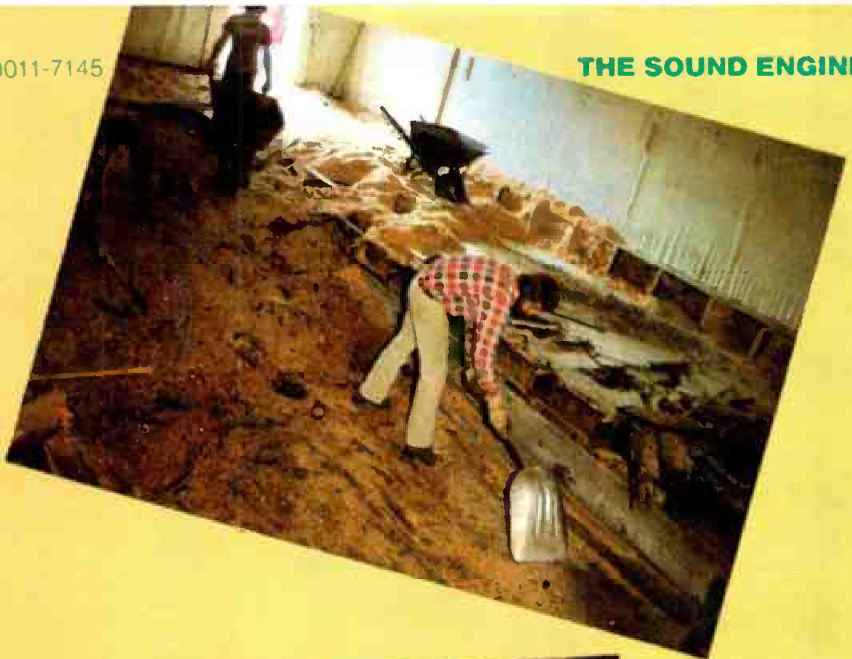
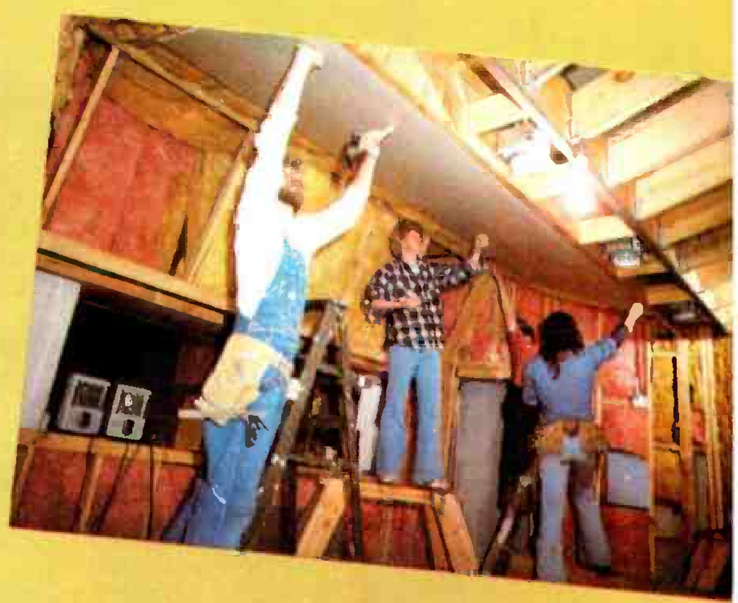
ISSN0011-7145

THE SOUND ENGINEERING MAGAZINE

db

JULY 1979
$1.95





Coming Next Month

• What weighs a ton, costs a fortune, and has 32 outputs? Why, it's "super console," of course. Next month, we'll take a look at several of the newest generation of big boards. We'll have feature stories describing the latest offerings from Harrison Systems, MCI and Solid State Logic, plus some suggestions about how to choose the right board for your dream studio.

• And for good measure, we'll include a report on the latest Audio Engineering Society convention, held last May in Los Angeles.

• All this and more, in the August issue of **db—The Sound Engineering Magazine.**

About The Cover

• These photographs were taken of Producers Studio, Eugene, Oregon, while in the construction stage. For details on the actual planning and construction—see Michael Dilley's feature, on this do-it-yourself studio, in this month's issue of db.

db

THE SOUND ENGINEERING MAGAZINE

JULY 1979 VOLUME 13, NUMBER 7

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

db, the Sound Engineering Magazine is published monthly by Sagamore Publishing Company, Inc. Entire contents copyright © 1979 by Sagamore Publishing Co., 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 $9.00 per year ($18.00 per year outside U.S. Possessions, Canada and Mexico) in U.S. funds. Single copies are $1.95 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

Synergetic Audio Concepts Sound Engineering Seminars:

10-12 **Minneapolis**

17-19 St. Louis

For information on these three-day seminars contact: Synergetic Audio Concepts, P.O. Box 1134, Tustin, CA 92680. (714) 838-2288.

13-16 **Audio Expo 80,** Civic Center, Philadelphia, Pennsylvania

OCTOBER

7-10 **National Radio Broadcasters Association's 6th Annual Conference & Exposition.** Washington Hilton, Washington, D.C.

Synergetic Audio Concepts Sound Engineering Seminars:

9-11 Syracuse

17-19 Boston

30-11/1 Philadelphia

For information on these three-day seminars contact: Synergetic Audio Concepts. P.O. Box 1134, Tustin, CA 92680. (714) 838-2288.

21-26 **121st Technical Conference Equipment Exhibit of the Society of Motion Picture and Television Engineers (SMPTE).** Century Plaza Hotel, Los Angeles, CA.

23 **1979 Sound Business Show,** Ambassador Hotel, Los Angeles, CA.

Department of Corrections

In the May, 1979 issue of db, an incorrect address was given for Delta-Lab Research, Inc., in the Directory of Signal Processing Manufacturers. The correct address is:

DeltaLab Research, Inc.
27 Industrial Avenue
Chelmsford, Massachusetts 01824

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
14 Inverness Drive E., Bldg. 1—Penthouse
Englewood, Colo. 80112 303-771-8181

Houston
6901 Corporate Drive, Suite 210
Houston, Texas 77036 713-988-5005

Los Angeles
424 West Colorado St., Suite 201
Glendale, Cal. 91204 213-244-8176

Portland
P.O. Box 25150,
8805 S.W. Cashmur Lane, No. 9
Portland, Oregon 97225 503-292-8521

San Francisco
265 Baybridge Office Plaza,
5801 Christie Avenue
Emeryville, Cal. 94608 415-653-2122

PATRICK S. FINNEGAN

db Broadcast Sound

Stereo Measurements

• When an f.m. station operates in the stereo mode, a different set of conditions exist. The addition of stereo to the operation must not detract from the FCC Rules' technical requirements for mono operation in any manner. In addition, the new operation must also meet other technical requirements as described in Part 73.322 of the FCC Rules. This month we will discuss the customary measurements a station operating in stereo makes to insure it is in compliance with FCC technical tolerances.

THE SYSTEM

The special technical tolerances of the FCC Rules for stereo essentially apply to the stereo generator and the transmitter combination. With modern day transmitters and stereo generators the station should have no real trouble in far-exceeding these minimum tolerances. Yet a considerable number of audio equipment items are added into the overall audio system for stereo, and all the station's programming passes through these units. A more realistic evaluation of the station performance can be achieved by including as many of these audio units into the measurements as possible. even though the figures which result may be somewhat less than that of the stereo generator/transmitter combination alone.

The configuration of the station will determine to a great extent what audio equipment can be included in the measurements. For a "live" type of operation, feed the audio tone signals into the console as you did when making the proof-of-performance measurements. However, if the station is full-time automation, then feed the tone signals into the chain at the same point the automation feeds it, or if it can be interfaced accurately, then into the main amplifier of the automation system.

TEST EQUIPMENT

No special signal generator is required for these measurements as the standard audio signal generator used for proof-of-performance is adequate. To measure distortion, a distortion analyzer is needed. This, too, is the same as for the proof measurements. In essence, all you need is the basic "proof package." A stereo modulation monitor is necessary, but the station is required to have this by the FCC Rules anyway. The monitor provides all the necessary measurement capability for the specialized stereo measurements.

For proper adjustment of the stereo generator and as a check on phasing, a good oscilloscope is needed. This unit should have very low phase shift in itself. And to facilitate the polarizing of the audio input signals to the Left and Right audio channels, some switching box or multiple jack/patch cord arrangement should be set up.

PRELIMINARIES

As a preliminary to making a full set of measurements on the stereo system, go through and balance-up the stereo generator, and make all the prescribed calibrations of the modulation monitor according to the respective instruction manuals. At the same time, check for proper Left & Right channel phasing through the stereo generator and the modulation monitor, and trim up the pilot phasing at the output of the generator.

When the stereo generator and the modulation monitor have been properly adjusted, feed audio signal into the head end of the audio system.

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.

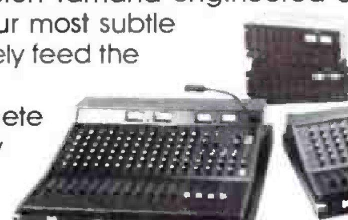
Think of the Yamaha PM mixers as business machines that insure your sound. The PM-170 and PM-180 are ideal as prime mixers for small clubs, discos, schools and the like. Or they're excellent submixers to extend the capability of larger consoles.

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 6600, Buena Park, CA 90622.

YAMAHA

Circle 23 on Reader Service Card

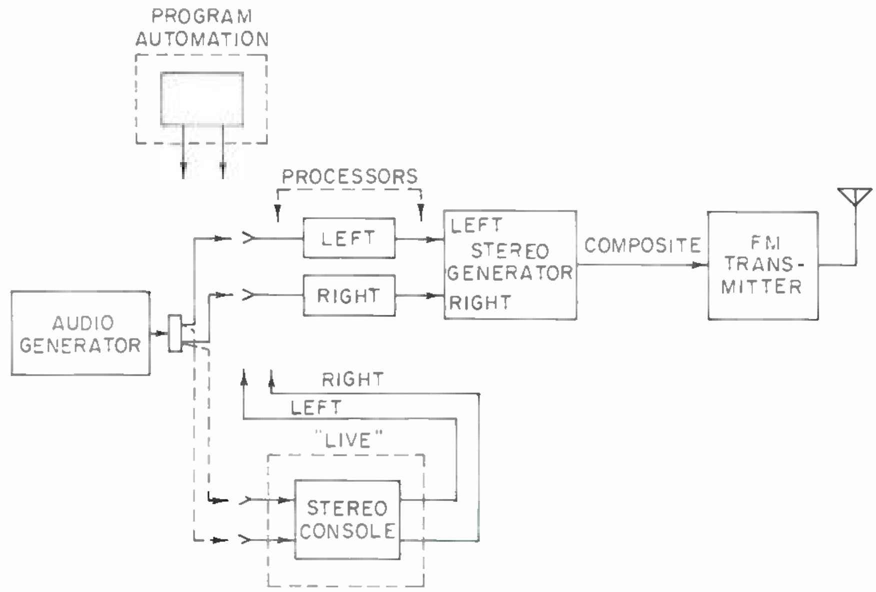


Figure 1. For a more realistic evaluation of the system, try to include as much of the audio equipment in measurements as possible.

Check for correct Left & Right channel phasing. Feeding the Left audio input of the system should appear on the Left meter of the stereo modulation monitor. An oscilloscope at the output of the stereo generator will indicate if one of these channels has been reversed (polarity). By feeding the Left & Right channels with an in-phase audio signal (tone), this will result in an in-phase audio signal out of the stereo generator. If the wiring has been reversed somewhere along the chain, the two channels will be out of phase and will be observed on the oscilloscope as the typical subchannel sideband pattern.

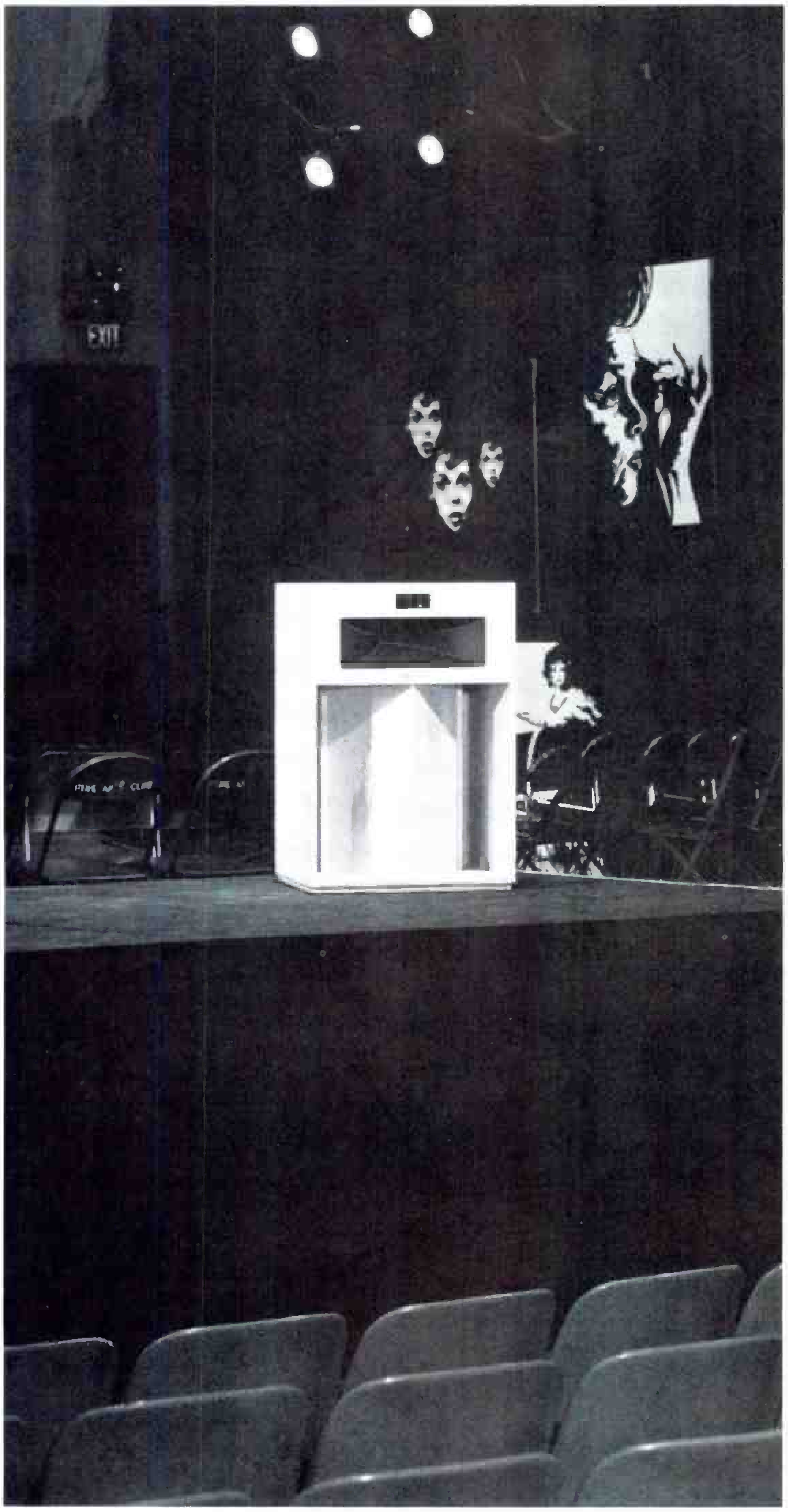
Once you know the channels are correct through the system, polarity is correct, then optimize the complete system as one unit. First, adjust audio amplitudes at each unit in the Left & Right channels so the corresponding units are nearly as identical as possible throughout. This insures that each channel is identical to the other, and each unit of each channel is identical with its counterpart in the other channel. In this manner all units will operate with similar characteristics. Combine the audio system to the stereo generator/transmitter and rebalance and trim up the stereo generator for balance. phase and separation so the complete system is balanced and optimized together as a single unit.

RESPONSE, DISTORTION, NOISE

Although in stereo, the system must still meet the required minimum tolerances for response, distortion, and noise. And since there are two complete audio channels in use at the same time for stereo, both the Left & Right channels must meet the minimum requirements as for mono, as well as the standard 75 μsec. pre-emphasis in each of these channels.

Run a set of audio tones through the Left side of the system, terminate the input to the Right side of the system. Use the same series of tones as used for the proof-of-performance so there will be a comparison. Modulate the transmitter to 100 per cent for each tone as indicated on the *total* modulation meter of the baseband monitor. Measure the input level of each tone with the system at 100 per cent modulation. The inverse of these signal input voltages when plotted will describe the system's audio response of the Left Channel. With the Left completed, terminate its input and run the response curve on the Right Channel. Plot these two curves on top of each other on graph paper and any differ-

UP YOUR SYSTEM



The Klipsch La Scala® is the speaker musicians use. Designed for theatre use, they can fill a monster like Radio City Music Hall, an auditorium, an opera house or your house.

These high performance loudspeakers perform like no others – with far less distortion. Feed them rafter-splitting rock or a gentle ballad. The three balanced horns give it right back the way you put it in.

Because of this sound and their moderate size and weight, La Scalas are ideal for road shows or one night stands. They are available in birch plywood, raw or black. Industrial models are also available with heavy duty woofers, fiberglass exteriors, handles, aluminum edge trim and corner protection.

Up your system at home or on the road. Put your ear to La Scala and hear what you've been missing.

klipsch

Please send me your FREE color brochure on the full line of Klipsch loudspeaker systems, along with a list of Klipsch dealers.

Name____________________

Address____________________

City____________________

State__________ Zip__________

klipsch®

P.O. Box 688 SE69
Hope, Arkansas 71801

In Canada. Superior Electronics, Inc.

Made from selected hardwood veneers

Circle 17 on Reader Service Card

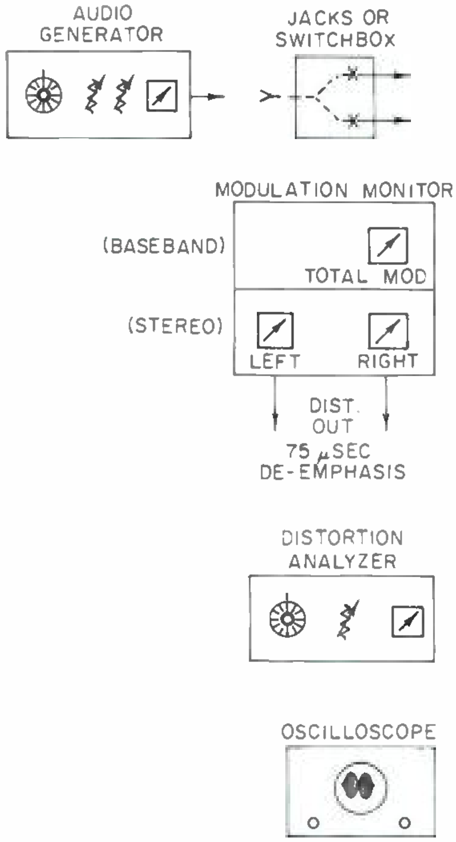


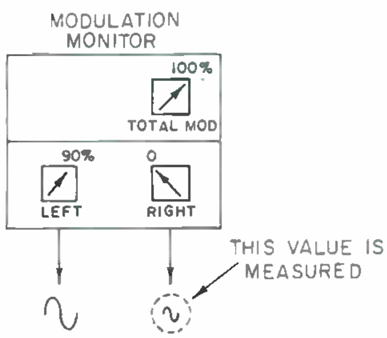
Figure 2. Equipment needed.

