Box 2752, Erlanger, Kentucky, 41018.**

MAGNETIC HEAD relapping—24-hour service. Replacement heads for professional recorders. **IEM, 350 N. Eric Dr., Palatine, Ill. 60067.**

SCULLY 8-TRACK w/Sync Master, mint condition; Accurate 8 x 8 mixing console; best offer over $6,000.00 takes both. **Le Mans Sound. (201) 359-5520.**

RANSTEELE custom heavy duty wall/ceiling speaker mounting brackets for JBL, Altec, Big Reds, etc., $160 pair. Ransteele 200W/ch stereo cutter drive amplifiers; used Westrex and Haeco cutterheads; complete line of custom disc mastering room audio equipment not available anywhere else! Reconditioned Scully lathes; complete turnkey mastering rooms. **Ransteele Audio, Inc. 1697 Broadway, New York, N.Y. 10019. (212) 265-5563.**

USED RECORDING equipment for sale. Professional mics, speakers, miscellaneous gear. **Dan (415) 232-7933.**

ALL GOLD MAKERS: MCI JH-416-24 LM, $25K; MCI Custom 20 x 16, $15K; Ampex AG440-8-C (d.c. servo capstan), $7K; McIntosh 2300, $1.2K; McIntosh 2105, $650; McIntosh 2505, $450. Previously owned but fully reconditioned. **Audio Consultants, Inc., Nashville, Tenn. (615) 256-6900.**

YAMAHA PM-1000 24 x 4 mixer; new, $7,000.00, from our demo room; fully warranteed at less than dealer cost. Call Bob at (716) 853-6500 for details. **Unistage, 330 Genesee St., Buffalo, N.Y. 14204.**

AMPEX MM-1000 8-track recorder/reproducer; excellent condition. Meets all specs. $6,500. **Pan Studios. (303) 473-1114.**

WANTED

WANTED. EMT Echo, **(707) 528-0304.**

WANTED: Recording equipment of all ages and variety; Neumann mics, EMT, etc. **Dan Alexander, 6026 Bernhard, Richmond, Ca. 94805. (415) 232-7933.**

WANTED: Used 24-track machine and console. **(503) 777-4621. Recording Associates.**

THINK YOUR ADVERTISING COULD BE STRONGER? Sid Goldstein and Parasound, Inc. announce full service advertising and marketing for the professional audio industry. Our credentials? Ten years of sales and marketing experience on the Orban/Parasound line, including advertising design, placement, new product development, and sales. Currently, we handle exclusive sales and marketing for Orange County Electronics. If you think your advertising could be stronger, please call us. **Parasound Inc., Wharfside, 680 Beach St., Suite 414, San Francisco, Ca. 94109. Ask for Sid Goldstein.**

GROWING SOUND REINFORCEMENT company tour/concert work. Pro equipment, two experienced engineers. Priced very reasonably. Interested? **Lobster Sound, Box 504, Amherst, Ma. 01002. (413) 549-2810 (Attn. Ken MacLeish).**

EMPLOYMENT

MAINTENANCE/CUTTING ENGINEER. Large independent East Coast disc mastering facility seeks an experienced maintenance/chief engineer who is looking for a bright future and who is completely familiar and is able to maintain Neumann, Scully, Westrex, and Capps cutting room equipment. Other duties will include occasional cutting, R&D projects, and construction. Applicant must be able to work with little or no supervision and be of high calibre. Excellent company benefit programs. Salary commensurate with qualifications. Reply with resume to **Dept. 81, db Magazine, 1120 Old Country Rd., Plainview, N.Y. 11803.**

DISC MASTERING ENGINEERS. The East Coast's largest independent disc mastering house is in need of two experienced cutters, preferably with a good technical background and customer following. Excellent salary and benefits. Apply with resume to: **Dept. 82, db Magazine, 1120 Old Country Rd., Plainview, N.Y. 11803.**

EXPERIENCED MUSIC MIXER
Major N.Y.C. studio. New automated 24-track. Send resume to **Dept. 83, db Magazine, 1120 Old Country Rd., Plainview, N.Y. 11803.**

db People/Places/Happenings

• **Parasound, Inc.,** under the direction of **Sid Goldstein,** has acquired the product line of **Orange County Electronics** of Winnipeg, Canada. Orange County will also continue to sell its products from Winnipeg. **Bob Patrick** is their new broadcast products manager.