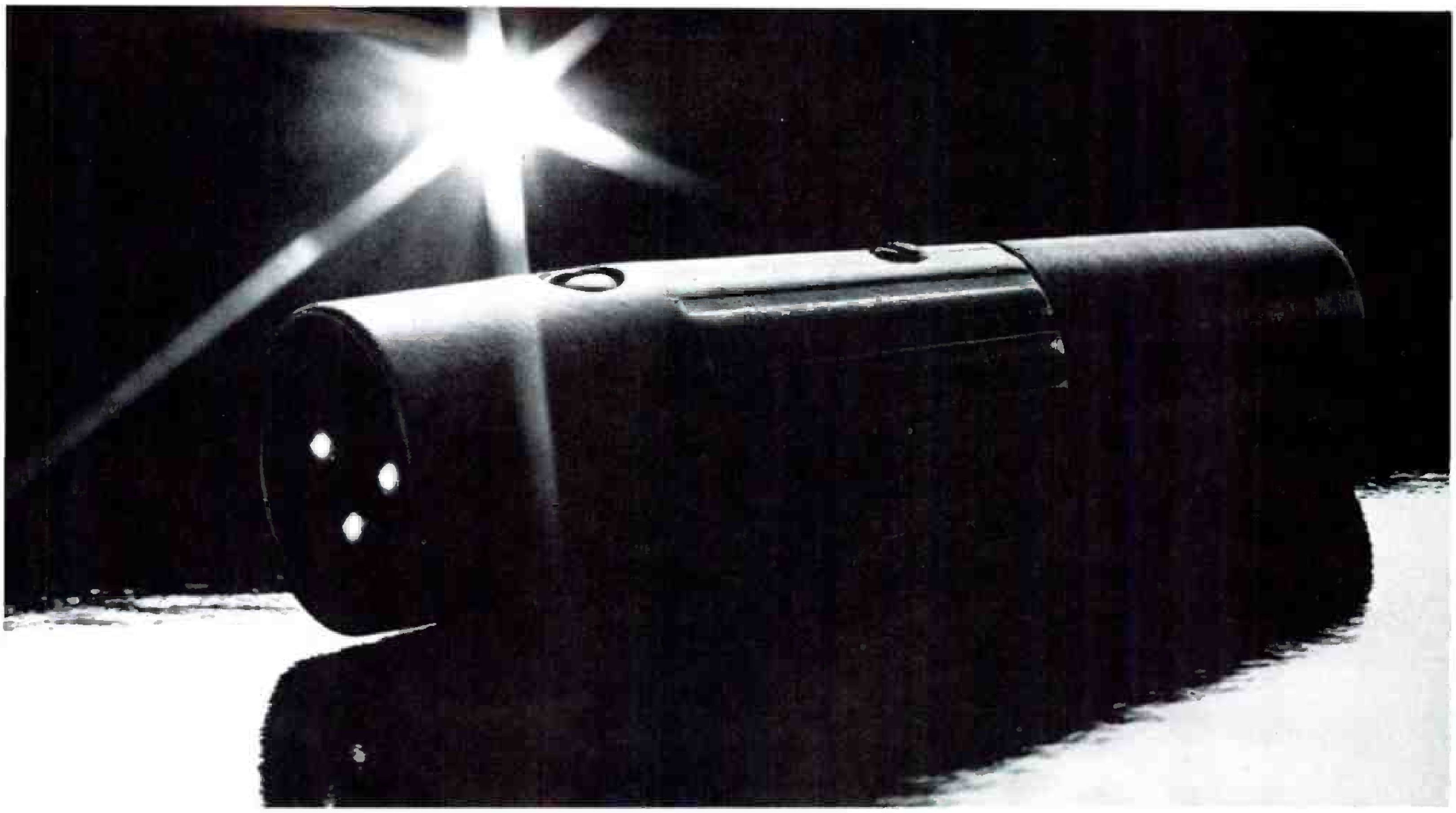
ences between the two channels will be very obvious.

Measure distortion on each channel, at each tone, at the same time the response measurements are made. Attach the distortion analyzer to the correct channel distortion output of the *stereo* modulation monitor. And be sure to use the output which contains the 75 μsec. de-emphasis in each case.

Make f.m. noise measurements on each channel when you get to 400 Hz of the run. Modulate the total modulation to 100 per cent with one channel only, remove the tone and terminate input, and measure the noise figure. Notice that this figure will be at least 1 dB poorer than that obtained

Figure 3. With tone in one channel only, and the carrier at 100 per cent modulation, the modulation monitor measures the residual that appears in opposite channel as separation.





Black Beauty

ADC's ultra-reliable audio connectors are available in black matte-finish shells. Now ready for immediate delivery.

Here's a case in point why more and more manufacturers are making ADC their sound connection. ADC has taken the regular family of low impedance input and output connectors and receptacles and finished them in a glare-free, conductive finish. Their rich, black matte finish adds a professional touch to your professional equipment. That's one reason ADC calls them the Professional Audio line.

Another good reason is that these units are highly reliable. Tested to 5,000 insertions. And all Professional Audio Connectors and Receptacles are completely interchangeable and compatible with existing audio connectors. Female connectors have positive latch locks to prevent accidental disconnection. There is also a choice of standard or small diameter strain relief grommets.

Most important, Professional Audio Connectors are available immediately. They're great performers. So make ADC your sound connection. Call or write ADC Products, 4900 West 78th Street, Minneapolis, MN 55435. Phone (612) 835-6800; TWX 910-576-2832; Telex 29-0321.

ADC Telecommunications
A DIVISION OF MAGNETIC CONTROLS

4900 West 78th Street, Minneapolis, MN 55435 (612) 835-6800
TWX 910-576-2832 TELEX 29-0321 CABLE ADCPRODUCT

Sales offices in: Atlanta, GA (404) 766-9595 • Dallas, TX (214) 241-6783 • Denver, CO (303) 761-4061 • Fairfield, CT (203) 255-0644 • Los Angeles, CA (213) 594-6160 • Melbourne, FL (305) 724-8874 • Minneapolis, MN (612) 835-6800 • Mountain View, CA (415) 964-5400 • Washington, DC (202) 452-1043 • Montreal, Quebec (514) 677-2869

Circle 35 on Reader Service Card

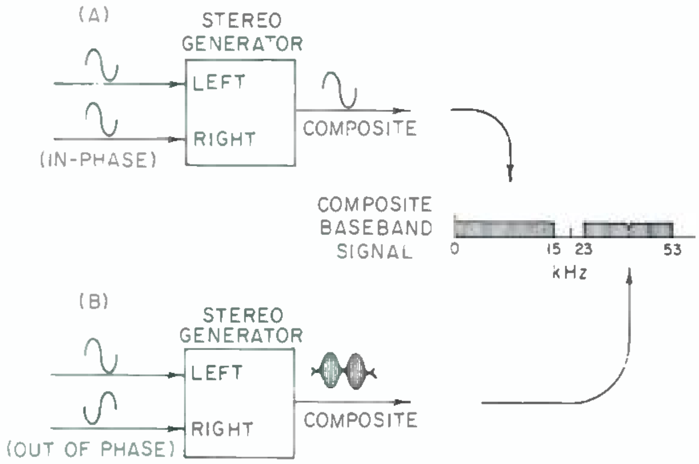


Figure 4. To measure crosstalk, the audio sine wave must be correctly polarized so it will all go into (A) the main channel, or (B) the subchannel of the baseband composite signal.

in the proof. This is due to the fact the pilot is taking up 10 per cent of the modulation capability and the audio is that much less.

If these measurement results are within the tolerances for the proof-of-performance of the station, the addition of stereo has not degraded the station's technical performance in terms of the FCC Rules.

SEPARATION

The first stereo measurement is separation of the Left & Right channels through the system. To meet the FCC technical requirements, the separation and other special stereo measurements need only be made from the stereo generator on through the rf transmission system. But as I said earlier, I prefer to include the complete system in the measurements for a more realistic measurement of what the system can do. Crosstalk between audio channels, as well as rf feedback interference, and different phase characteristics of these two channels will reduce the figures as could be obtained through the stereo generator only method. But if the system has been optimized together with the stereo generator as a single unit, these effects will be reduced considerably.

The modulation monitor measures the residual that appears in the opposite channel from the one being fed tone as separation in dB. These measurements should be made at the same time that response and distortion measurements are made. That is, when making these measurements on the Left channel, for example, measure the residual that appears in the Right channel. When making response measurements on the Right channel, measure the residual on the Left channel. As mentioned for response, always terminate the input of the idle channel to avoid noise and open circuit hum from interfering with the measurements. This is particularly true here as anything on the channel will show up as poor separation. The minimum tolerance is —29.7 dB.

CROSSTALK

The next stereo measurement is crosstalk between the main channel and the subchannel. These terms, as used here, refer to the spectrum space of the baseband signal. The main channel is the carrier modulation in the area of 0 to 15 kHz (the mono signal). The subchannel is the spectrum area 23 kHz to 53 kHz (subcarrier sideband region). Highly accurate band-pass filters are used in the monitor to "screen out" the particular area from the recovered composite modulation signal so that the measurement section can "see" only the desired area to measure. Sine wave modulation requires correct phasing at the system input to force all the signal into the main or subchannel area so the other can be measured.

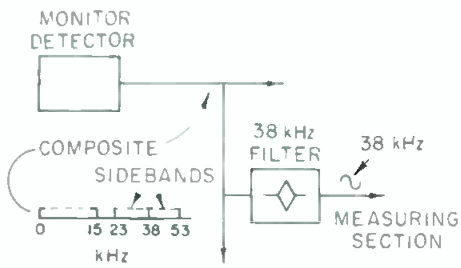


Figure 5. The subcarrier is amplitude modulated and the subcarrier itself is suppressed. The modulation monitor measures how successfully this has been accomplished.

To measure main channel crosstalk into the subchannel: feed the front end of both audio channels with a 400 Hz IN-PHASE audio tone, and modulate the carrier to 100 per cent on the total modulation meter. The in-phase audio causes all the audio to go into the main channel only, nothing in the subchannel. Now measure whatever may appear in the subchannel area according to the instructions with your monitor.

Now reverse the polarity of the audio signal to one of the audio channel inputs. This puts the two audio channels out of phase and will force all the audio into the subchannel as modulation of the subcarrier, and nothing in the main channel area. Again modulate the main carrier to 100 per cent and measure whatever appears in the main channel as crosstalk according to the method provided with your monitor.

The residual that appears in either of these channels is caused by harmonics, sub-harmonics, spurious signals, and so forth. In either case, the crosstalk must be less than 1 per cent modulation (—40 dB).

38 kHz SUPPRESSION

The audio signal amplitude modulates the 38 kHz subcarrier, and then the subcarrier itself is suppressed and not transmitted. (What you observe with an oscilloscope in the composite signal are the sidebands only of the subcarrier.) The measurement here then is to determine just how well this suppression has been accomplished. A narrow band-pass filter in the monitor "screens out" everything but the 38 kHz itself and measures any amount that is present. Use the procedures as required for your monitor, and measure first without modulation, and then with modulating signals of 5 kHz, 10 kHz, and 15 kHz. The subcarrier must be suppressed to less than 1 per cent modulation of the main carrier (—40 dB). ■

NORMAN S. CROWHURST

db Theory & Practice

Getting Rid Of Noise

• Like anything else, once someone has solved the problem, the solution seems obvious. But also, when the problem has been solved for so long that people do not even remember there was a problem, there may be a question as to why it even needed doing, in the first place. So let us go back over what was involved in getting rid of noise, over the years.

You may not realize it, but the first noise eliminator, and possibly still the most efficient one, when it gets used, is the human hearing faculty. It can develop ways of "tuning out" noise from the sounds we hear that, even with today's technology, are not easy to duplicate. But go back to when tubes were providing amplification and radio reception, loudspeakers were just moving iron mechanisms (like those used for headphones of the time) with a diaphragm attached.

Signals were coming in from fantastic distances, often as freak reception, and the listener was bothered with noise, spasmodically. During a good skip wave, reception would be as good as from a local station, with very little noise. And who bothered about that? The thrill of being able to hear at all made us ignore that scratchy sound that came with it, unless it got so loud we couldn't hear what we were listening for at all.

And that happened, in waves. As the reflective capabilities of the upper layers of atmosphere broke up, or changed, the transmission would disappear, and noise would drown the tiny signal that might still be there, buried underneath it. As the signal "went down," our hearing would try to follow it and, as we became more accustomed to such selective listening, we would follow it for longer, until it eventually became impossible, and our hearing "gave up."

In those days, the oscilloscope was a relatively new invention, although cathode rays had been known since Sir William Crookes first demonstrated them around 1875. We had progressed from the folly of "When in doubt, ground it," to the more sensible "When in doubt, look at it"—on an oscilloscope. Looking at what we listened to in long distance reception was quite revealing.

ELECTRONIC LAWNMOWER

When the signal was coming in strongly, the noise was just like tiny "grass" decorating the audio waveform. But as the signal got weaker, the grass got bigger, and the audio got smaller until, before it became impossible to hear the signal, you could not *see* it, down in the grass. This led to the first idea for getting rid of noise—use an electronic lawnmower! Clip off all those spikes, so you could see what was underneath them—and hear it.

When that was the nature of the problem, the method proved remarkably effective. It didn't get rid of the noise, as we later realized, but it did cut it down, so you could still hear the signal, far beyond where you would have been able to, without this peak suppression. When something is that bad, any improvement is appreciated, until you get dissatisfied with what is left.

Further looking and listening revealed something else. To use our electronic lawnmower, the grass must be tall enough to cut. The real problem, more often, was that the grass was no higher than when reception was good. It was the signal that was getting lower. And we used more radio-frequency (or i.f.) gain, to get the grass tall enough to cut. And the trouble with limited band amplification, is that it passes only a limited range of frequencies. That fact had, in fact, been helping to get rid of noise, before we even realized it was there, in addition to helping us get one station and eliminate its neighbor on the frequency scale. But in doing that, the amplification also modified what noise was left.

What went in, at the antenna terminals as very sharp (if small) spikes, equivalent to momentary bursts of a frequency well removed from the carrier frequency, came out as much lower spikes, but broader, equivalent to sidebands that conveyed the signal we wanted. While these weren't so high, they were still much bigger than the audio we wanted.

If only we could pull the tiny, but tall, spikes out, and leave just the audio. Whether that was the next step or not, depends on what kind of noise problem you are talking about but, assuming we are still with the high-level noise problem, that was the next step. Use the amplification to sense the arrival of each tall spike, and use it to cut off the amplification momentarily, for a duration short enough to eliminate the spike, but not to interfere with more-slowly changing audio.

HISS REDUCTION

The real problem, all along, tackled in various ways, was to get stronger audio, so the noise did not bother it. And the best way to do this, was to make the audio stronger (or actually, the radio that carried the audio) before the noise got added to it. In other words, a stronger transmitter is the answer. Now we are getting from where our noise problem is in being able to hear what we want to hear at all, to where we want to get rid of that hiss, that tells us we are listening to reproduced program, and not the real thing, the original.

This applies not only to transmitted signal, but also to recorded signal. Using a more powerful transmitter (or being closer to a smaller one) or using more modulation on the record groove (or later, on tape) does help, but there is only so much you can do, in any of these areas. You can use only 100 per cent modulation (preferably, not quite that much) of the transmitter, only so much of the groove width, otherwise you shorten the program a certain size disc can take, or there is a saturation density your magnetic tape material can take, that you must stay below.

Thus, in every medium, whether transmission or storage (recording) there is a dynamic range limit—the level range between background noise that will be reproduced as hiss, and the upper limit, whatever that is. To make the hiss inaudible, you need a healthy dynamic range: 40 or 50 dB, preferably much more. Just what it takes depends somewhat on the program—what range there is between its pianissimo and fortissimo parts. If that runs 30 or 40 dB, then obviously 50 dB dynamic range isn't all that wonderful!

So we have two kinds of problems. In the first, it is a question of hearing at all. To achieve that, we want as much signal power as possible, and we want to keep the modulation that constitutes "signal" to stay as high as possible, in its own dynamic range. In the other kind we want realism. If an orchestra, for example, develops a crescendo with all 50 (or however many) of its instruments putting forth full blast and, at the other extreme, has a single solo violin playing very softy, that in itself is a tremendous dynamic range.

COMPRESSION AND EXPANSION

In the latter type of program, it seems that you either blast the crescendo into excessive distortion, or lose the pianissimo down in the noise. So the idea came along, of decreasing the dynamic range, prior to recording, transmitting, or what-have-you, and then restoring it when the basic limitation on range had been passed. This used compression at the sending end, and expansion at the receiving end.

The first reaction to it, as with each other improvement as it came along, was that it made an unexpected difference. We did not realize, for example, that we heard the noise only on the pianissimo passages, because the crescendos drowned it out *in our ears*, or hearing faculty. The quiet passages enabled us to hear it, and we knew it was still there in the loud passages, not realizing that our hearing "turned itself down" so that in fact we could no longer hear it.

But listening to a program that was compressed before recording or transmission, and expanded again after playback or reception, the first reaction was that the system had gotten rid of all the noise, completely. But as we listened longer, we found that it had some unnatural characteristics. Obviously, it used variable-gain devices. On compression, it turned down on the loud passages, and up on the quiet ones, to decrease the dynamic range used. On expansion, it did the reverse —turned the gain up on the loud passages, down on the quiet ones.

To do this, each device must take its instructions from the signal it was processing. And for both units to use identical "instructions" they must be taken from the same place—the compressor from its output signal, the expander from its input. And the processing must use time constants in the way it changes gain, to cope with certain problems.

A sudden crescendo must get the gain turned down fast, or distortion will occur. And the expander must restore what the compressor did. And after the crescendo has passed, if it is followed by something pianissimo, the change must not be too sudden, but it must be quick enough not to let the average listener's hearing catch it "cheating," as it were.

That is one set of problems. Another is in the fact that any variable-gain device, when operating at minimum gain, with a big input compared with smaller ones at other gain settings, will distort more than a well-designed linear amplifier. So the compressor inevitably put in some distortion that the expander could not take out! In fact, however distortion gets in, you cannot take it out again. We need a system that just does not put the distortion in, in the first place.

DOLBY SYSTEM

In essence, that problem arises because we use an amplifier with more gain than we need, and have to "throttle it down." The Dolby approach reverses this. Getting maximum output with low distortion is one problem. Getting low-level signal sufficiently above the noise level is another. This is how Dolby treats it. If, on a Dolby system, you switch the Dolby off, you have a linear system operating in the way it does on Dolby, at maximum output level.

When you switch the Dolby in, this introduces some auxiliary amplifiers that come into action only at lower levels, not maximum level. To achieve the equivalent of compression, the Dolby adds to the level recorded or transmitted, thus reducing the dynamic range, or the level by which minimum level falls below maximum level. And at the other end, it subtracts from the level, thus increasing the range there. by dropping the minimum level back down where it was.

At low levels, keeping distortion down is much less of a problem than it is at high levels. So with the Dolby system, only the main amplifiers. which are totally linear and low distortion, are operative. At the low level, where keeping distortion low is not so much of a problem, signals are combined so the amplification at the compression end is boosted, while at the expansion end it is reduced.

Dolby offers some additional advantages. By treating the Dolby part in separate frequency bands, the noise component at frequencies momentarily absent from the signal can be reduced. even eliminated. Absence of signal. on playback, reduces gain in that part of the frequency range. This is something that would be impossible with the older compressor-expander approach. ■

MARTIN DICKSTEIN

db Sound With Images

Dissolvers

• It seems that our travel experiences always lead us to our next subject of discussion. In this case, a recent trip down South brought to my attention something with which some of you may be familiar, but could be of utmost importance to all of you, and warrants serious consideration on the next show you program whether for single- or multi-screen projection using dissolves.

First, let's take a look at some of the models available, their capabilities, specs, and one of the things that is not listed in the literature but which can be critical in some instances. According to the Audio-Visual Equipment Directory of NAVA, 1978-1979, there are just under 20 companies making electronic programmers, 4 companies producing "synchronizers," 6 makers of multi-image encoders, and 27 manufacturers of dissolve controls. These do not include the 23 makers of tape machines capable of putting a control signal on a track, nor the 11 producers of control panels for operation of devices listed above. (Of course, some companies are included in the different categories and maybe in all of them, but this is just to give you an idea of the number of items being made for control of audio-visual devices such as slide projectors, filmstrip projectors, 16mm film projectors, and others.)

Prices range from somewhere between $100 and $200 all the way up to $7,000 for programmers. Some of these units work with tone signals, others with digital signals, and still others with punched tape. Functions handled by these devices run from as few as two, to others having 5,000 or 10,000 cues with 10,000 functions. Encoders, small devices to put tone signals on magnetic tape, or holes in punched tape, run from as low as under $100 for a single cue tone up to about $2500 for 2 tones. The synchronizers cost from about $50 to over $300, and either put tones on tape or a pencil mark (right, a pencil mark) on the tape. (A special head, on the synchronizer, is used to "read" the pencil marks and to advance or reverse one projector or advance a second projector.)

The brief rundown on the specifications of the various devices listed in the book are meant only to indicate some of the characteristics and capabilities of the units. They are meant only to whet the appetite of the reader, to get the person who is checking through the book to get more information from the manufacturer. Looking at the more technical specs sent by the maker gives a lot more detail, of course, along with a lot of sales talk. The equipment is described as to the functions performed, the number of cues it can hold in its memory, the speed of action of the electronics, etc.

WHY DISSOLVES?

Usually, in the less sophisticated slide programs, a single projector can only change slides individually, leaving a black pause on the screen. The time of the slide change mechanism is about 1½ seconds. Images can't be activated any faster than that. There can be no movement of any kind, no time lapse indicated, no smooth transition between one image and the next.

The dissolve unit, as simple as it may be, or as complex as possible, has really one object—to smooth out the black space between sequential slides. After that, the rest is gilding. The simplest kind of unit has only one dissolve rate, whether it is two seconds from maximum brightness of one slide to maximum of the next, or any other time of operation. These, of course, are the least expensive. Then comes the variable speeds which allow the user to adjust the rate as desired, the fast cut which permits instant changeover from one projector to another, freeze-image which keeps one projector in its present mode (lamp on or off) while the other projector is operated, "up-projector" control which gives the operator of the projector system the option of working with the projector that is on while the other remains stationary, and so on. Some units also permit "flashing" so that one image can be frozen on the screen but the lamp is varied in intensity to make the slide change in brightness. A combination of freezing one image while flashing another gives the effect, in the case of a superimposition of the two images, of motion on screen. "Supering" also permits captions to change, for example, over the same background image. Slides, properly created, can seem to remain on the screen while additional material is added, as in the case of a build-up of a total image from smaller segments, or the addition of lines of copy to a word slide. No matter what the effect created, the purpose of all this is the elimination of the black space between slides and to add interest for the viewer—thereby getting the information across more memorably and with greater retention.

RATE OF CHANGE

Dissolvers also increase in complexity with regard to the number of projectors they can control. The most usual case is the control of two projectors, the action of the lamps changing between them, creating a smooth transition between slides. The next step is to control three slide projectors. With the various functions built into the dissolve units, the use of three projectors permits some animation. While the lamp cuts from the first to the second to the third projector, the first one is changing slides and is then ready to be illuminated again in rapid sequence. The movement may not be as fast as film, but it is similar and can create an interesting sequence. More dissolves, with more projectors, and the multi-screen, multi-image program can really take off. Now it becomes a matter of how fast the cues can be activated.

Cues can be put on the magnetic tape while the tape is running the sound track. This real-time programming is dependent on how fast the person doing the cueing can hit the proper buttons. As the background music increases in tempo, for instance, there is a limit to the number of cues the operator can hit in a shorter and shorter length of time. Also, tone cues have a finite length on the tape, and unless the dissolve control can distinguish overlapping tones, the dissolve action will not take place as originally desired.

For faster action, control devices were developed with digital signals and memory banks, and the capability of setting up cues in rapid fire sequence "off the line," or while the tape is not running. This information can then be put on the tape from the memory bank. The tape signals can then be checked against the original programming, and if satisfactory, the memory can then be wiped clean ready for the next show. Should it be necessary to correct the cues in any way, the tape signals are fed back into the memory, the alterations made, the new cues checked, and the revised program put back on the tape. Shows can now be just about as complicated as the wildest imagination can conceive. All this assuming, of course, that the programming device and the dissolvers are determined in advance, and the system is used as designed, or with fully compatible substitutions.

DRUM ADVANCE—BEFORE OR AFTER?

What happens, though, when, in the simplest of shows, a different dissolve unit is used than the one for which the cues were intended? If they, the dissolve units, are similar in action—nothing happens, and the show goes as expected. However, if the dissolvers are not precise substitutions for each other, the show will not be as perfect as intended. All dissolvers are the same, you say. They all have the same functions (2-second dissolves, fast cuts, etc.). You're right, they all have the same functions, but there is one thing that has not been considered here. There is one thing that dissolvers do that has not been mentioned here, and that is to advance the drum on the dark projector. They all do that, you say. Right again. The question is, though, does it advance the drum before the light comes up on the next cue, or does it advance the drum immediately after going dark on the same cue that changed the lamp? Does it make a difference? It sure does.

The program, with which I traveled to the South, was set up for a dissolve unit which advances the drum immediately after the projector goes dark. The unit supplied at the show was the Kodak EC-K. The client was told that the unit worked just like any other dissolver and had variable dissolve rates in case this was desired. The client said that only the fast cut was going to be used, and the supplier pleased the client by telling him that the unit was capable of that function.

Arriving at the presentation site just minutes before the showing was to go on, there was not time to get another dissolve, so the show went as is. It turned out that the Kodak unit advance the drum on the dark projector on the next cue before changing the lamp. This meant that each slide was behind the audio track by 1½ seconds. When the voice spoke the word on which the image should have changed, there was a pause before the slide came up. Fortunately, in only a few spots was this difference critical, but in this case, the object of the presentation was a research problem with only one viewer at a time. To some of the viewers, the difference was noticeable and may have thrown-off the resulting responses. Overall, the client believed that because of the number of individuals involved in the survey, the results would not be thrown-off too much.

Think of what would happen in one of your fast-action multi-image shows if slides did not come up as expected. It would be even worse if one of three dissolvers was similar to the Kodak while the others advanced the drums immediately. Seems like this type of information in the specs would be very helpful. Only one, that we looked at, mentioned this detail at all. Just another thing to look out for. ■

New Products & Services

DIGITAL REVERB

● The model 224 digital reverberation system provides reverberation with smooth, natural decay without coloration, "twang," or "boing." A 5 x 8-inch remote control console puts reverb control at the producer's fingertips. The unit's high-speed digital processor accepts up to eight different programs. To operate the 224, a basic program, selected by push-button from a library of programs, is tuned for the desired sound by adjusting six slide pots whose parameters are digitally displayed in engineering units. As an alternative to large mechanical reverberation systems, the 224 requires only 7 inches of rack space.
Mfr: Lexicon
Circle 52 on Reader Service Card

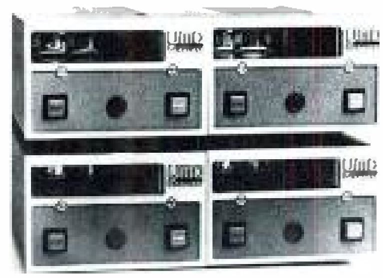
LOUDSPEAKER

● A three-way, 12-inch ported speaker system, the AUDITION provides low distortion and high sensitivity. Separate up-front L-pads are provided for the tweeter and midrange speakers. The grill snaps away for adjustment of the L-pads, and access to the system fuse. Power handling capacity is 50 watts rms at 8 ohms. The cabinet is walnut vinyl clad (28 x 16 x 12 inches), and weighs 52 lbs.
Mfr: Auernheimer Laboratories & Co.
Circle 53 on Reader Service Card

PULSE GENERATOR

● Independently variable pulse width and spacing controls from 100 nanoseconds to 1 second are offered in the 4001 pulse generator. The unit features six pushbutton-selectable modes: run, trigger, gate, single-shot, square wave and complement. The run mode is frequency settable from 0.5 to 5 MHz through the pulse width and pulse spacing controls. The trigger mode accepts d.c. to 10 MHz signals from an external source. The gate mode starts the generator synchronously with the leading edge of the gate signal. One pulse output, each time the momentary manual pushbutton is depressed, is the function of the single-shot. The square wave mode operates at up to 2.5 MHz, and the complement mode inverts the output signal. A single vernier adjusts the output amplitude over a 0.1 to 10 Volt range, with an output rise and fall time of less than 30 nanoseconds.
Mfr: Continental Specialties Corporation
Price: $149.95
Circle 54 on Reader Service Card

BROADCAST CART MACHINE



● A four-slot broadcast audio cartridge tape reproducer, the Model 4D features an individual motor and power supply for each slot; thereby eliminating some of the problems associated with three-slot, single motor and power supply designs. With the ability to align each individual motor, shaft-to-deck plate perpendicularity is no longer a problem; as a result, better stereo performance is achieved, with minimum crosstalk between channels. The model 4D can accommodate either four individual reproducers or two reproducers and one recorder/reproducer in the same desk or rack mounted housing.
Mfr: UMC Electronics Co.
Circle 55 on Reader Service Card

MULTICABLE SYSTEMS

● Included within the expanded line of MULTICABLE COMPONENTS are Multiboxes, Multiracks, Multitrunk sections and Multitails. Housed in a chassis constructed of 0.090-inch steel (welded and ground), Multiboxes feature two bar-type protective handles. The multiracks are designed to mount directly into all standard 19 inch equipment racks. Multitrunks and Multitails incorporate individually shielded, multipair cable with heavy wall neoprene shrink tubing at the connector to provide stress relief, as well as AMP Multipin and Switchcraft QG Series connectors. Available sizes range from 3 to 50 pairs.
Mfr: Wireworks Corporation
Circle 56 on Reader Service Card

FLANGER/DOUBLER

• Utilizing analog semiconductor technology, the Flanger/Doubler provides a variety of cost-effective time delay effects. The flanging or doubling mode is easily selected via a single push button. A Bucket Brigade Device (BBD) is used for the shorter delay times (flanging), while a Charge Coupled Device (CCD) provides the longer delays needed for the doubling effects. Other effects available include vibrato and reverberation. Separate connections are provided for instrument and line levels. Delay ranges are: 0.25 to 5 ms (flanging), and 17.5 to 70 ms (doubling).
Mfr: MXR Innovations, Inc.
Circle 60 on Reader Service Card

POWER AMPLIFIER

• A stereo power amplifier, the SA2 is rated at 220 watts-per-channel minimum rms into an 8 ohm load (both channels operating, 20 Hz to 20 kHz, with total harmonic distortion less than 0.05 per cent). Incorporating new circuit technology, the SA2 limits output only when a built-in computer reports that the power transistors are approaching their safe operating limits for conditions under which it is operating. Functioning essentially as two separate amplifiers, the two channels in the SA2 are electrically separate—each with its own power supply and circuitry. A two-speed fan, built into the rear of the unit, provides the necessary cooling functions. Included on the front panel are two led output level indicators. The green led's indicate the actual signal level, while the red led's report all types of output signal distortion. Recessed to prevent unwanted switching, three rear panel switches allow: defeat of the seven-second turn-on delay; stereo to mono output conversion; and defeat of the low-frequency protection built into the amp. Frequency response checks-in at: ±0.1 dB, 20 Hz to 20 kHz at 1 watt into 8 ohms.
Mfr: Crown International
Circle 61 on Reader Service Card

DUAL-CHANNEL PREAMP

• Specifically designed for radio automation service, the model 377 dual-channel tape playback preamp interfaces with a wide variety of tape heads and transports, and is pin-compatible with Ampex and Schafer equipment. With low noise and wide range response, the model 377 is fully RFI-proofed and offers balanced outputs capable of +24 dBm. Front panel controls provide gain and equalization adjustments, and ±5 dB level trim.
Mfr: Inovonics
Price: $395.00
Circle 62 on Reader Service Card

LOUDSPEAKER

● The AR90 loudspeaker features two 10-inch side-firing acoustic suspension woofers, an 8-inch high-temperature acoustic suspension lower midrange, a 1½-inch high-temperature hemispherical-dome upper midrange, and a ¾-inch high-temperature hemispherical-dome tweeter. Nominal impedance is 4 ohms, with crossover frequencies at 200 Hz, 1.2, and 7 kHz. The AR90 requires 50 watts minimum per channel, and may be used with amplifiers capable of delivering 300 watts continuous power per channel (being driven to clipping not more than 10 per cent of the time on normal music source material). The AR90 floor-standing speaker (44 inches high) weighs in at 82 lb.
Mfr: Teledyne Acoustic Research
Price: $550.00 per speaker
Circle 50 on Reader Service Card

VARIABLE SPEED CONTROL

● When used with Tascam 40-4 and 80-8 recorder-reproducers, the VSK-88 variable speed control can change either speed or pitch. The unit adjusts at 15 in/sec. plus or minus 20 per cent. In musical terms, the VSK-88 also adjusts pitch a tone and a half.
Mfr: TEAC Corporation of America
Price: $350.00
Circle 51 on Reader Service Card

SIBILANCE CONTROLLER

• A single-channel de-esser, the 526A dynamic sibilance controller removes annoying exaggerated sibilance, without affecting presence or intelligibility. In operation, the unit examines the voice signal for excess energy in the spectrum above 6 kHz. When such energy exceeds the pre-selected level (chosen via the front panel threshold control) a control signal is developed which "ducks" the entire channel long enough to remove the sibilant; but not long enough to be audible. The 526A includes balanced, floating, rf-suppressed inputs and outputs and accepts mic or line-level inputs. Attack time is approximately 1 ms; while recovery time is roughly 10 ms.

Mfr: Orban Associates, Inc.
Circle 57 on Reader Service Card

MONO/STEREO MATRIX UNIT

• Solving the problem of broadcasting in stereo to a predominantly mono audience, the Monstermat model RD770 mono/stereo matrix unit converts the signal into left-plus-right and left-minus-right, putting the all-important L + R mono signal on to one cart track—safely out of the way of phase shifts due to machine misalignment or tape warp. The second track carries the difference, L-R, signal. Full stereo is restored on playback and dematrixing. Old mono carts can be played on stereo machines, with the full mono signal on both channels. The Monstermat utilizes an automatically switching dbx noise reduction system, so that both encoded and non-encoded carts can be mixed. The unit is available in two formats: record/play (providing encoding and decoding for one cart machine); and play/play (which can handle two cart machines in the play mode).

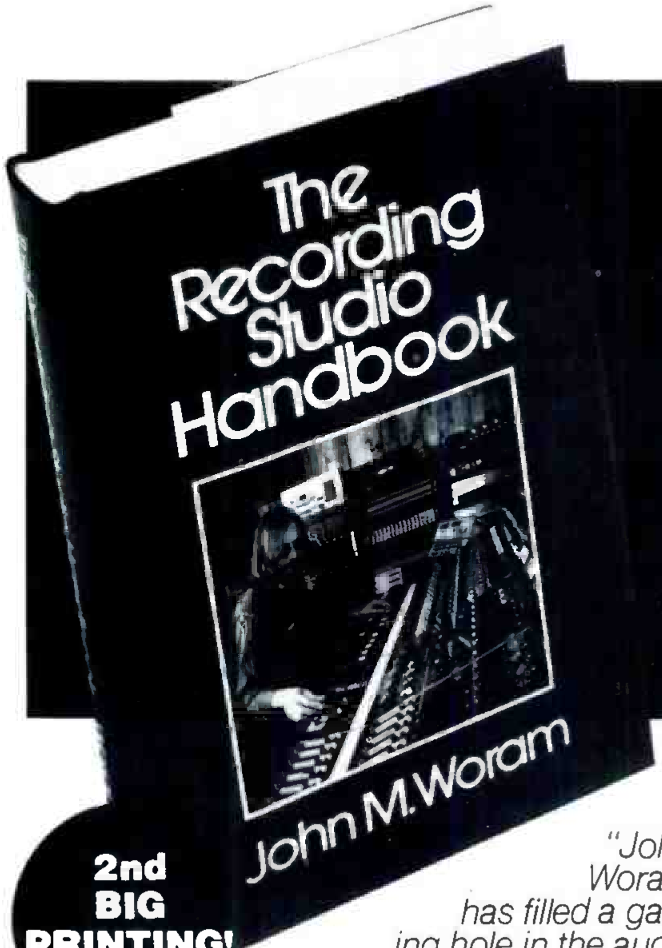
Mfr: Eventide Clockworks, Inc.
Price: $995.00 in either configuration
Circle 58 on Reader Service Card

OSCILLOSCOPE

• Compact and portable, the OS255 dual-trace/X-Y oscilloscope features 15 Mhz response, 2 mV/cm sensitivity, sweep speeds to 500 ns/cm (100 ns/cm with 5X Expand), AC/DC and TV trigger coupling, channel sum and difference displays, and a 1 Volt Z-mod input to facilitate use with logic analyzers.

Mfr: Gould Inc., Instruments Division
Price: $795.00
Circle 59 on Reader Service Card

Circle 26 on Reader Service Card



2nd BIG PRINTING!

From the publishers of db

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

"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

New Literature

INSTRUMENTS & BREADBOARDING EQUIPMENT

● Solderless breadboard products, IC test clips, and a family of digital troubleshooting equipment and measurement products are contained in a new catalog. Source: Continental Specialties Corporation, 70 Fulton Terrace, New Haven, Conn. 06509.

A/V CASSETTE

● "Heavy-Duty Audio-Visual Cassette Products for Educational and Industrial Use," features seven models currently in the professional audio-visual cassette line. Source: Robert Garbutt, Sharp Electronics Corporation, 10 Keystone Place, Paramus, NJ 07652.

MICROPHONE MIXERS

● A newly introduced line of microphone mixers is described and illustrated in an engineering bulletin, complete with technical information and application data. Source: Industrial Research Products, Inc., 321 Bond St., Elk Grove Village, Illinois 60007.

TRANSFORMER GLOSSARY

● A new glossary of transformer terms provides a quick guide to phrases commonly used in describing transformer parameters. In addition, schematics, test circuits, and formulae are provided. Source: Bulletin F248, Microtran, P.O. Box 236. Valley Stream. New York 11582.

ANALOG/DIGITAL MULTIMETERS

● The complete line of portable digital and analog multimeters is detailed in a four-page color brochure, containing full specifications for each model. Source. Soar Electronics (U.S.A.) Corp., 813 2nd Street. Ronkonkoma. New York 11779.

LOUDSPEAKER HANDBOOK

● Now in its second printing, the 48-page "Loudspeaker Handbook and Lexicon" aims at providing a basic understanding of the science of speaker design. Source: The Little Speaker Company, Inc., 78 Stone Pl., Melrose. Massachusetts 02176.

VIDEO PRODUCTS

● No larger than a roadmap, a compact 40-page foldout covers the complete range of video products for business, government, and other institutional users. Source: Sony Video Products Catalog, Sony Corporation of America, 9 West 57th Street. New York, NY 10019.

SPEECH CONTROLLER

● "The Listening Plus: VSC," a four-page brochure, details the use of speech compressor/expanders in special education classes, libraries and media centers, reading and language labs, training programs, business and government offices, law enforcement agencies and hospitals. Source: The Variable Speech Control Co., 185 Berry St., San Francisco, CA 94107.

FLAT CABLE GUIDE

● Bonded and laminated flat cable are described in a new 8-page illustrated booklet. The publication, No. ED79-1, provides space-saving and technical data on flat cable for multi-point interconnection applications. Source: Belden Corporation, Electronic Division, Manager, Marketing Communications, 2000 S. Batavia Ave., Geneva, IL 60134.

SYNTHESIZER PATCHES

• A book of patching and programming, *The Source* represents one of the largest collections of patches for music synthesizers. For easy adaptation, to varying synthesizers brands, patches charts are shown in a block diagram/flow chart type of notation. Cost—$4.00. Source: Polyphony, P.O. Box 20305, Oklahoma City, Okla. 73156.

INDICATOR LIGHT GUIDE

• A technical manual on off-the-shelf indicator lights features photographs, dimension drawings, mounting information, technical specifications and ratings for led indicator lights, relampable types. Source: Form FDG, Industrial Devices, Inc., Edgewater, NJ 07020.

CUSTOM AUDIO COMPONENTS

• Outlining new custom audio components for the OEM market, a four page catalog covers services in product areas such as: communications microphones, audio microphones, cords & cables, plugs & sockets, and microphone components. Source: Mura Corporation, 177 Cantiague Rock Road, Westbury, NY 11590.

FREQUENCY COUNTER SPECS

• "Understanding Frequency Counter Specifications," a 34-page application note, reviews basic frequency counter specifications. Detailed, in the publication, are input characteristics of counters including range, sensitivity, signal operating range, dynamic range and trigger level considerations. Source: AN 200-4, Publication No. 02-5952-7522, Inquires Manager, Hewlett-Packard Company, 1507 Page Mill Road, Palo Alto, CA 94304.