• Loudspeaker design and development will be the particular province of **Tim Halchuck,** recently appointed as vice president of acoustical engineering at **KLH/Burwen. Daniel von Recklinghausen** will continue in his capacity of vice president of research and development, concentrating on research.

• Two promotions at **Tannoy-Ortofon Inc.,** of Plainview, N.Y. have placed **Henry Roed, Jr.** in the position of general manager and **Robert Goodman** in the post of national sales manager. The two will be working together in developing U.S. marketing programs.

• In a shift of responsibilities, **Burton "Bud" Stone** has moved from the presidency of Precision Film Laboratories, the New York lab of **DeLuxe Laboratories,** Hollywood, Ca. to the California office. Replacing **Robert Kreiman,** who has started his own firm, Mr. Stone has assumed the presidency of DeLuxe General Inc.

• Quality control of all audio products from **Cetec Audio** of N. Hollywood, Ca., is the responsibility of **James R. Williams.** Mr. Williams, coming from **RCA,** recently joined Cetec, with the title of quality control manager.

• Extensive responsibility for a number of operations has been delegated to **Donald W. Miller,** newly appointed director of creative production at **Ball Communications,** Evansville, Indiana. Mr. Miller will handle production of video tape recordings, film, audio, photography, conventions, multi-media presentations, as well as supervision of production crews.

• New national sales manager at **Pentagon Industries,** Chicago, Ill. is **Joseph F. Hollenkamp.** Mr. Hollenkamp comes to Pentagon from **Bell & Howell.**

• There have been three vice-presidential promotions at **Nikko Audio,** of Van Nuys, Ca. The titles were assumed by **John Schroder,** eastern division sales manager; **Jeffrey Quist,** secretary/treasurer; and **Yogi Tuchiya,** director of finance.

• The newly created position of chief engineer for the Advanced Development Group at **Telex Communications, Inc.** of Minneapolis, Minn. has been filled by **Michael J. Lamb.** Mr. Lamb came from **TRW,** of Redondo Beach, Ca.

• A new marketing and systems engineering firm, **Auscom Associates,** has been formed by **Richard H. Wood,** formerly of the systems design and engineering divisions of **RCA, Phillips** and **IMI.** The firm will offer consulting services in design and engineering in broadcast, business, and educational t.v. areas. Their address is P.O. Box 544, Glen Rock, N.J. 07452, telephone (201) 447-6462.

• A western regional office has been opened by **Lexicon, Inc.** The new facility, managed by **Keith Worsley,** is located at 24 Greenbank Ave., Piedmont, Ca. 94611. Their telephone number is (415) 654-2371.

• Moving up from the position of Assistant Chief Enginer, **Joseph A. Fabian** has been appointed Chief Engineer at **WEJL/WEZX** in Scranton, Pa. He replaces **Norman J. Avery,** who has moved to **WENE/WMRV,** Endicott, N.Y. filling the Chief Engineer slot there.

• Based at their Cherry Hill, N.J. facility, **Carroll Ogle** has joined **CCA Electronics Corporation** as manager of broadcast products, handling sales of a.m., f.m., and t.v. broadcast transmitters and associated equipment. Mr. Ogle has considerable broadcast expertise; he has built several radio stations and UHF television stations, as well as functioning as the sales manager of WRDU, UHF television station in Raleigh, N.C. Another personnel change at CCA is the promotion of **Don Powers** to the position of area sales manager for most of the Central Atlantic states.

• A bit of bucolic atmosphere has been recreated in mid-Manhattan at the newly renovated studio of **National Recording Studios,** dubbed Edison Hall and located in the **Edison Hotel,** between 46th and 47th Sts. and Broadway. Amidst the ambience of an old-fashioned New York State farmhouse, you can rock on a real oak rocker while rock sounds are being processed by an ultra-modern 24-track console and other equipment of like sophistication.