BACK PLANE WIRE

• Terminating systems for back plane wires, is the subject of a new brochure, including four pages of tables and technical data on UL and military listings, conductors and various properties of back plane wire. Source: Brand-Rex Company (Back Plane Wire, EC5-78), P.O. Box 498, Willimantic, Conn. 06226.

COAXIAL CABLE

• Covered in a new 20-page illustrated guide, are the selection and use of a broad line of CATV coaxial cables, including flooded, dual, and messengered constructions. In addition to technical data, a number of alternative shielding methods are also described. Source: Publication EL 10-78, Manager, Marketing Communications, Belden Corp., 2000S. Batavia Ave., Geneva, Ill. 60134.

"1979 CSC" CATALOG

• Signal generators, electronic test instruments, logic probes, frequency counters, solderless breadboards, digital troubleshooting instruments and IC test clips are all featured in a new 32-page catalog. Also included are four new cases for carrying test equipment. Source: Continental Specialties Corporation, 70 Fulton Terrace, New Haven, Connecticut 06509.

PRODUCT SELECTOR

• A quick reference, six-page product selector provides capsule information about all the products in this broadcast line, including: cart recorder/reproducers, automatic splice finders, broadcast audio consoles, news recording systems, etc. Source: Product Selector, Broadcast Products Division, UMC Electronics Co., 460 Sackett Point Rd., North Haven, CT 06473.

OSCILLOSCOPE BULLETIN

• Three dual-trace instruments and one true dual-beam unit are spotlighted in a 4-page bulletin on low-cost, general-purpose oscilloscopes. Source: Form No. 449-7, Marketing Services, Gould Inc., Instruments Division, 3631 Perkins Avenue, Cleveland, OH 44115.

WIRELESS AUDIO PRODUCTS

• Of special interest to the broadcast engineer and ENG user is this new 16-page catalog of wireless audio products—including several wireless systems and accessories. Source: HM Electronics, Inc., 6151 Fairmount Avenue, San Diego, California 92120.

AV "PRODUCT PORTFOLIO"

• A full color "product portfolio" displaying audio visual and library furniture is available. The portfolio contains information on video consoles, AV tables and Overhead projectors. Source: H. Wilson Company, 55 W. Taft Drive, South Holland, IL 60473.

RESISTIVE PADS

• A booklet entitled "Resistive Pads" provides information and specific data on the various types of resistive pads used in professional audio systems—line matching pads, bridging pads, VU meter pads, and splitting pads. $6.95 ($1.00 additional handling for Canada). Source: Electric Sound of Minnesota, P.O. Box 634, Anoka, Minnesota 55303.

MULTI-TRACK RECORDING

• A 16-page booklet entitled "Are You Ready for Multi-track?" describes, in detail, the steps in multi-track recording. Source: TEAC, 7733 Telegraph Road, Montebello, CA 90640.

db Editorial

For years, **db** Magazine has covered the world of professional audio, and it has never been necessary to define what that word "professional" really means. We've just understood it to mean . . . well—professional.

When prodded, we think of the audio pro as someone who's making a living working in some area of audio. Of course, our "pro" is working with "professional" equipment—whatever that is.

If professional equipment implies three-pin connectors, balanced lines, +4 dBm and a price tag that reads like a bridging input across your bank balance, what about equipment that does not meet these specs? Does a phono plug at −10 dB mean "not professional"?

In that case, how do we label the engineer who runs a successful studio built around a -10 dB board? On the other hand, what about that well-off client who just purchased a 20-foot console and has no idea what all the pretty little knobs and switches are for? Which one is the "pro"?

The amateur is a little easier to define. He makes his living in some field not related to audio, and amuses himself on weekends by fiddling around with a tape recorder. He's as easy to spot as the amateur photographer. He probably has no objection to being called an amateur. Clearly, his field of expertise lies elsewhere, and his tape recorder or camera are merely pleasant diversions.

We get into trouble when we look at that vast army of people standing somewhere between the amateur recordist and the chief engineer at "super studio." Are these people—and their equipment—all semi-professional? The dictionary doesn't help much. The semi-professional is "actively engaged in some field for pay, but on a part-time basis." And then, there's "having some features of professional work. but requiring less knowledge, skill and judgement.

The first definition seems to suggest that professionalism is mostly a matter of longer hours. As for knowledge, skill and judgement, there's plenty of that required by anyone involved in the production and/or engineering of a master tape, regardless of the hours.

Perhaps we could solve part of our problem by banishing the professional/semi-professional designation from our equipment. Hardware with high impedance, phono plug outputs could be designated "Type I," while a balanced +4 dBm would mean "Type II," and so on. Then, it would be strictly up to the user to decide whether to employ his equipment in a professional manner or not.

This would reduce professionalism to a state of mind, rather than a price tag. The professional could make high-quality cassette recordings, while the semi-pro tried his luck at getting through a multitrack mixdown.

While still a student, the professional would learn as much as possible about this craft. The semi-pro could afford to cut classes, since he requires less knowledge, skill and judgement. Once working (full- or part-time, Type I or Type II equipment) the professional would continue the learning process. The semi-pro wouldn't need to bother.

Semi-pro could get to be somewhat of a dirty word. In time, it might disappear entirely. Already, some manufacturers are studiously avoiding the term. In the eyes of many, it seems to suggest that—since the equipment is less-than-professional—it is less-than-desirable.

Perhaps we just shouldn't try so hard to neatly label everything. With a little less attention to semantics and definitions, the semi-pro designation might last a little longer—at least until we come up with something a little more satisfying to all those involved.

In the meantime, **db** will continue to devote itself to meeting the needs of the pro. That means you, doesn't it? ■

J.M.W.

MICHAEL S. DILLEY

Producers Studio: A do-it-yourself Construction Project

Armed with tools, timber, and some back issues of db, a frozen-food locker is turned into an up-to-date recording studio.

PRODUCERS STUDIO STARTED OUT in an 850 square-foot barn, with no office space or restrooms. At the time, our only acoustic insulation was our countryside isolation: we could set the studio clock by listening for the chapel prayer bell, ringing at a convent about a mile away.

The interior of our barn had been framed, covered with gypsum, textured and painted. An expensive track lighting system and wall-to-wall carpeting made the interior very attractive. Acoustical treatment consisted of covering several walls with fiberglass, covered with felt. Framed hangings of silk-screened fabric over fiberglass completed the treatment.

The control room measured only 12 x 12 and, with a full-size 24-track console and outboard equipment, it required a shoehorn to fit the engineer in. But, business was good, and everyone liked the country location, complete with chickens and sheep. So, when it came time to expand, we wanted a new country location in the hills overlooking the Willamette Valley and the McKenzie and Willamette Rivers.

No such luck. After months of frustration looking for a new studio location in the country, we called a meeting with a local real estate agency, and turned our attention towards the city of Eugene.

At an early meeting, one of the realty agents looked across the table and asked me to summarize, in ten words or less, the kind of building we would like to have. It came in a flash—a frozen-food locker. The agent was astonished. The firm held an option on a former meat-packing and storage locker, only a block or so from where we were meeting. The property was a real loser, and they were going to let the option expire within two weeks.

Within two minutes, our group was groping through the darkness with flashlights, and clambering over the roller-coaster floors. Within fifteen minutes, we had found our new home.

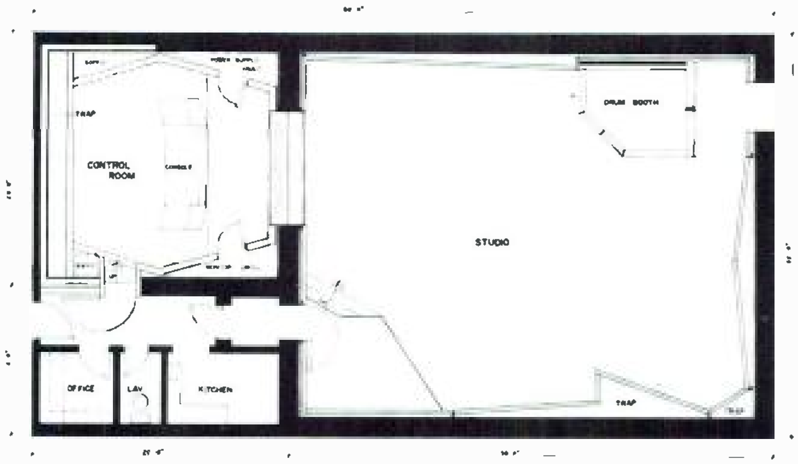
Steve Diamond, our recording engineer, was so impressed, he almost quit on the spot. We were on the busiest street in town, there was not a level floor anywhere, and the humidity was so high you could swim in it. Steve had also gone into an immediate allergic sneezing fit, from the mold growing on the walls. But to me, the building was an undiscovered beauty. My confidence was high, as I estimated four-to-six weeks for a facelift. My foreman, Roger Stephen, chuckled and gave me a knowing smile. We had worked together for years, and he knew very well that my confidence was always greater than reality would probably allow.

FIRST TESTS, AND A WORK SCHEDULE

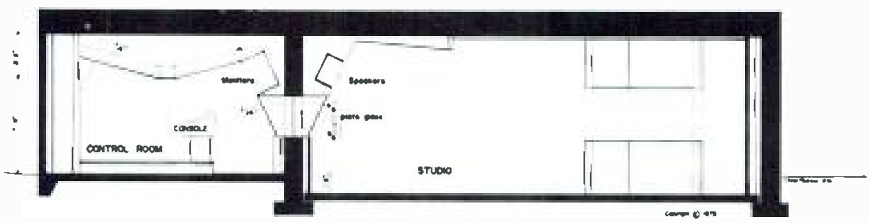
I wanted to get relative sound level readings inside the locker before we started construction. Readings were taken at peak traffic periods for Saturday, and again the following Monday. In the meantime, tools and equipment were moved in. Sound level readings were astonishingly good. Exterior street noise was consistently greater than 90 dB, while within the building the reading was below 35 dB.

Work was scheduled to complete the control room first, followed by the studio, entry hall, bathroom, office and kitchen. Our plan was to have the control room equipment installed and wired while the studio was being finished. Our first session—an album for Sally Coombs of San Francisco—was scheduled for January 1, 1979. How-

Michael S. Dilley is the owner of Producers Studio, Eugene, Oregon.



PLAN



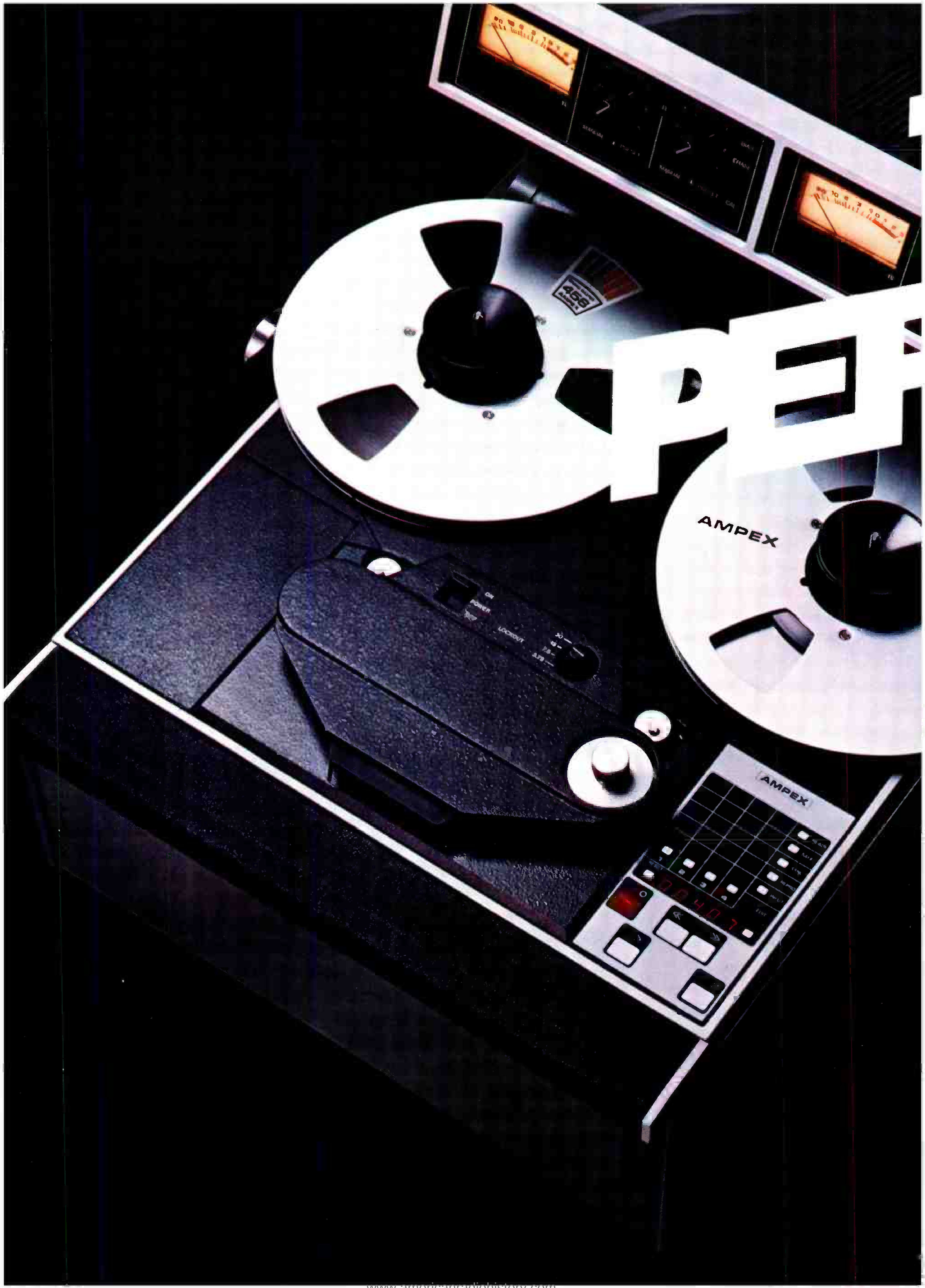
SECTION

Floor and sectional plan of Producers Studio.

ever, the control room was not completed as far in advance of the studio as we had planned, since some problems in material acquisition and continual surprises whenever we cut into a new area necessitated shifting our attention away from it from time to time.

STUDIO CONSTRUCTION

We soon began installing the noise control systems. Wherever an existing opening (door, window, vent, etc.) was closed off, we used R-11 insulation and acoustical caulking. Resilient metal channel was screwed to the ex-


AMPEX
AMPEX

HE
FORMER

ATR-100

Sound is a perishable commodity, and Ampex has developed a way to keep it fresh. The way is an astounding tape recorder called the ATR-100. There isn't another machine like it anywhere in the world.

Unmatched for both audio performance and tape handling, the ATR-100 is truly transparent. You'll play back the original sounds with nothing added or subtracted by this recorder. And along with the most gentle tape handling you've ever seen on an audio machine, you'll get real time savings with the 500 ips shuttle and the Spool Mode that winds tape perfectly for storage.

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

Ampex designed the ATR-100 as a simple solution to audio excellence. All signal electronics are in the overhead modular bay, and all mechanical parts are mounted on the transport deck with plenty of elbow room. (Rather than make claims about reliability, we'd prefer that you ask studios now using ATR-100s.)

No matter how you wish to measure audio tape recorder performance, the ATR-100 by Ampex comes out ahead. This is the performer that defines excellence in sound recording.

AMPEX MAKES IT EXCITING.

Ampex Corporation, 401 Broadway, Redwood City, California 94063 415/367-2011

Circle 38 on Reader Service Card

Removing sawdust insulation from old floor in future location of control room.

Starting to hang gypsum over sound deadening board on resilient channel in control room, showing caulking on seams.

isting walls and ceilings in the control room and studio. A bead of caulking was run along each channel to prevent vibrational buzzes and rattles.

There are some mechanical problems in working with resilient channel. Care must be taken to insure that the channel is indeed resilient. Don't install it upside down, or allow it to come in contact with the existing wall or other objects, so that it cannot vibrate. It is difficult to set the screws at the proper depth without going so deep that they contact the existing wall.

Half-inch sound deadening board (SDB) was screwed to the channel, and all seams were caulked. Particular attention was paid to making sure that all seams throughout the noise barrier layers were airtight. Over this initial layer of sound deadening board, a layer of ⅝-inch gypsum was screwed down with the seams offset from the SDB joints. The gypsum seams were taped and sealed with joint compound. A quarter-inch spacer was used at the foot of the resilient wall while installing the gypsum and sound deadening board. Later, this spacer was removed, and the gap filled with caulk. Where two walls joined, a quarter-inch spacer was also used. This technique

Taping and caulking gypsum layer over sound deadening board in studio.

Starting the drum booth showing the sand drying out and styrofoam strips underneath.

Hanging the corduroy over the rear control room wall.

Pictured from left are Michael S. Dilley (studio owner), Steve Diamond (engineer), and Georges Bouhey (producer), discussing mix for Diamond Jackson.

prevented the wall from being rigidly locked where it joins another plane.

After this first noise barrier, we built an intermediate wall in the control room to help control street noise. By this time, the only noise problem we had came from the wall facing the street. A massive floating wall was needed to control the remaining noise. This was the only acoustical part of the building without an existing freezer wall. A 2 x 4 frame was glued with construction adhesive to the floor and ceiling, with a layer of half-inch SDB and half-inch rubber glued to the top and bottom plates of the wall, resulting in a floating wall.

The sound deadening board and rubber used to float this intermediate wall was cut wide enough to accommodate the 2 x 4 frame, plus three layers of ⅝-inch gypsum and two layers of ½-inch SDB. Each layer was sealed with all joints offset from each other. They were installed in the following order; ⅝-inch gypsum, ½-inch SDB, ½-inch SDB, ⅝-inch gypsum, ⅝-inch gypsum. This wall was built two inches-in from the existing wall, and insulated with R-19. The residual leakage was nearly imperceptable, and completely eliminated by the trap planned for the rear of the control room.

2 x 10s were used in the original floor, with a 2 x 6 tongue-and-groove deck. Half-inch underlayment was added to this, followed by three layers of ½-inch SDB. The elevated portion of the control room floor was framed on 2 x 8s, and covered with two offset layers of ⅝-inch chipboard. Also, a half-inch space was left around the periphery. The floor and SDB were held in place with construction adhesive.

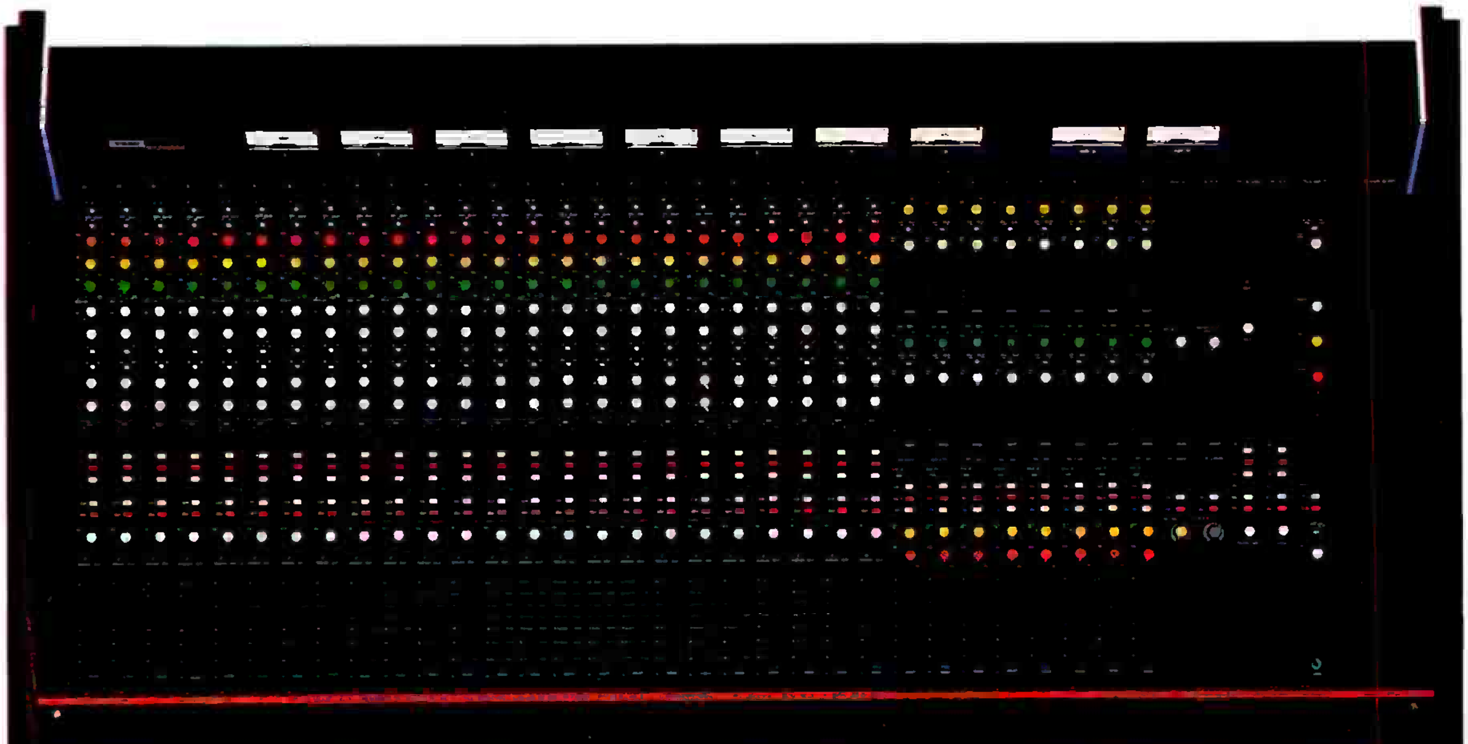
ELECTRICAL SERVICE

Next, the electrical service was brought through. The a.c. runs were planned for maximum separation from the low level microphone input cabling and with reasonable separation from all other signal lines. To do this, ¾-inch conduit was run on the walls several feet off the floor. Number 12 wire was used throughout, and a half-dozen separate circuits were used. Four-inch square boxes were mounted at intervals to run flexible conduit to the yet-to-be-built final wall, so that there would be no mechanically-rigid connections through the conduit.

The conduit was securely fastened, and caulking placed at strategic locations to prevent mechanical noises. Several hundred feet of conduit—from half-inch to one inch—was placed in the elevated floor of the control room. Several spare runs were provided to each equipment location. Outgoing signals, incoming signals, power supply lines and control cables each had their own conduit. The only liability of conduit is that connectors must be removed before changing a cable route.

One problem discovered much too late was that the conduit carrying the earphone line was screwed to a resilient channel that also held an a.c. conduit strap. Inductive coupling occurred between the earphone feed amps and the a.c. ground, causing the immediate destruction of a

YOU'VE GOT IT WIRED WITH A MODEL 15.



Buying a big mixer can be very deceiving. From the time of delivery to the moment your board is operational, you can run into quite a few additional costs and frustrating time delays.

But consider the Model 15. Rear panel patch points are already wired. Included in the cost. The meter bridge is already wired. Included in the cost. The separate power supply plugs right in. Also included in the cost. It's not unusual to get your board in the morning and do your first session that same night.

With the Model 15, you've got performance and flexibility wired, too.

From the discrete microphone preamplifier, equivalent input noise is –126dB (weighted). With one input assigned to one output buss, signal-to-noise is 76dB (weighted).

Formats are 16- or 24-channel input/8-buss output. Fully modular.

The Model 15 will drive any 16-track recorder and give you a vast array of mixing, monitoring and cueing capabilities. For example, the Cue mixing position can be fed by 48 sources simultaneously (all the inputs plus all 16 tape playback positions plus all eight echo receives).

Out of the crate, you'll have a lot more mixer in the Model 15 than you can get elsewhere for the money. Add your savings on installation (both parts and labor), and the Model 15 becomes even more cost-effective.

So think about the real, often hidden costs of buying a mixer. When you add it all up, we think you'll see the practical advantages of getting it wired with a Model 15.

The Model 15's functions, interior layout and complete specifications are described in our 10-page Product Information Bulletin. See your Tascam Series dealer or write us for a free copy.
Tascam Series,
TEAC Corporation of America, 7733 Telegraph Road, Montebello, CA 90640.

TASCAM SERIES

TEAC Professional Products

View of studio from near control room window.

power supply. There was no way to get into the wall to correct this situation, so I installed a 70-volt transformer on the output of the amp to isolate the system.

THE CONTROL ROOM

The control room window is designed around two resonant cavities with different fundamental frequencies. Three different thicknesses of glass (¼-, ⅜-, and ⅝-inch), with different fundamentals, were also used. Corduroy stapled over SDB is used to line the cavities. A separate frame was used for each window, separated by half-an-inch, and mounted in three separate walls to complete the installation.

A slope different than the console face was used for the front half of the control room ceiling. Used to frame the ceiling were 2 x 12s and 2 x 10s, covered with ⅝-inch gypsum, ½-inch SDB, ½-inch CDX plywood and ¾-inch tongue-and-groove oak. Recessed lighting was used to minimize fixture-induced sound shattering. Symmetry was a priority in the control room design. Outboard equipment wings were placed on both ends of the console, and tape machine soffits were located with this in mind. Entry into the control room is through the original freezer-locker door.

Traps at the back wall and rear half of each side wall have R-19 on two-foot-wide lengths of half-inch SDB. These panels are hung at angles, so that sound waves from the monitors travel the maximum distance through the fiberglass and become trapped between the layers of SDB. Corduroy stapled over window screen covers the control room traps. Fabric seams are covered with ¾-by 3-inch strips of oak, held in place with chrome-plated screws and finishing washers for easy removal and fabric repair. If I had to do it over again, I would add a thin layer of upholstery padding, to hide defects in the screen. Much extra time went into bending the screen so that wrinkles did not telegraph through.

AIR CONDITIONING

Calculating the capacity of the air conditioner required a lot of "guesstimation," since few manufacturers of electronic systems measure the actual heat dissipated by their equipment. Maximum mechanical life of an air conditioner occurs when it is closely matched to the cooling requirements of the room; an over-powered system will cycle on and off far too frequently. Rigid fiberglass ducting with a few right angles stops air conditioning noise. Over-sized ducts and even-larger ports reduce air velocity, and the attendant noise, to a desirable level. Two separate air conditioning systems are used—one for the control room and one for the studio. In the control room, air enters from the upper-center of the back wall. Exhaust is provided from the two equipment rooms on the left and right of the control room window. This prevents heat from power supplies and amplifiers from entering the working space. Air flow is through the traps.

THE FINISHING TOUCHES

Rough-finished pine was used on most of the walls and about one-third of the ceiling. Traps and the phantom portion of the ceiling were covered with corduroy. A linoleum-covered concrete slab replaced the former wood floor. Styrofoam was used to isolate the slab from the existing building. In the drum booth, an elevated floor was built on 2 x 6 strips of styrofoam, and filled with several thousand pounds of sand. The inertia of the floor keeps the drummer's energy going into the kick drum and helps prevent a shock wave from travelling through the main floor. The styrofoam provides a second resilient barrier between the main floor and booth. The trapping around the drum booth was largely accomplished with half-inch sound deadening board, and fiberglass hung overhead. Peripheral traps face into the studio, and help control the room ambience as well as attenuating the wave front folding through the drum booth opening. The entire drum booth is de-coupled from the main structure, while at the same time being built-in.

The walls are filled with R-11 fiberglass behind the pine covered areas. Horizontal furring strips were run across the backside of the wall framing to help keep the insulation in place. The sound control "sandwich" used was ½" sound deadening board, ½" C.P.X. plywood, and ½" tongue-and-groove pine. The top and bottom wall plates are glued to SDB, rubber, and finally the existing building. There are two 20-amp circuits using #12 wire servicing the convenience outlets. Each outlet has a duplex receptacle for the two circuits. Earphone jacks are located directly above each a.c. receptacle. Additionally, there are four 20-amp circuits using #10 wire servicing eight duplex receptacles centrally mounted in a large electrical box for photographic or theatrical lighting.

Studio traps use the same fiberglass/sound deadening board/fiberglass baffles mentioned previously. Some of these panels measure a full four feet in width, depending on their location. Window screen was again used to a height of six feet to keep things from falling through the corduroy covering. Additional horizontal framing was also built-in to help accomplish the same goal. Sound stops are placed at several locations in the walls from floor to ceiling to prevent peripheral piping of sound. Gypsum and sound deadening board were nailed to a framing stud leaving a ¼" gap between floor, existing wall and ceiling. The gap was filled with acoustical caulk.

Construction began November 1st (1978). New Year celebrations marked the completion of all the acoustical noise barriers and shell treatment. Sally"s session was delayed two weeks. Construction had been going on for seven days a week, ten hours a day, with three to ten people working per day. For New Year's, everyone took a couple of days off before we started working 12 hours per day. As it turned out, none of the cosmetics were completed by the time we started Sally's recording. The acoustical treatment was finished with one minor exception —the false ceiling in the front half of the studio had not been installed. Two weeks of recording were completed

View of studio toward the control room.

with tools and lumber neatly stacked around the building in various rooms and corners.

During the planning stages, advertisements, pictures, magazine articles and books were collected. Selected material was duplicated and placed in a binder forming a single, readily accessible resource. The most valuable material came from several articles by Michael Rettinger, published in **db** over a period of four years. His book, *Acoustical Design and Noise Control*, also contributed significantly. The articles of interest are listed as follows:

"Recording Studio Acoustics," Part 1, *db Magazine*, August 1974
"Recording Studio Acoustics," Part 2, *db Magazine*, October 1974
"Recording Studio Acoustics," Part 3, *db Magazine*, December 1974
"Recording Studio Acoustics," Part 4, *db Magazine*, February 1975
"Recording Studio Acoustics," Part 5, *db Magazine*, April 1975
"Recording Studio Acoustics," Part 6, *db Magazine*, June 1975
"Low Frequency Slot Absorbers," *db Magazine*, June 1976
"Control Room Acoustics, *db Magazine*, April 1977

Anyone planning a recording facility on their own, regardless of budget, should collect these articles before all others.

Producers Studio has been open for about sixty days, as of the time of writing, and we are still getting to know our room. We are pleased with the results, and the response of our clients and visitors. Our first album project (Sally Coombs) is presently being considered for release by a major record label. We have three similar projects in various stages of completion, and a few invitations to send further material for review.

Construction of the studio area was the most rewarding part of the project. After visiting and working in studios from Los Angeles to Seattle and Denver, I formulated my own ideas of how a room ought to contribute. I wanted the musicians to hear and feel their sound, while giving the engineer the separation he needed.

I don't know that I did anything particularly original, but I have pride in having done it myself. I highly recommend it as a rewarding experience. ■

KENNETH B. SACKS

The New World of "Creative Audio"

In less than a decade, a new category has firmly established itself within the recording industry.

IN THE EARLY '70s, there were—as always—vast numbers of people in search of audio production capabilities. However, the world of professional audio had already expanded enormously, and the price tag on a professional multi-track recording studio (for sale or for rent) was far beyond the reach of many such people.

A few years earlier, the electronic music explosion marked by such artist/engineers as The Beatles had permanently changed the course of the music/recording industry. With multi-track fast become standard operating procedure. many aspiring musicians—as well as aspiring engineers and producers—were often frustrated by cost-prohibitive production time in a state-of-the-art studio. Moreover, the complexities of the sophisticated recording equipment now in use were often not thoroughly understood by artists and producers who were kept out of the control room by the financial barriers imposed there.

Ironically, the whole multi-track concept was not a product of technology alone. In fact, it was the artist (Les Paul and Mary Ford—Ed.) in search of flexibility and creative freedom who got things started. Subsequent developments in engineering technology made it possible for the artist to expand his horizons and satisfy his creative appetite. But the cost was often prohibitive.

In earlier times, it was quite easy to recognize the artist. the producer, or the recording engineer: each had his own clearly-defined task. But then, the lines separating the inter-related titles began to blur. Artists and engineers began to experiment with production techniques, while producers would often devise new engineering procedures to capture a unique "sound."

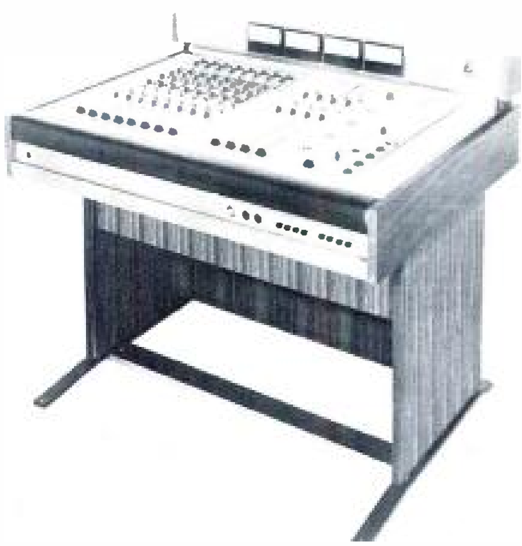
CREATIVE ENTERPRENEURS

The phenomenon has been given many labels, and much has been written about the new breed of person who combines various aspects of each job. After thinking about it for quite a while, I've decided to label those who suffer from the artist/producer/engineer syndrome as "creative enterpreneurs." Slightly abusing Webster's dictionary, the creative enterpreneur is defined as a person having imaginative and artistic inventiveness. who organizes and/or manages an undertaking (such as a recording project), assuming the risks for the sake of profit.

As the creative enterpreneurs first came into being, he discovered that equipment manufacturers were not quite ready to recognize his existence. In those early years, manufacturers of recording hardware were reluctant to commit R&D time and money to creating products for imaginary people, and the creative enterpreneur was not yet able to identify himself as a real customer, worthy of some creative attention.

For the moment, recording equipment remained "professional" and therefore, expensive. The "C.E." was stuck without a vehicle with which to prove his talent and ability and establish his position in the marketplace. Japan—the consumer-electronics giant—was still recording in real-time, and the concept of multi-track record production was as foreign as those crazy Americans who felt the need for it. There was therefore a formidable barrier confronting the

Where it all started—the Tascam model 10.



Kenneth B. Sacks was formerly the national sales manager of Teac Tascam. Mr. Sacks is now executive director of CAMEO, Simi Valley, California.

creative entrepreneur in search of reasonably-priced equipment on which to pursue his craft.

Eventually, the TEAC Corp. of America took a closer look at the market prospects. However, the "professional" audio industry remained aloof, since there was no statistical data on the C.E. Therefore, such a person did not exist, and there was no point in developing a product line based merely on some instinctive thinking. This "catch-22" stirred the thinking processes of a man named Yoshiharu Abe. He, along with his Japanese and American colleagues, began to realize that if manufacturers would make a commitment to satisfy the needs of the creative enterpreneur, this new customer would begin producing master tapes that would sell. And this in turn would provide a clear indication to other manufacturers that the market was out there, waiting to be developed.

TASCAM (TEAC Audio Systems Corp. of AMerica) came into existence, and a small group of design engineers was assigned to product development. The TASCAM model 10 mixing console was introduced by Westlake Audio at the 1972 convention of the Audio Engineering Society. The model 10 had eight inputs, four outputs, and a price tag of less the $2,000! To keep costs down, the traditional +4 dBm output level became —10 dB into a load of 10,000 ohms or more.

TEAC and others manufactured compatible tape recorders, but at first there was little or nothing available in the way of accessory equipment. The creative enterpreneur tried his own hand at studio system interfacing, and met with varying degrees of success. He was convinced that success was attainable, despite the fact that he had never operated equipment of this complexity before.

With time and experience came improved results—a fortunate few began making money and soon took their place among the ranks of those professionals who exchange master tapes for money.

As the TASCAM product line expanded to meet the demands of this growing market, it was seen by many as a springboard to the world of pro' audio. As other manufacturers joined the competition, the field came to be regarded as the "semi-pro" industry, although this identification is now falling out of favor with those involved.

To TEAC goes the credit for acting at a time when few others would have thought such a venture to be feasible. In the ensuing years, TASCAM has introduced a wide range of second generation mixers and recorders for the "affordable" studio. Now, many other manufacturers are producing a wide range of signal processing devices, designed specifically for easy interface in the creative enterpreneur's studio system.

Many companies now cater exclusively to this important segment of the audio industry. Others have expanded into the fully-professional category as well. Still others, who were previously identified as suppliers of high cost gear only, have developed more economical products to meet the needs of this market.

BUYER/SELLER COMMUNICATIONS

As the market expands even more, some hurdles remain. Unlike the supervisor of a major recording studio, the creative enterpreneur may need the services of a knowledgeable hardware dealer. Such a dealer will be able to guide his customer around the obstacles he will encounter as he sets up his equipment. Interface requirements that are taken for granted in a "super studio" may need to be explained in detail. Efficient lines of communication between buyer and seller must be developed and maintained, so that the buyer may get the information he needs in order to make an intelligent purchase. Likewise, the manufacturer must know more about the needs of his customer, in order to better meet them.

Complicating the picture is the proliferation of new products, and the diversity of end users. Recording equipment is no longer found only in recording studios. The ready availability of affordable audio has stimulated sales to commercial, industrial and institutional groups, such as advertising agencies, the training departments of large corporations, and church groups. The needs for these new market areas may be met by anything from a pocket cassette recorder to a full-scale multi-track production facility. However, even the most expansive facility need not be expensive, in full-professional terms.

THE ROLE OF CAMEO

Over the last year, a new organization of manufacturers has been formed, to look after the job of defining, informing and educating the creative enterpreneur and his suppliers. The organization calls itself CAMEO (Creative Audio and Music Electronics Organization), and represents a group of manufacturers who feel there is more to the creative audio business than getting products onto the dealers' shelves. CAMEO's board of directors will represent manufacturers of musical instruments, signal processors and interface equipment, microphones and speakers, amplifiers and mixers, recorders, and instrument amplifiers.

FEEDBACK & COMMENTS

CAMEO wants to know what's good (or not so good) about the new generation of equipment being supplied to the creative enterpreneur. What sort of new products are needed? What sort of lines should be drawn between the audio pro and the creative enterpreneur? Perhaps no line at all? CAMEO is looking for feedback, and welcomes reader comments. ■

Creative Audio and Musical Electronics Organization (CAMEO), formed in May, 1978, is an industry trade organization uniting the manufacturers of studio recording, sound reinforcement, and electronic music equipment to form the total scope of professional product equipment used to create original sound.

As of this writing, there are 36 manufacturers who have joined CAMEO as members, plus one associate member and seven associate press members. Ken Sacks is Executive Director of CAMEO, with elected officers: Larry Blakely, President; Dave Friend, Vice President; Vern Eszlinger, Secretary; and Dave Merrey, Treasurer.

CAMEO offices are located at: 5430 Los Angeles Avenue, Simi Valley, California 93063; (805) 522-8805, 8806.

The following is a list of current CAMEO members.

Acoustic Control
7949 Woodley Avenue
Van Nuys, California 91406
(213) 997-6631

AKG—Philips Audio Video
91 McKee Drive
Mahwah, New Jersey 07430
(201) 529-3800

Altec Lansing Corporation
1515 S. Manchester
Anaheim, California 92803
(714) 774-2900

ARP Instruments, Inc.
45 Hartwell Avenue
Lexington, Massachusetts 02173
(617) 861-6000

Biamp Systems, Inc.
9600 S.W. Barnes Road
Portland, Oregon 97225
(503) 297-1555

Bose Corporation
100 The Mountain Road
Framingham, Massachusetts 01701
(617) 879-7330

BSR Corporation

dbx, Inc.
71 Chapel Street
Newton, Massachusetts 02195
(617) 964-3210

Uni-Sync, Inc.
742 Hampshire Road
Westlake Village, California 91361
(805) 497-0766

Cetec Gauss
13035 Saticoy Street
North Hollywood, California 91605
(213) 875-1900

Cerwin Vega
12250 Montague St.
Arleta, California 91331
(213) 896-0777

Dallas Music Industries
150 Florence Avenue
Hawthorne, New Jersey 07506
(201) 423-1300

DiMarzio Musical Instruments
1388 Richmond Terrace
Staten Island, New York 10310
(212) 981-9286

Eastern Acoustic Works
59 Fountain Street, Box 111
Framingham, Massachusetts 01701
(617) 620-1478

Electro-Voice, Inc.