• The **Allied Electronics** division of the **Tandy Corporation** has been sold to **AE Division, Inc.** a subsidiary of **Spartan Mfg. Corp.** of St. Louis, Mo. Allied Electronics is a national distributor of industrial electronic products. The company sold for $5,150,000 cash and in addition, Tandy received warrants to purchase 100,000 shares of Spartan common stock.

• Appointment of **Jon Rapp** as executive vice president, operations, at **James B. Lansing Sound,** of Northridge, Ca. has been announced. Mr. Rapp, who had previously been with **Samsonite,** will directly supervise JBL's engineering, manufacturing, and product development divisions. Another major appointment at JBL is that of I.R. Stern, who has assumed the role of executive vice president, marketing. Director of the marketing services division is **Ed Walsh** and **Bruce Scrogin** has been appointed director of the international division.

• A new division, the Magnetic Tape division, has been created at the **Sony Corporation** of New York City. **Dr. Terry Aoki** has been named general manager. Dr. Aoki is the inventor of two semi-conductor processes.

• Joining **KLH/Burwen Research** at their new facility in Westwood, Mass., **Robert Coppola** has assumed the post of executive vice president. Mr. Coppola, who had been the owner of **Phonopol,** will direct expansion within the international market for speakers, signal processors, and stereo headphones, and will be in charge of marketing and sales of KLH and Burwen research products.

• **Orban/Parasound,** of San Francisco, has dissolved its operating agreement and become two separate companies. **Parasound, Inc.,** an independent marketing organization, is under the direction of **Sid Goldstein.** All marketing functions of Orban Associates is being handled by the **Orban Associates Marketing Organization.**

• The **Ampex Corporation,** of Redwood City, Ca. has been granted the exclusive right to be named the official supplier of videotape recorders, slow motion disc recorders, and magnetic recording tape for the Olympic Games to be held in Moscow in 1980. The company has also been granted the right to use the official emblem of the games in conjunction with the designation "Official Supplier."

Use the attached postage-free Reader Service Cards for free technical data.

Circle the number on this card that corresponds to the number beneath the ad or editorial.

1	21	41	61	81
2	22	42	62	82
3	23	43	63	83
4	24	44	64	84
5	25	45	65	85
6	26	46	66	86
7	27	47	67	87
8	28	48	68	88
9	29	49	69	89
10	30	50	70	90
11	31	51	71	91
12	32	52	72	92
13	33	53	73	93
14	34	54	74	94
15	35	55	75	95
16	36	56	76	96
17	37	57	77	97
18	38	58	78	98
19	39	59	79	99
20	40	60	80	100

PLEASE PRINT CAREFULLY

Name & Title

Company

Company Address

City/State/Zip

August 1978—Use this card before November 1978

☐ I AM A SUBSCRIBER

Please check your area of employment or occupation:

☐ (a) Recording Studio
☐ (b) Radio Broadcasting
☐ (c) TV Broadcasting
☐ (d) Audio/Visual
☐ (e) Video Recording
☐ (f) Commercial Sound
☐ (g) Film Sound
☐ (h) Other

Keep db coming!

THE SOUND ENGINEERING MAGAZINE db

Enter my subscription to **db — The Sound Engineering Magazine.** My check is enclosed.

	North America except Canada	Foreign	Canada
1 Year	$ 7.00	$14.00	$ 8.00
2 Years	$12.00	$24.00	$13.00
3 Years	$16.00	$32.00	$17.00

Name

Address

City/State/Zip

Company Affiliation

Title

Signature & Date

IF RENEWAL PLEASE CHECK ☐

THE SOUND ENGINEERING MAGAZINE db

Enter my subscription to **db — The Sound Engineering Magazine.** My check is enclosed.