Tapco Audio Corporation
3810 148th Avenue N.E.
Redmond, Washington 98052
(206) 883-3510

Eventide Clockworks, Inc.
265 West 54th Street
New York, New York 10019
(212) 581-9290

EXR Corporation
11523 Dexter-Pinckney Road
Pinckney, Michigan 48619
(313) 878-9445

Fender Musical Instruments
1300 East Valencia Drive
Fullerton, California 92631
(714) 879-8080

James B. Lansing Sound, Inc.
8500 Balboa Boulevard
Northridge, California 91329
(213) 893-8411

Kustom Electronics
1010 West Chestnut
Chanute, Kansas 66720
(316) 431-2700

MICMIX Audio Products, Inc.
2995 Ladybird Lane
Dallas, Texas 75220
(214) 352-3811

Musical Instrument Corp. of America
170 Eileen Way
Syosset, New York 11791
(516) 921-9070

MXR Innovations, Inc.
247 North Goodman Street
Rochester, New York 14607
(716) 442-5320

Peavey Electronics Corporation
P.O. Box 2898
Meridian, Mississippi 39301
(601) 483-5365

Phase Linear Corporation
20121 48th Avenue West
Lynnwood, Washington 98036
(206) 774-3571

OSC Audio Products
1926 Placentia Avenue
Costa Mesa, California 92627
(714) 645-2540

RolandCorp U.S.
2401 Saybrook Avenue
Los Angeles, California 90040
(213) 685-5141

Scientific Audio Electronics (SAE), Inc.
701 East Macy Street
Los Angeles, California 90012
(213) 489-7600

Sequential Circuits, Inc.
1172G Asper Avenue
Sunnyvale, California 94086
(408) 296-3116

Sescom
1111 Las Vegas Boulevard North
Las Vegas, Nevada 19101
(800) 634-3457

Sound Workshop Professional Audio Products, Inc.
1342 Motor Parkway
Hauppauge, New York 11787
(516) 582-6210

Sunn Musical, Inc.
P.O. Box 429
Tualatin, Oregon 97062
(503) 638-6551

Tangent Systems, Inc.
2810 South 24th Street
Phoenix, Arizona 85034
(602) 267-0653

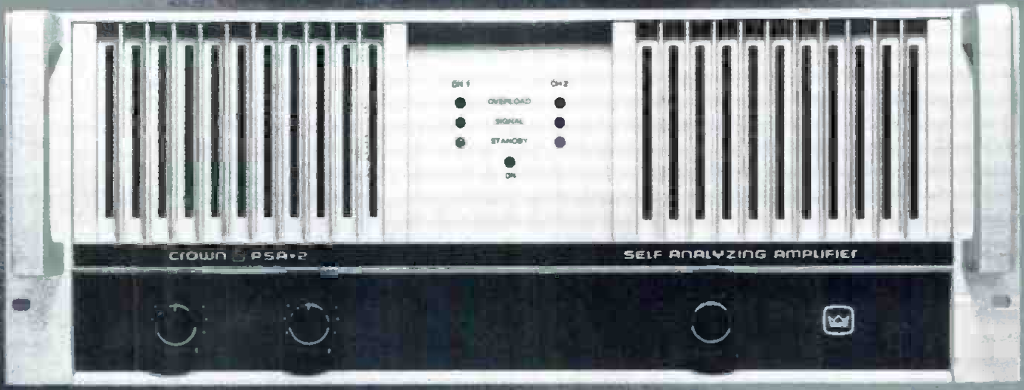
Teac Corporation of America
Tascam Series Division
7733 Telegraph Road
Montebello, California 90640
(213) 726-0303

Unicord
Korg Synthesizers, Marshall Amplifiers
89 Frost Street
Westbury, New York 11590
(516) 333-9100

VSC Corporation
29-50 Northern Boulevard
Long Island City, New York 11101
(212) 729-8400

Yamaha International Corporation
6600 Orangethorpe Avenue
Buena Park, California 90622
(714) 522-9015

Five years from now,



The Crown PSA-2 Professional Power Amplifier*

220 watts per channel minimum RMS (both channels operating) into an 8 ohm load, 20Hz-20KHz at a rated RMS sum total harmonic distortion of 0.05% of the fundamental output voltage. (tested per FTC specifications)

250 watts ±1dB per channel, 20Hz to 20KHz into 8 ohms with no more than 1.0% THD (EIA Std. SE-101-A).

400 watts ±1dB per channel, 20Hz to 20KHz into 4 ohms with no more than 1.0% THD (EIA Std. SE-101-A).

685 watts ±1dB at 1K per channel into 2 ohms, with no more than 1.0% THD.

*Designed for installation and use in professional sound systems

SAM ZAMBUTO

One Man's Choice

Choice Records, an independent jazz label, provides a unique alternative for musicians and jazz purists.

It's quite likely that guests at the home of Gerald and Patricia Macdonald will be entertained—perhaps unknowingly—right smack in the middle of "Studio A" of Choice Records. The label is one of a small group of independent record companies, dedicated to meeting the needs of a relatively select segment of the record-buying public. Choice Records specializes in the production of contemporary, acoustic jazz recordings.

But how can a warm, cozy, traditionally-decorated living room be transformed at a moment's notice into a busy recording studio? That's exactly what I sought to find out on my visit to the Macdonald house, overlooking Roslyn Harbor, on the north shore of Long Island.

A LITTLE BACKGROUND

Gerry Macdonald, owner and president of Choice Records, was a jazz musician himself for some ten years in his native Canada. Moving to the U.S. in the early 50s, he became involved in electronics—and eventually in tape recorder electronics. Within ten years, Gerry was working to incorporate d.c. servo motors into the tape transport system. Eventually, he developed a high-quality synchronous phase-locked capstan drive system.

Gerry's particular interest in this area had begun when, as a development engineer at Photocircuits Corporation, he worked on the company's S-1 Servo System. In a Photocircuits technical paper, he describes the S-1 as a device which incorporates a printed motor and a d.c. servo amplifier in such a way as to maintain an extremely high degree of accuracy with respect to motor shaft speed and instantaneous position in the presence of disturbing torques. Applications listed in the paper included the movement and control of various media, such as magnetic tape.

As the 60s drew to a close, he had the chance to try out this application for himself. With Gerry as president, MRS (Magnetic Recording Systems, Inc.) was formed, and the d.c. servo motor tape transport went into limited production. The transport design drew wide attention, and in time the company was purchased by the Singer Corp. The Singer management decided to divert the company's efforts into instrumentation recording—not very encouraging for a former jazz musician.

And so, Gerry parted company with MRS, to pursue his first love: jazz, and better-quality audio. A contractual agreement left him with four MRS tape transports (less electronics) from a production-line run of 80 machines.

His first step was to set to the task of designing his own signal electronics, and together with his wife Pat, he formed his own mini-production line.

The outcome of their labors produced; a two-track stereo record/playback tape recorder (now used to record the master tapes for Choice Records), a two-track stereo playback machine (primarily for editing purposes), a one-inch, 8-track record/reproduce machine (which records only two channels at a time), and a more-conventional one-inch, 8-track machine with all eight record channels operative. This one is still in the nearing-completion stage.

In addition, they designed and built a special-purpose console, consisting of eight microphone inputs and two outputs, plus an eight-channel (24 inputs via three-position switches) monitoring console.

With the addition of a pair of KLH 5 speakers for monitoring, dbx 124 noise reduction, an Audio-Pulse digital time-delay system, and a Soundcraftsman 20-12A equalizer, Choice Records was ready for operation. The label was incorporated in 1973.

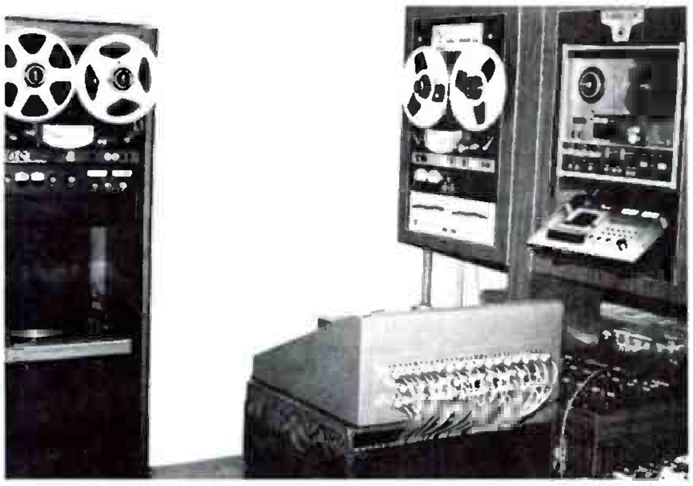
With the production line now shut down, Pat's "retirement" was a brief one—She's now the managing editor of the prestigious *Journal of the Audio Engineering Society*.

STUDIO LAYOUT

Choice Records' control room is located on the 2nd floor of the Macdonald house, in what used to be the master bedroom. (The Macdonalds use the guest bedroom.) The living room, 12′ x 22′, complete with a beautiful bay window overlooking the harbour, doubles as the recording studio. The room remains untouched, in terms of acoustic treatment for the walls and sound barriers for isolation—Gerry prefers the natural sound that the odd shape of the room has to offer.

The Macdonald's living room, or "Studio A" for Choice Records.

Sam Zambuto is associate editor of db Magazine.



The Choice control room. Clockwise, from the left is the MRS 8-track tape machine, the MRS 2-track, and a Teac 2300s and Nakamichi 600 (both used for making dubs of the sessions for the musicians).

Zoot Sims recording session, 1974. Musicians, from left to right: Mickey Roker, Bob Cranshaw, Zoot Sims, and Jimmy Rowles.

Conceding that the room has its size disadvantage (the largest session recorded, to date, had seven musicians), Gerry feels that the informal, relaxed atmosphere of the home-studio arrangement—both during and after recording sessions—largely outweighs any disadvantages.

THE RECORDING TECHNIQUE

Largely improvised, the music recorded for the label is exclusively contemporary acoustic jazz, performed mostly by internationally known and respected jazz musicians.

With what some might consider to be a giant step backward, the recording process is, in essence, a live stereo session recorded directly on to the 2-track machine—mixdown is achieved while the session is going on. The recording is either a "take," and everybody is happy about it; or it isn't—there are *no* overdubs. In the recording process, *no* equalizers, limiters, noise gates, etc. are used—the natural sound coming from each musician's instrument is to be captured on tape as accurately as possible.

BLUMLEIN TECHNIQUE

Using the Blumlein technique, a typical studio set-up would incorporate a Bang & Olufsen BM5 stereo microphone (containing two bi-directional ribbon microphones) plus a few spot microphones for added presence on some of the instruments.

By today's standards, the recording technique is, by choice (no pun intended), different and highly-specialized. Its use is almost dictated by the nature of the music—something Gerry feels very strongly about.

POSITIONING THE MUSICIANS

Due to the improvisational nature of the music, instant communication through sight is extremely important. Consequently, the set-up that has evolved over the years is one where the musicians are facing each other; able to feed-off of one another.

Considerable time is spent, of course, in getting the proper levels set, since there'll be no "fixing it in the mix." Musical balances are controlled through the careful positioning of the musicians at varying distances to the microphone set-up. To a large extent, the musicians tend to balance themselves, as in a live performance situation, as each solo instrument plays.

SIGNAL PROCESSING

We mentioned a digital delay system, and you might be wondering where that fits into the Choice scheme of things. While no signal processing occurs in the live recording process, a slight bit of reverberation is added to the finished product when making the final master tape.

ARTIST & REPERTORY

The decision as to who will record for the label is made by Gerry, and that is based on his own personal likes and dislikes. Songs to be recorded are left primarily to the cooperative decision of the leader and musicians who will be playing on a particular session—it can be anything from "originals" to "old standards."

Currently, Choice Records has released 20 records, with an additional 6 records at various stages of completion. The records, which are catalogue items, are distributed exclusively by Inner City Records, a division of MMO (Music Minus One) Music Group, Inc., in the U.S. and Canada, as well as exports to Europe and other countries. In a licensing arrangement with Japan, the master tapes and negatives for the album cover are sent to Japan, and the records are pressed and produced in that country.

A sampling of the catalogue listing includes recordings by jazz musicians such as: Zoot Sims, Roland Hanna, Irene Kral (two-time Grammy nominee for Best Jazz Vocal, 1976 & 1978), Chuck Wayne & Joe Puma, Buddy Defranco, Lee Konitz, Joanne Brackeen, Jimmy Giuffre, and Toots Thielemans. The complete catalogue of current Choice listings can be obtained by contacting Gerry Macdonald at: Choice Records, Inc., 245 Tilley Place, Sea Cliff, NY 11579. (516) 671-7299.

Gerry Macdonald, owner/president of Choice Records, at the console.

Another view of the control room, showing the front panel of the 8-channel, home-built, monitoring console.

A LOOK AHEAD

Future plans for Choice Records include completion of the 1-inch 8-track MRS tape machine, bringing with it the flexibility of additional tracks—not only for the recording of the spot mics that are used in conjunction with the stereo pair in the studio, but more importantly, for the capability of location recording, in clubs, to capture the inspiration provided by a live audience.

On another front, Gerry would like to "see" the musicians in the studio on the floor below; a problem he intends to solve with the acquisition of a video monitor.

WHERE DOES "CHOICE" FIT IN?

In an industry which runs the gamut from massive recording complexes to "semi-pro" basement or garage operations, Gerry Macdonald has found a niche that lies somewhere "betwixt and between."

Professional in the sense that the end product is the master tapes of a viable record label, the Choice recording studio provides the jazz musician exposure to, and a "choice" of an alternative, relaxed, low pressure, creative, professional atmosphere, in what is essentially an ideal "home recording studio" operation.

Obviously, economics played a large role in Gerry's decision to set up a record company and studio in his house. The economics of the number of records to be sold, in that particular music market, did not justify a large studio operation. However, all things taken into account, Gerry concedes he probably wouldn't change much —even if money was not a consideration. ■

RICHARD LERNER

Test Equipment Without Tears

A new generation of multimeters brings improved test and measurement procedures within reach of everyone, regardless of budget.

FOR YEARS, most electronic and electrical measurements have been made with the same type of meter and few improvements were made on the fundamental design. Most were d'Arsonval meter movements, backed up by the appropriate series or shunt resistors, or used as a bridge to measure resistance. Early units couldn't measure a.c. at all, or did so with a great deal of circuit loading. Voltmeter input impedances of 5000 ohms-per-volt weren't uncommon.

It was a long time before individual meters for each measurement, or even each range of measurement, were replaced by an all-in-one instrument called the multimeter. This most-used instrument was around in the same physical form for almost half a century, in tool kits, on benches, and in almost any place where volts, milliamperes and ohms need to be known. Even as the technology improved through the years, most multimeters couldn't boast of better than 20,000 ohms-per-volt input resistance. Any higher input impedance usually required a vacuum tube amplifier, with many problems such as the need for a power source making field or portable equipment impractical. The meter movements improved as time went by, but all of us remember how easy it was to drop and break a meter movement, or to wind the meter needle around the peg when the wrong range was selected. It is amazing that so much has been done with these meters.

In recent years, the multimeter has undergone a series of dramatic improvements, with various manufacturers now supplying a number of similar measurement instruments. Best of all, costs are low. If your boss wants to know why you need that expensive meter when he has seen all those ads for low priced meters lately, don't argue with him until you take a second look. The accuracy, input capabilities and versatility of small, inexpensive units has improved almost while we weren't looking. Of course, there are still those times where high stability, accuracy, precision of extreme sensitivity count. Wayne Jones' recent feature on Audio Tests & Measurements described the latest generation of state-of-the-art test gear. But for less-demanding applications, the studio engineer may need an instrument that leans more towards convenience than cost.

With the recent advances in the semiconductors avail-

Calcumeter 4100 by Electro Scientific Industries.

Richard Lerner is senior test engineer for Unidynamics/Phoenix Inc., Phoenix, Arizona.

B+K Precision/Dynascan model 2810, a 3½-digit digital multimeter.

able. and in improved displays, a veritable deluge has come from manufacturers old and new. Names long associated with analog multimeters as generic—such as Simpson and Tripplet—have been joined by a host of newcomers. all proving that the tasks of the humble multimeter are still with us. In fact, modern technology now permits rugged, portable measuring instruments that only a few years ago could only be found in expensive laboratory equipment. So far has the field advanced that far more complex data processing can be done with small. rugged. hand-held equipment.

MEASUREMENTS BY MICROCOMPUTER

One of the innovators in this new wave is Electro Scientific Industries. They have developed a custom CMOS microcomputer which does far more than simple measurements. Their Calcumeter 4100 can automatically condition measurements made in volts, amps or ohms.

At first glance. Calcumeter looks like a digital calculator. It has an lcd display, and function keys which perform much in the manner of ordinary calculators. But much attention has been paid to electrical engineering data processing. Using reverse Polish notation, the keyboard provides square and square root, reciprocal, memory manipulations (of 5 memories), natural and Naperian logs. Features which are aimed at electrical measurement are the choice of fixed or automatic ranging. 3½-digit display in meter mode (8 in the calculator mode) and the choice of continuous readings at a two-per-second rate, or holding the last value taken on the display. The 9-volt battery boasts one million single measurements or 3000 hours of use.

This versatile meter can perform tasks usually found only on much more expensive equipment. It will accept a constant to use as a scaling factor on any measurement. and can also automatically add or subtract a constant to a direct or scaled value.

Digital signal averaging will program away noise, and increase resolution. High-low limits sorting will graphically display each measurement value proportional to wide dynamic range limits. Inverse conversion permits displaying each measurement as its inverse value. The decibel voltage mode displays each measurement relative to a programmed value in decibels.

Deviation mode shows each measured value as a per cent deviation from a programmed nominal figure or from a previously measured value. There is even an audible alarm, which sounds whenever an error or over-limit condition occurs. An optional data logging printer is available, with an internal clock control to command internal measurements.

LIQUID CRYSTAL DISPLAY (LCD)

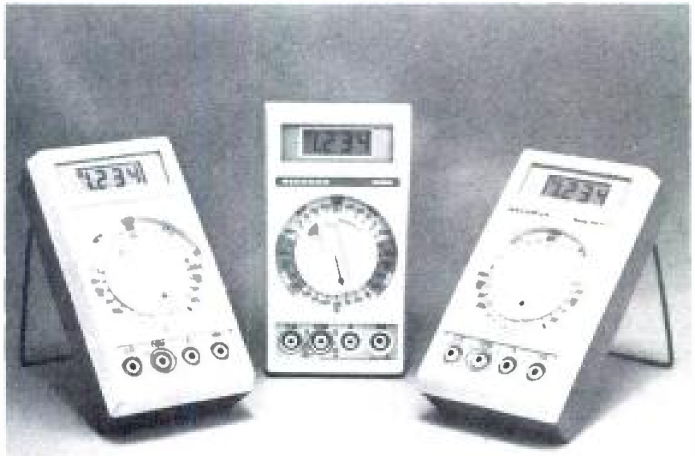
As we said before, a veritable deluge of digital instruments has hit the marketplace. Most of these use the liquid crystal display, which has the virtue of being easily read in both brightly and dimly lit situations. While not as rugged as the light emitting diode (led) displays, the power consumption of the lcd is so low that new batteries have been developed to provide better space usage, at the low power demands of the lcd. Most of these instruments duplicate the functions of the analog multimeter. but there are also some new devices appearing, such as capacitance meters, which no longer need to come in large boxes with huge dials. Measuring the value of a capacitor is now a matter of connecting it and pressing a button. Data Precision makes a lightweight unit which also promises long term stability.

Unlike other capacitance meters, this one measures capacitance by determining the ratio of change in a stored charge to the change of voltage across the unknown capacitor. Since neither a bridge nor time-measurement technique is used. as in most other meters, neither voltage nor time must be measured accurately to determine capacity. Calibration is by means of just one internal adjustment, and should hold for at least one year. The internal 9-volt battery is rated for 200 hours of operation. Designated as model 938, measurement capability is from 0.1 picofarads to 1999 microfarads, in eight ranges. Its 3½-digit display settles to the value in about 0.5 to 2.5 seconds. depending on the capacitance value. Accuracy is 1 per cent of reading ±1 least significant digit, with an additional ±0.5 picofarad below 200 microfarads. Data Precision also manufactures a similar looking digital multimeter as model 935. With an accuracy rating of 0.1 per cent, the meter has 29 ranges of d.c. or a.c. voltage and current or resistance measurements. A low excitation voltage of 250 millivolts measures resistance without semiconductor turn-on.

The compact and low-priced model LX303 lcd multimeter from Hickok features capabilities found in some of the more expensive units, such as auto-zero, auto-polarity and 100 millivolt d.c. sensitivity. With 19 ranges of a.c., d.c. and resistance measurements. protection from overload is provided, and the unit also has a one-year guarantee. A snap-on cover contains the meter leads. Accuracy is rated at ±0.5 per cent. Accessories available include 10-amp shunt, carrying case and a 10-kV probe.

B+K Precision/Dynascan manufactures a large line of service and test equipment. Recently included are a digital voltmeter and a digital capacitance meter. using led displays. The multimeter, model 2810. has a 3½-digit display, with 0.5 per cent accuracy. All 29 ranges feature overload protection, and auto zeroing. Various accessories such as probes are available, and a companion solid state temperature probe, model TP-28, is very handy for determining both component and air temperatures in tightly-packed electronic cabinets. Reading in either Fahrenheit or Celsius, it operates with almost any voltmeter—digital or analog.

Tripplett has recently introduced a 3½-digit compact multimeter. Hand-size, with a single range switch covering 24 functions. a low-power ohms scale makes the meter suitable for semiconductor testing. The firm continues to manufacture its line of analog meters. as does Simpson. with its 460 Series of digital multimeters. Typical is model 463. with 3½-digit lcd readout, 26 ranges. 200-hour battery operation, and 0.2 per cent d.c. voltage accuracy. The



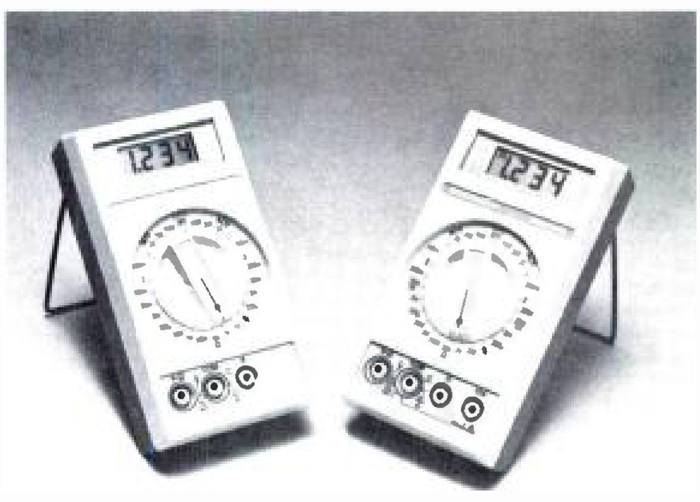
Models 3010, 3020, and RMS 3030—3½-digit portable multimeters from Beckman Instruments.

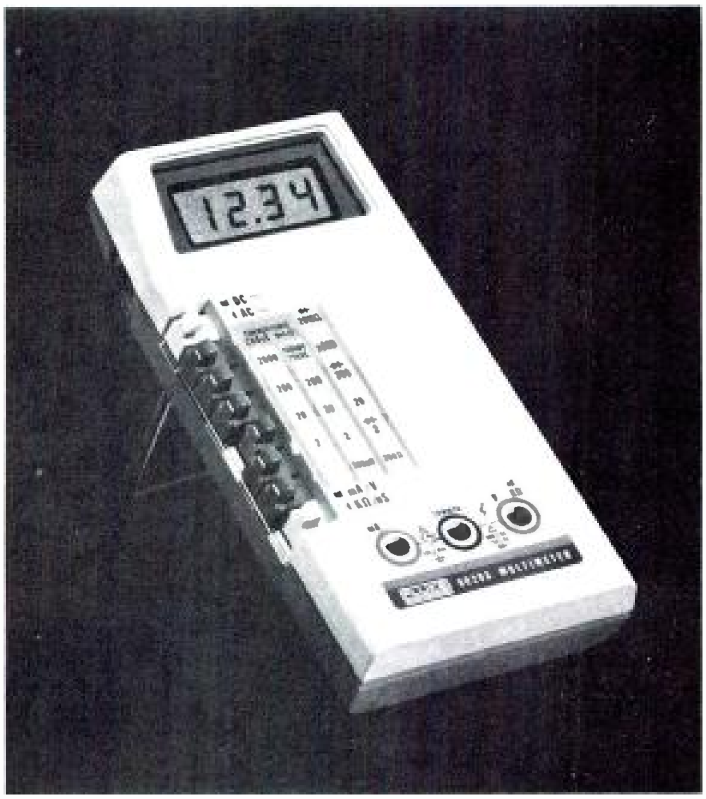
series has overload-protected LSI circuitry, automatic polarity, and a full line of accessories.

Non-Linear systems, who call themselves the originator of the digital voltmeter, have a 5-function 3½-digit lcd multimeter. With input protection and a d.c. accuracy of 0.5 per cent, automatic zeroing and polarity selection, an automatic overload indicator, and optional nickel cadmium batteries and charger, the instrument is aptly called the Volksmeter.

The strong market surge in multimeters has prompted a manufacturer long known for displays back into the instrumentation field. Beckman has recently announced a line of hand-held digital multimeters, the 3000 series, with their own lcd displays, of course, as well as many of the other plastic and electronic parts. This vertically-integrated manufacturer has several hand-held meters, with features not found on many similarly priced units: 0.1 per cent d.c. accuracy, a 10 amp range, and true rms a.c. current and voltage measurement capability. In addition to the 3000 line, Beckman has also introduced the lower-priced TECH 300 series of portable multimeters. With a 0.5 and 0.25 per cent d.c. accuracy respectively, the model 300 and 310 provide many of the features found in the 3000 line. Philips is offering multimeters with your choice of either lcd or led readouts, with autoranging or manual ranging. They provide true rms measurements for a.c. signals, and overlead protection. An optional temperature probe is available.

The TECH 300 and TECH 310, two multimeters in the new TECH 300 Series by Beckman Instruments.





The Fluke hand-held digital multimeter, model 8020A.

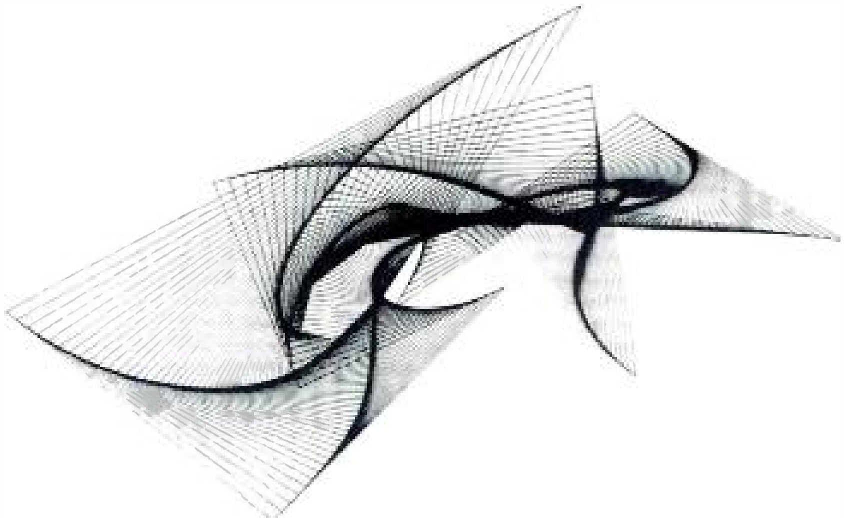
Fluke, in addition to its fine line of laboratory-grade test instruments, now has several units suitable for bench or field. The line includes the model 8020A—a hand-held dmm—as well as several slightly-larger bench or field systems with increased flexibility, and specifications approaching laboratory units. With a large display and true rms capability to 50 kHz, the line has features not found on the instruments already mentioned. Handiest is the touch and hold probe. A special button switch holds the reading for viewing after the probe tip leaves the test point, permitting full attention to the probe tip while it is on the test point. Accuracy specifications are guaranteed for one year; a savings in calibration expense. When calibration is required, only five adjustments are necessary, for another time saving. A conductance measurement feature makes possible resistance ranges not within the capability of any other meters. Conductance is the inverse of resistance, and is expressed in siemens (formerly, mhos). Simple conversion of direct-reading conductance to resistance yields values to 10,000 megohms, without requiring special noise-limiting shielding. Resistance values in high-voltage dividers can be easily verified, as can leakage resistance of capacitors, printed circuits, cables and insulators. A test adaptor permits measurement of transistor Beta and leakage, which is more useful and informative than simple junction tests. Also available is an optional battery system. Nickel-cadmium batteries installed in the meter are kept continually charged while the power cord is plugged in, and a low-battery indicator is provided. Accessories include the touch-hold probe, a temperature probe, an rf probe, and a current shunt for a.c. or d.c. measurements up to 20 amps.

These are but a few of the relatively-inexpensive test devices now becoming available. Aside from their obvious application as companions to the more-costly, high-performance measurement devices, they deserve the serious consideration of the studio engineer who lacks either the need, or the resources, for a complete test bench. ■

JOHN WORAM

A Mini-survey of Graphic Recorders

Once strictly a "laboratory animal," the graphic recorder is now making popular appearances, in a variety of formats.



Is this the output response from one of last month's psycho-acoustic "black boxes"? Not quite—it's just an example of the capabilities of the latest generation of graphic recorders. Our "artist" is the Hewlett-Packard 9872A Graphics Plotter.

Although our April issue highlighted the latest developments in audio tests and measurements, the subject "spilled over" into the next two issues, as Wayne Jones continued his three-part essay on the subject.

As we've discovered, graphic recorders have made their way out of the laboratory and onto the studio test bench. (We're defining a graphic recorder as any device capable of drawing hard-copy plots of various audio measurements.) With the graphic recorder becoming a more-accessible device, it's being seen in a variety of new formats, from the traditional laboratory XY recorder, to the micro-processor-based four-color graphics plotter. To help minimize the confusion, here's a brief glimpse at a handful of such devices.

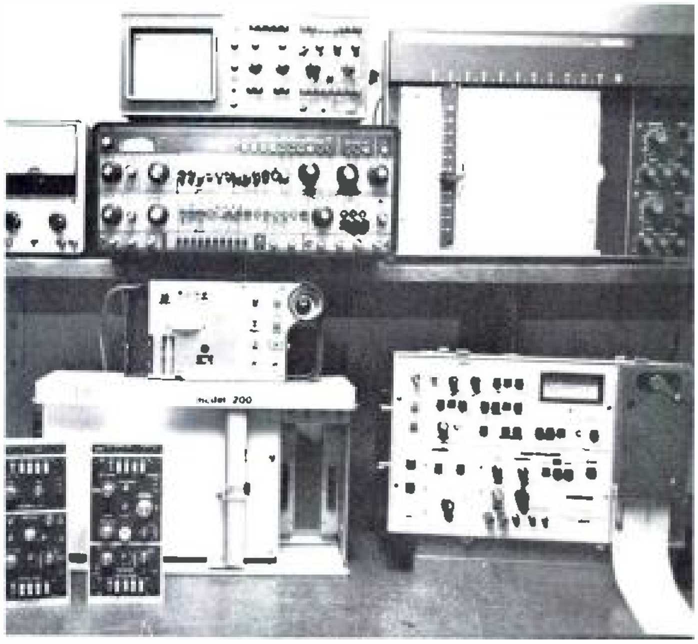
XY RECORDERS

The XY recorder is a simple two-input device, capable of drawing any sort of graph with X (horizontal) and Y (vertical) axes. The trouble is, its inputs are d.c.-only. Therefore, some sort of audio-to-d.c. interface is required. The Philips PM-8141 seen in Figure 1 is a typical example of such a device. On our test bench, it is connected to the Amber 4400a Audio Test Set, which furnishes the necessary a.c.-d.c. conversion, to draw frequency or phase responses, or whatever. An optional time-base module provides its own d.c. output, which increase linearly with time. This output may be applied to either input, making it possible to plot either X or Y data, versus time.

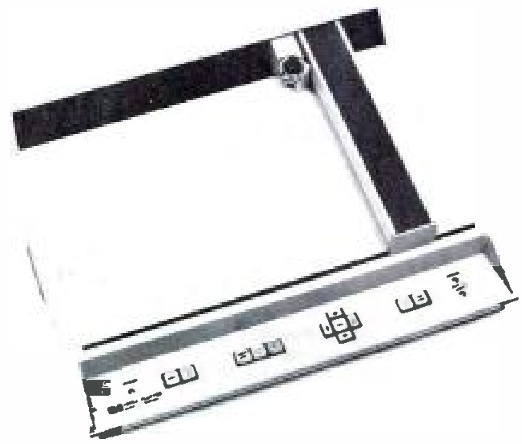
Although the d.c. inputs preclude the XY recorder from most stand-alone audio applications, they do make for easier interface with a host of other test and measurement gear, designed for such purposes.

RESPONSE PLOTTERS

The UREI Automatic Response Plotting System was described in detail in the May issue of **db**. Essentially, it is a complete system, consisting of an XY recorder, plus the necessary interface modules for accommodating various audio inputs. Using the appropriate plug-in module, the system will supply an audio output signal to drive a device



*On the **db** test bench—a group photo of some graphic recorders. In the upper right-hand corner, the Philips PM 8141 X-Y Recorder shares the shelf with some other test equipment. Just below the Amber Audio Test Set is the Neutrik 3201 Audiotracer, sitting on top of UREI's model 200 Response Plotting System. Plug-in modules for the system are seen in the foreground. Directly below the Philips recorder is the Leader LFR-5600 Frequency Response Recorder.*



Hewlett-Packard's model 7225A Digital X-Y Plotter.

under test (a tape recorder, amplifier, loudspeaker, etc.). The audio output of the device is then returned to the Plotting System, and a hard-copy XY plot is drawn.

CHART RECORDERS

Chart recorders generally feed out a strip-chart trace of some parameter (amplitude, impedance, etc.) versus frequency. The Neutrik 3201 Audiotracer is a representative example of such a device, consisting of a send, a receive, and a recording section.

The send section comprises a voltage-controlled, swept sine-wave oscillator, with a warble-tone generator function that may be switched in or out. The generator frequency-modulates (warbles) the send output, over a one-third or one-half octave range, whose center frequency is the instantaneous frequency of the swept oscillator.

The Neutrik Audiotracer (as well as most other chart recorders) may be used for recording amplitude versus time data, simply by putting the system in the start mode and selecting a suitable speed for the paper feed. For this application, the chart recorder has an advantage over the XY systems described earlier, since it will record amplitude variations over a period of many hours. With more than 100 feet of paper on a roll, a suitably-slow paper feed will keep the recorder in operation for a day or so. By contrast, the XY system records on a single sheet of graph paper, so even at a slow sweep rate, the recorder will complete its run within a matter of a few minutes, rather than hours.

Another chart recorder—the Leader LFR-5600 Frequency Response Recorder—was described in the April issue of **db**.

DIGITAL PLOTTERS

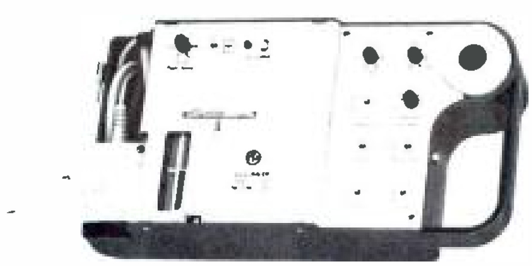
Perhaps the ultimate in hard-copy devices is the latest generation of XY recorders built around microprocessor-based systems. In fact, the "artwork" at the head of this survey was run off on such a system—the Hewlett-Packard model 9872A Graphics Plotter. It's yours for a mere $4,200, but you'll need some sort of computer to drive it. With a little programming prowess, such devices can be interfaced with a personal computer, although Hewlett-Packard supplies its own computers specifically designed to complement the graphics capability of such plotters. The company's model 7225A, seen in FIGURE 3, is a lower-cost ($1,850) device, without the automatic color-changing capabilities of the 9872A.

THE INTERFACE BUS

In either case, the XY recorder has now evolved into a highly sophisticated, computer-controlled system, with neither traditional d.c., nor analog-audio inputs. Instead, it receives its instructions from the computer-controller, and this may be interfaced with still other test equipment, via the IEEE-488 interface bus. Part III of Wayne Jones' feature on Audio Tests and Measurements, in the June, 1979 issue of **db**, provides a little more information about the application of the interface bus, to control the latest XY recorders, as well as other test equipment.

Eventually, the interface bus, or a latter-day equivalent, should be able to link test equipment (including XY recorders), computers, and consoles, so that your audio system will be under constant surveillance by your test equipment. And, your graphic recorder will keep hard-copy records for you to help spot potential troubles, long before they become potential disasters. ■

The Neutrik 3201 Audiotracer.



JOHN M. WORAM

Audio Problem Solving with a Home Computer

With most personal computers, otherwise-tedious audio problems may be solved in seconds.

IN THE JANUARY, 1979 issue of **db**, Dr. Albert E. Hayes Jr. offered a program for calculating noise voltages of microphones ("Audio Problem Solving with a Programmable Calculator"). The program was written for the Hewlett-Packard HP-97 calculator, and was based on an earlier article by John Maxwell ("Noise of Sources"—May, 1977). Maxwell's feature described, in detail, the lengthy computations, which—using Hayes' calculator program—require only about 30 seconds to run.

To run the program, a handful of variables are entered (capacitance and resistance values, lowest bandwidth of interest, and its center frequency). Immediately after entering the center frequency, the calculator begins its run through the program, and eventually displays the answer, which looks like:

7.96 −06

The user understands this to mean 7.96 microvolts. To briefly summarize the program, the answer is found by calculating the "mean square noise voltage" in each of ten one-octave bands, summing these, and then taking the square root of this sum. (The "square root of the sum of the squares," as the mathematicians would say.)

CALCULATORS VERSUS COMPUTERS

Obviously, one must be very careful. A careless error during the original programming, or perhaps an incorrect data entry later on, will send the calculator merrily on its way towards finding you an answer that isn't even close to correct. On the more-sophisticated calculators (such as the HP-97), a printer will provide a hard-copy record of all the intermediate steps, and this can certainly be handy for "de-bugging" a program. On the other hand, it is a bit tedious to read, especially for the novice programmer.

By comparison, the CRT on a computer provides a screen that you may fill to your heart's content (within reason, of course). With a little prowess at the keyboard, the computer will actually ask you all the right questions, accept your answers, neatly tabulate intermediate calculations if you like, give you the final answer in English (NOISE VOLTAGE = 7.96 MICROVOLTS, for example), and then conclude by re-displaying the values you "inputted." By examining these, you may be sure you didn't enter 50 when you really meant 5, and if those intermediate values seem to be taking off into outer space, it may make the de-bugging process a little more obvious, and therefore, easier.

FROM CALCULATOR TO COMPUTER

The following computer program takes the work of Maxwell and Hayes, and converts it into the BASIC language that most personal computers just love. As written, it works on both the Apple II and the Radio Shack TRS-80 (Level 2) computers.