	North America except Canada	Foreign	Canada
1 Year	$ 7.00	$14.00	$ 8.00
2 Years	$12.00	$24.00	$13.00
3 Years	$16.00	$32.00	$17.00

Name

Address

City/State/Zip

Company Affiliation

Title

Signature & Date

IF RENEWAL PLEASE CHECK ☐

FIRST CLASS
Permit Number 217
Clinton, Iowa

BUSINESS REPLY MAIL
No Postage Stamp Necessary if Mailed in the United States

Postage will be paid by

db The Sound Engineering Magazine
P.O. Box 2521
Clinton, Iowa 52732

Please fill in *all items* on the
reverse side of this card
and be sure to enclose your check.

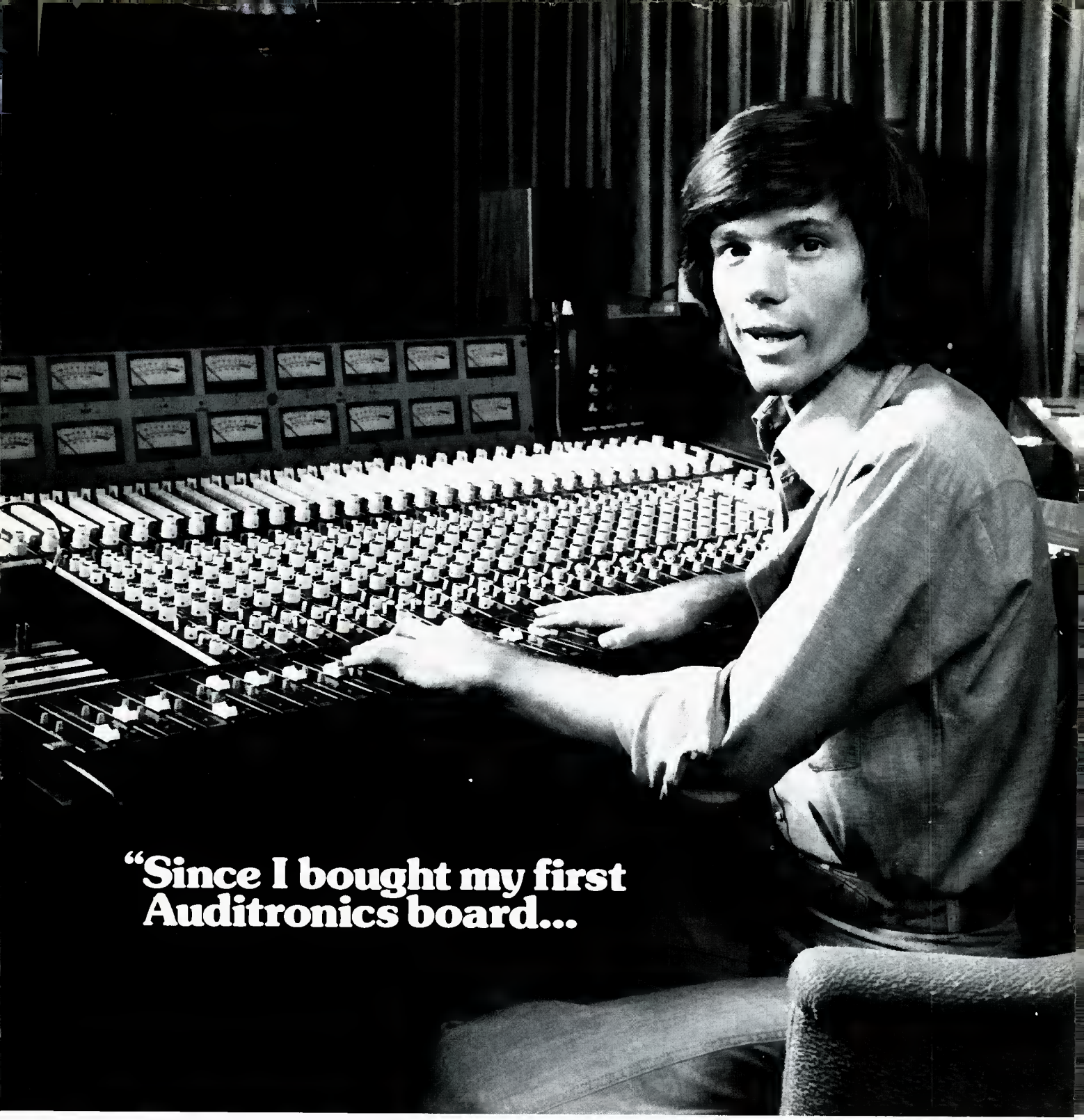
Mail to:

The Sound Engineering Magazine
Sagamore Publishing Co.
1120 Old Country Road
Plainview, New York 11803

Please fill in *all items* on the
reverse side of this card
and be sure to enclose your check.

Mail to:

The Sound Engineering Magazine
Sagamore Publishing Co.
1120 Old Country Road
Plainview, New York 11803



...five years ago, I've done all of Shaun Cassidy and Leif Garrett on it, most of Donny and Marie, plus Al Martino, Sammy Davis, Debby Boone, the Supremes and others."

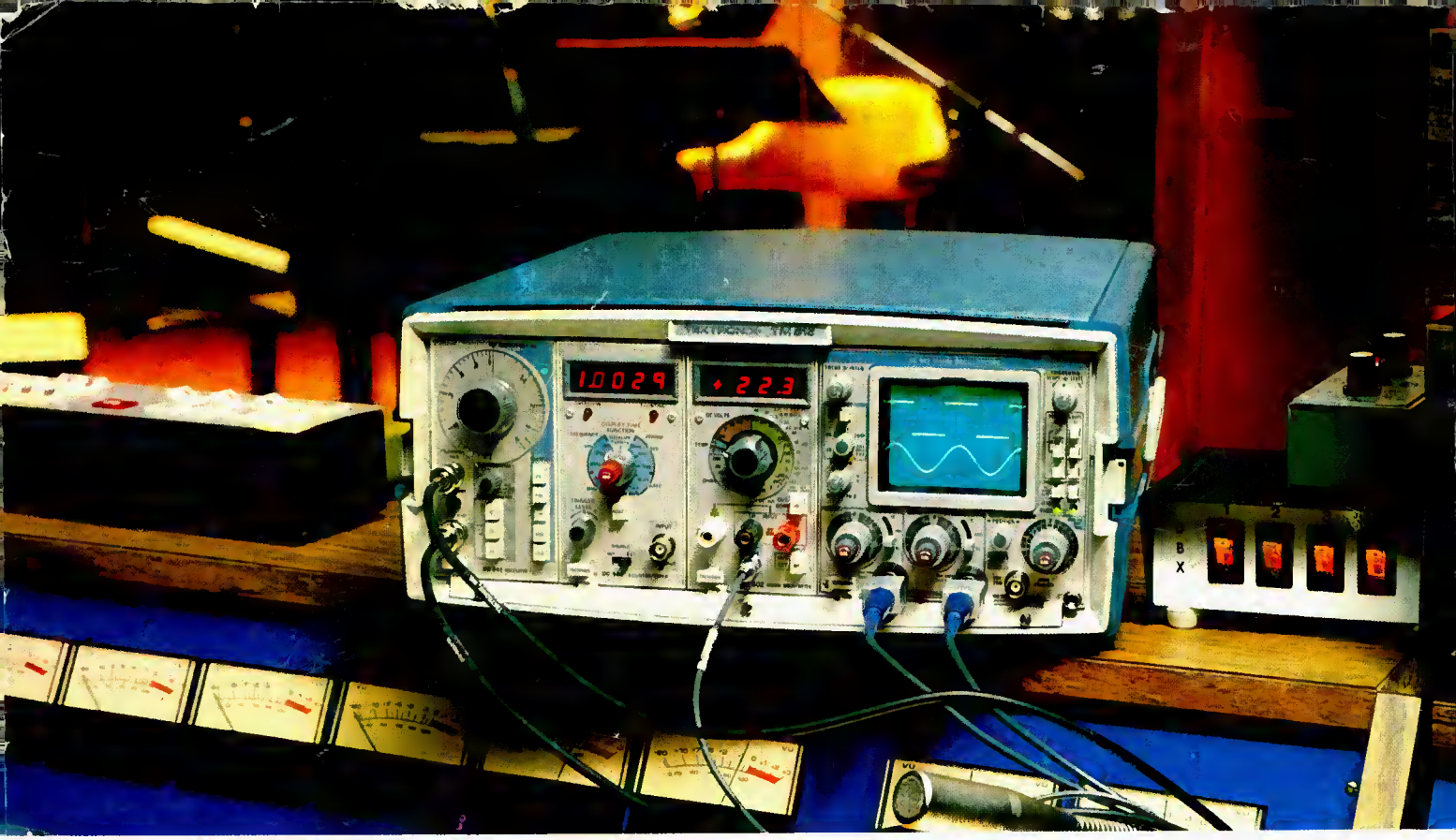
"After 20 singles and 12 albums on this console, 25 of them gold and platinum, I guess you could say my Auditronics 501 (serial number 0002) is a real money-maker. It does what I want as well as when it was new, and I'm still cutting on it today."

Independent producer Michael Lloyd is one of over 300 satisfied Auditronics console users. If you'd like to learn some of what they know about Auditronics console quality and reliability, circle reader service number or write to

3750 Old Getwell Road, Memphis, Tennessee 38118 (901) 362-1350

auditronics, inc.

Circle 11 on Reader Service Card



Test and Save.

A simple philosophy? Yes. But, one that can save you and your clients many dollars.

Consider this:
You're recording an exciting, new spot for a new client. The musicians and vocalists are set. You're getting noise on the tape and you can't find it anywhere. Testing with a TM 500 audio test set before recording could have saved time and money.

Or; does this sound familiar?
You're midway through an important broadcast. You've sold every commercial minute allowable, when your audio fuzzes out. During a commercial minute a make good is in order. A quick check through your basic frequency/response levels with a TM 500 Oscillator/dB reading meter combination could have saved that minute.

Try this:
You're engineering a big theatre production. It's opening night with a full house attending. The curtain goes up while your audio stays down. Troubleshooting with a TM 500 test set before the show could have found the problem.

In this world of sound, time is money. TM 500 is a collection of modular test and measurement instruments from Tektronix that can save you plenty of both.

The heart of our TM 500 Audio Travel Lab is our 600 Ω low distortion audio oscillator, which generates square or low distortion sine waves from 5 Hz to 500 kHz (0.035% THD 20 Hz to 50 kHz).

For general troubleshooting combine this compact oscillator with a full function TM 500 Multimeter with ac, dc, current, temperature and resistance readings as well as dB capabilities. Add one of our TM 500 Counters (measuring capability to 1 GHz) with a TM 500 Oscilloscope (5 MHz, 15 MHz and 80 MHz varieties), you've got a complete, portable TM 500 audio test set.

Or if your in need of a signal source, try our 40 MHz function generator capable of tone bursts, 20 Hz to 20 kHz log or linear sweep, and amplitude modulation.

TM 500 even has a tunable bandpass filter which selects narrow bands for selective frequency tests and a hi-gain differential amplifier with hi or lo filter capabilities.

These versatile plug-ins can be mixed, matched and packed in any one of 6 portable, benchtop, or rackmount TM 500 Mainframes to make a test set that suits your measurement needs.

The Traveler Mainframe is on the move with you.

When you're in and out of a lot of studios our TM 515 Traveler Mainframe is your number. The TM 515 carries up to five TM 500 plug-ins, looks like and acts like carry-on-flight luggage. A rear interface circuit board in the TM 515 Traveler Mainframe lets you interconnect the plug-in instruments to make gain, loss or response measurements — at the touch of a pushbutton.

TM 500 Designed for Configurability

Your nearby Tektronix Field Engineer would like to help you save time and money in audio measurements. Call today or write for a TM 500 Catalog: Tektronix, Inc., P.O. Box 500, Beaverton, Oregon 97077, (503) 644-0161, Ext. 5283. In Europe: Tektronix Limited, P.O. Box 36, St. Peter Port, Guernsey, Channel Islands.

Tektronix®
COMMITTED TO EXCELLENCE

Circle 12 on Reader Service Card