COMPUTER PROGRAM

```
100 PRINT "ENTER MICROPHONE'S SHUNT
    CAPACITANCE."
102 PRINT "IN PICOFARADS."
110 PRINT
120 INPUT A
130 PRINT
140 PRINT "ENTER PREAMP'S INPUT
    CAPACITANCE."
142 PRINT "IN PICOFARADS."
150 PRINT
160 INPUT B
170 PRINT
180 D = A + B
190 C = D * 10 ↑ -12
200 PRINT "ENTER LOAD RESISTANCE."
202 PRINT "IN MEGOHMS."
210 PRINT
220 INPUT R
230 PRINT
240 RL = R * 10 ↑ 6
250 PRINT "ENTER LOWEST BANDWIDTH,"
252 PRINT "IN HERTZ."
260 PRINT
270 INPUT BW
280 PRINT
290 PRINT "ENTER CENTER FREQUENCY,"
292 PRINT "IN HERTZ."
300 PRINT
310 INPUT CF
320 MG = 2 * 3.14159 * CF
330 MM = MG ↑ 2
340 RR = RL ↑ 2
350 CC = C ↑ 2
360 DE = 1 + MM*RR*CC
370 RE = RL/DE
380 Z = (RE * RL) ↑ .5
390 BK = 1.656E - 20
400 NV = BK * BW * RE
410 IF BW > 25 THEN GOTO 450
420 PRINT "BANDWIDTH";
430 PRINT TAB (12) "RE(Z)";
440 PRINT TAB (25) "Z"
445 PRINT
450 PRINT BW;
460 PRINT TAB (12)RE;
470 PRINT TAB (25)Z
480 X = NV + Y
490 IF BW = 12800 THEN GOTO 535 [or 540—see text]
500 BW = 2 * BW
510 MG = 2 * MG
520 Y = X
530 GOTO 330
535 PRINT: PRINT: PRINT
540 PRINT TAB (4) "NOISE VOLTAGE =";
550 PRINT TAB (20) INT (X ↑ .5 * 10 ↑ 6 * 100 +.5)/
    100; (see text)
560 PRINT TAB (25) "MICROVOLTS."
565 PRINT
567 STOP (TRS-80 only)
570 PRINT "SHUNT CAPACITANCE =";
580 PRINT TAB (20)A;
590 PRINT TAB (25) "PICOFARADS."
595 PRINT
600 PRINT "INPUT CAPACITANCE =";
610 PRINT TAB (20)B;
620 PRINT TAB (25) "PICOFARADS."
630 PRINT "  LOAD RESISTANCE ="; (Note 2 spaces
    between " and L, instead of a TAB instruction.)
640 PRINT TAB (20)R;
650 PRINT TAB (25) "MEGOHMS."
660 END
```

PROGRAM ANALYSIS

As with calculator programs, each instruction receives its own line number. With a computer however, these must be typed by the user. It's good practice to skip at least several numbers between each instruction, so that if you discover you've forgotten something, you can insert it later on. The computer will follow the numerical sequence of your line numbers, which makes programming a bit easier. For example, if you've just completed line 370, and realize you omitted something that should happen just after line 50, you can just make the next line a 55, type in whatever you forgot, and then go to line 380, 390, etc. Before executing the program, the computer will pick up line 55, and place it between 50 and 60, where it belongs. This is both a convenience, and a caution. If you thought you typed 370, but only got as far as 37, this instruction will apparently "disappear" from where it is supposed to be (between 360 and 380) and will be found lurking between 30 and 40.

INSTRUCTING THE COMPUTER

As I have already discovered (see the November, 1978 Sync Track), the computer is quite literal, and stupid (or, literally stupid, if you like). Therefore, if you type PRINT "A + B = ORANGES," the computer will display A + B = ORANGES, even though the statement doesn't make too much sense (just as I suspected!—Publ.). In its mindlessly efficient manner, the machine has faithfully carried out your instructions, by printing *everything* you enclosed within the quotation marks.

If you had wanted to know the answer to the problem, A + B, you would type PRINT A + B. The computer will respond with a nice big fat Ø, since it has no idea of the values of A and B. So, it takes the easy way out, and assigns a value of zero to both of them, until you instruct it otherwise. By the way, that slash-mark through the zero (Ø) merely distinguishes it from the letter "O." To save the typesetter some heartburn, our printed program doesn't bother doing this, although the slashes will show up on the CRT display.

LINES AND COMMENTS

100 tells our friend to print something. Later on you'll read this line, and do what it says. 102 was added, pretty much as an afterthought, to remind you that the shunt capacitance should be entered in picofarads. 110 doesn't look very promising. However, the computer takes this instruction for what it's worth, and prints nothing at all, on the line that comes immediately below IN PICOFARADS. In other words, it skips one line on the display before moving on to the next instruction.

At 120, a question mark appears on the screen, and the program comes to a halt. This is your cue to follow the instructions on the screen, and INPUT (that is, type in) the value for the shunt capacitance. As soon as you have done so, the computer skips another line (130) and then asks for more information (140-170). Now that it knows the values for A and B, it adds them (180) and then multiplies this value by 10^{-12}, which converts the sum to picofarads. By the way, the asterisk (*) seen in line 190—and elsewhere throughout the program—is the symbol for multiplication, thus preventing confusion with the letter "X."

Since you have not asked for a print-out of the value found in line 190, you don't get one. However, the value is tucked away in memory, for use later on.

By now, lines 200-310 should be easy enough to figure out. If not, go back and review the previous paragraphs.

So far, we've merely been entering data, and converting it into the proper magnitudes for the calculations that are to follow. It may be worthwhile to clarify what's going on at line 240. At 200-202, we were instructed to enter the load resistance, in megohms. However, typical resistive loads are apt to be in gigohms (10^9), or, 1,000,000,000 ohms. This is a bit easier to handle if we think of it as 1,000 megohms. So, if we enter 1000 at line 220, this is equivalent to 10^3. To convert to 10^9, we must multiply by 10^6 ($10^3 * 10^6 = 10^{3+6} = 10^9$), and that's what happens at 240. (Note that values such as 1,000 must be entered as 1000, since commas are reserved for special instructions, which we'll talk about at some other time.)

Assuming we are trying to solve the same problem used in Maxwell's original example, we will enter the following value when we run the program; 120 A = 10, 160 B = 5, 220 R = 1000, 270 BW = 25, and 310 CF = 37.5.

THE CRT DISPLAY—SO FAR

If all is well, the CRT display should look like this (just *before* we enter the center frequency at line 310)

```
ENTER MICROPHONE'S SHUNT CAPACITANCE,
IN PICOFARADS.

?10

ENTER PREAMP'S INPUT CAPACITANCE,
IN PICOFARADS.

?5

ENTER LOAD RESISTANCE,
IN MEGOHMS

?1000

ENTER LOWEST BANDWIDTH,
IN HERTZ

?25

ENTER CENTER FREQUENCY,
IN HERTZ

?
```

At this point, the computer is waiting for you to enter the center frequency, and, as soon as you do so;

THE MATH BEGINS

At 320, omega is calculated. Since the computer doesn't have the proper symbol (the Greek ω), MG was arbitrarily chosen, to symbolize oMeGa. 330-350 calculate the squares of omega, RL and C, which we shall need in the formula found on the next two lines. Then, at 380, Z is equal to the square root of the product of RE and RL. Line 390 is merely the "constant" required in the formula listed in the next line. In the BASIC language, E-20 is just a form of shorthand for 10^{-20}.

Finally, line 400 gives us the square of the noise voltage in the lowest bandwidth of interest, which was entered at line 270, as 25 (Hz).

THE PRINT-OUT BEGINS

Line 410 says that IF the bandwidth is greater than 25, THEN skip to 450. But since BW = 25 at the moment, this "goto" instruction is ignored, and we proceed directly to the next line, where we print out some headings, and at the same time collide with a little more computer jargon. Line 420 is an easy one. The computer simply prints the word BANDWIDTH. The semicolon instructs it to stay on the same line, and await further instructions. In line 430, PRINT TAB (12) "RE(Z)"; means, move 12 spaces from the left side of the screen, and print RE(Z). Again, the semi-colon means "stay put—there's more coming." And, in 440, the computer is told to move 25 spaces (from the left side of the screen again), and print Z. As you might suspect by now, BANDWIDTH, RE(Z), and Z are three intermediate values that we shall examine as we progress. The instructions just listed will print these words across the top of the screen, before we begin tabulating the actual values.

THE TABULATION REALLY BEGINS

To keep things neat, we skip a line (445) and then, 450-470 print out the actual arithmetic values of BW, RE, and Z. As before, the TAB instructions and semi-colons keep things in place.

At line 480, we define X = NV + Y. Since the computer knows NV (from line 400), and has never heard of Y (yet), this means that X = NV + Ø = NV. We never did find out what value NV has, but it doesn't matter—the computer (bless its stupid little memory) knows! So, for the moment, this unknown value is stored, both as X and as NV.

A little digression is needed at this point, to inform TRS-80 users to ignore line instructions ending in 5 (e.g., 445, 535, etc.) All of these are simply instructions to skip one or more lines, strictly for the sake of "housekeeping"—that is, making the display a bit more readable. However, the TRS-80 is not able to display as many lines as the Apple II, and so, these blank lines will drive some of the data off the top of the screen. Otherwise, they have no effect on the program.

Getting back to the program, line 490 says that IF the bandwidth equals 12,800 (Hz—note the absence of a comma in the program, though), THEN goto line 535 (540 for TRS-80 users). Well, BW doesn't equal 12,800, so we find ourselves at line 500, staring at a formula that seems to be contradicting itself, for how can a BW be equal to two-times-BW? This is just a little more "computereze." It means that, from now on, the value stored away as BW shall be equal to twice the value that was formerly stored as BW. In other words, it drags the old BW (= 25) out of memory, multiplies it by 2 (= 50) and puts it back in memory, again as BW. At line 510, the same thing happens to the old value of MG (oMeGa).

At 520, the value of X (from line 480), is stored away as Y. (For the moment, it's also still there as X.) Next, 530 sends us back to 330 for some more math.

We are about to begin calculating NV for the next BW of interest. This would be the one-octave BW beginning at 50 (that is, 50 Hz to 100 Hz). For whatever its worth, its CF (center frequency) would be twice the CF we entered at 310. And that means the oMeGa in 320 would also be double its former value. In effect, we accomplished just that in line 510. So, as we move on from 330, we eventually get to 400, where the new NV is discovered. BW is now greater than 25 (it's 50), so 410 sends us ahead to 450, since there's no point to printing those headings (420-440) all over again. 450-470 print out the new values for the three intermediate steps we are tabulating, and once again we arrive at 480. This time around, X is equal to the *new* NV (from 400), plus Y, which is no longer zero. Y is now equal to the *old* NV (remember line 520?), and that means that X is equal to the sum of both values of NV.

But BW still doesn't equal 12,800 Hz, so 490 is again ignored, and—one more time!—we double the BW and MG, store that X summation as Y again, and go back to 330.

This could go on forever, except that eventually BW *does* equal 12,800 Hz, which finally satisfies line 490, and we are freed from this loop, and set off to 535 (or 540) to begin printing what we *really* want to know—the noise voltage. The TAB (5) instruction in 540 is just to line up NOISE VOLTAGE with the print-outs that will follow later on.

Line 550 will take some explaining. Actually, X ↑ .5 represents that famous "square root of the sum of the squares" (in other words, the noise voltage), while 10 ↑ 6 converts this to a reading in microvolts. The INT (integer) instruction as well as the other numbers [(. . . *100 + .5)/100] merely takes the final answer and rounds it off to two decimal places. This gives us 8.42, instead of 8.42312196. Line 560 tags on the word MICROVOLTS.

KNOWING WHEN TO STOP

At this point, line 567 (TRS-80 users only) will bring things to a halt. There are now some twelve lines of data on the CRT display, and any further information will cause the upper lines to "scroll" off the top of the screen. So, until satisfied that the program is running properly, TRS-80 users may want to ignore the remainder of the program (570-660), which merely serves as a print-out of the data entered by the user at the beginning of the program.

Once the intermediate steps (BANDWIDTH, RE(Z), and Z) have been studied, and you are satisfied the program is correct, the line 567 STOP instruction can be removed if you like, since the off-screen scrolling does not remove any vital data—just the column headings and a couple of the intermediate listings. Or, if you keep 567, then typing CONT (continue) will finish off the program. Apple II users can ignore all of this, since there's room on the display for everything.

RUNNING THE PROGRAM

If the program is run using Maxwell's CF of 37.5, the final display will appear on the display as shown:

BANDWITH	RE(Z)	Z
25	74122407.7	272254307
50	19621390.4	140076374
100	4978613.1	70559287.9
200	1249318.18	35345695.4
400	312622.468	17681133.1
800	78173.9463	8841603.16
1600	19544.6325	4420931.79
3200	4886.22975	2210481.79
6400	1221.56191	1105242.92
12800	305.390757	552621.714

```
NOISE VOLTAGE =7.96  MICROVOLTS.
SHUNT CAPACITANCE = 5  PICOFARADS.
INPUT CAPACITANCE = 10  PICOFARADS.
LOAD RESISTANCE =1000  MEGOHMS.
```

These values can be compared with Maxwell's own tabulation in the May 1977 issue of **db**. A discrepancy will be discovered in the final values of RE(Z) and Z. Amateur computerniks are invited to figure out why these values don't agree. If you get stumped, Dr. Hayes provides a clue toward the end of his article in this year's January issue.

CONCLUSION

I'd like to assure all beginning computer mavens that it takes a lot longer to explain this program than to write it. For the reader with neither a computer nor a calculator, it would take forever to "run" such a program with just a pencil and paper. No doubt, that's one of the reasons why so many studio engineers have cheerfully stayed away from such dreadful tasks.

But, with a reasonable minimum of effort (*and* a computer or calculator), anyone can get more involved with some of the theory behind the practice. And in the process, get a better understanding of what's going on in today's computerized world (both in-studio and out).

Where appropriate, the computer can plot graphs, draw polar patterns, remember your microphone selections, keep track of your tracks, and be a general help around the studio. You can train it to challenge improbable data inputs, and make helpful suggestions. But that's another story. Or rather, several other stories.

A POSTSCRIPT—FIBONACCI AT THE COMPUTER

In the June, 1979 issue of **db**, a feature article by Barry Hufker discussed Fibonacci numbers. Although Fibonacci probably didn't have a personal computer available, here's a little program that will generate the sequence in a matter of seconds. For a little diversion, try changing line 170 to PRINT TAB (30)B/A.

```
100 PRINT "THE FIBONACCI SEQUENCE";
110 PRINT TAB (30) "RATIOS"
120 PRINT
130 A = 1
140 B = A + B
150 PRINT A;
160 PRINT TAB (15)B;
170 PRINT TAB (30)A/B
180 A = A + B
190 X = X + 1
200 IF X = 20 THEN END
210 GOTO 140
```

■

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.

FOR SALE

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 various B&K Sound Level Meters. **B&K Instruments, Inc., 5111 W. 164th St., Cleveland, Ohio 44142.**

IVIE SOUND ANALYZERS, all models in stock—demo models and discounts available—sales and rentals. **Theatre Technology, 37 W. 20th St., New York, NY 10011 (212) 929-5380.**

PROFESSIONAL AUDIO COMPONENTS: AKG mics; Badap 1; Crown; dbx; Delta Lab; Eventide; Frazier; Gauss; GLI; Ivie; Malatchi; MasterRoom; Nagra; Neumann mics; Orban; 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.**

WANTED
RECORDING
EQUIPMENT
OF ALL AGES AND
VARIETIES
microphones, outboard gear, consoles, tape decks, etc.
Dan Alexander
6026 Bernhard
Richmond, Ca. 94805 USA
(415) 232-7933 or (415) 232-7818

AMPEX, SCULLY, OTARI, all major professional audio lines. Top dollar trade-ins. 15 minutes George Washington Bridge. **Professional Audio Video Corporation, 384 Grand St., Paterson, N.J. 07505. (201) 523-3333.**

NEUMANN SM69 fet with NS69i, matrix system, and 100 feet of cable; $1500. Two Ampex 440C electronics $500.00 each. One Ampex PR10 ¼-track stereo $350.00. **L. Cooper, Box 453, Shamokin, PA 17872.**

THE LIBRARY . . . Sound effects recorded in STEREO using Dolby throughout. Over 350 effects on ten discs. $100.00. Write **The Library, P.O. Box 18145, Denver, Colo. 80218.**

REELS AND BOXES 5" and 7" large and small hubs; heavy duty white boxes. **W-M Sales, 1118 Dula Circle, Duncanville, Texas 75116. (214) 296-2773.**

BEST PRICE ON TEAC, Tascam, Ampex, Sennheiser, Allison, Eventide, Sound Workshop, UREI, BGW, Electro-Voice, JBL and more. **Paul Kadair's Home and Commercial Audio, Baton Rouge, Louisiana (504) 924-1006.**

JFET TUBE REPLACEMENTS for first playback stages in most Ampex Professional audio tape recorders/reproducers available from **VIF International, Box 1555, Mountain View, CA 94042. (408) 739-9740.**

AMPEX AND NAGRA TAPE RECORDERS: ART-100, ATR-700 stocked. Laboratory alignment, calibration, and quality assurance. Washington's most experienced professional audio dealer. **Techniarts, 8555 Fenton Street, Silver Spring, MD 20910. (301) 585-1118.**

FOR SALE: IN CONSOLES: MCI 428 console, 28 in, 24 out impeccable condition, Scully 280 stereo ½-track, all new heads, takes 14-inch reels, Ampex 440B stereo ½-track, all new heads, new power supply. Eventides 1745 digital delay, Omnipressor, Arp Oydessy, Large Buchia Synthesizer in Futurist cabinet, Sequential Circuits Digital Sequencer. Mint condition: Tascam 80-8 w/DX8, 40-4 w/DX4, both with remotes, patch bay and consoles. Revox A-77 stereo ¼-track, portable Uher 4200 2-track w/mic. Mint RMI electric piano, Allison Keypex rack w/power supply, one Klipschorn Cornwall speaker, two vintage Altec 604E speakers in original cabinets, Sony STR-6045 stereo all-purpose receiver/amplifier, Technics SL-1300 turntable, and a Dynaco stereo graphic equalizer. **RPM Sound Studios, 12 East 12th St., New York, NY 10003. (212) 242-2100** anytime.

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.**

MIKES FROM STOCK!
AKG/EV/SONY/SHURE/SENNHEISER
Sound Solutions
DETROIT'S
PRO-AUDIO WAREHOUSE
(313) 739-7020

(continued)

USED STUDER CONSOLE FOR SALE
Model 189-080 Swiss made like a fine watch—a steal at $20,000 complete & in perfect condition.
Steve (212) 765-2005

16 TRACK SCULLY 100 (equipped with Spectra Sonics guts & mod for quick punch), $10,000; 16 x 4 x 16 track APSI Console (mod. with TL072 I.C.s), $5,000. Call **(617) 426-3455** or **(617) 492-8649.**

AMPEX TAPE. Factory fresh, quality inspected. ¼-inch and wide widths. We ship around the world. **Techniarts, 8555 Fenton Street, Silver Spring, MD 20910. (301) 585-1118.**

FAIRCHILD TURNTABLES AVAILABLE! Used equipment, good condition. Fairchild #755, 2 speeds 12" turntable. One #412 single speed 12" turntable. One #750 single speed 16" turntable. Motors for models 440 and 755. For information call or write **Sam Jones, 75 Austin Blvd., Commack, NY 11725. (516) 543-5200.**

AMPEX 351, FULL TRACK, in roller cabinet, mint, best offer. Write: **CAA, Box 50314, Chicago, IL 60650.**

MCI-JH 16-RECORDER, with autolocator, 8-track heads, vari-speed, mint condition, best offer over $12,500.00. 16-channels dbx-157, $2,500.00. Call: **(201) 359-5520.**

AMPEX PR10 TRANSPORTS and Ampex AG500 transports and electronics—mono and stereo. All used. For sale. Call: **Tony—(212) 581-5025.**

TAPCO and Electro-Voice: mixers, equalizers, amps, mics, and raw loudspeakers. Write or call for low mail order prices. **Sonix Co., P.O. Box 58, Indian Head, Md. 20640. (301) 753-6432.**

CROWN QUAD RECORDER, $950.00. Ampex 300 ¼ and ½ inch transports with consoles $400.00 each. 400 half-track with cases $250.00. 351 electronics, $160.00. Magnecord 1028-2 needs heads $200.00. 1028 no electronics $75.00. PT6A, PT6J (2), PT6M $100.00. **ASHLEY (215) 338-1682.**

NEUMANN U 87 mic plus Neumann 2-mic power supply, cable, pop screen, in warranty; $800.00. **(413) 232-7077.**

AMPEX, OTARI & SCULLY recorders in stock for immediate delivery; new and rebuilt. **RCI, 8550 2nd Ave., Silver Spring, MD 20910.** Write for complete product list.

FREE CATALOG & AUDIO APPLICATIONS

CONSOLES
KITS & WIRED
AMPLIFIERS
MIC, EQ, ACN, LINE, TAPE, DISC, POWER
OSCILLATORS
AUDIO, TAPE BIAS
POWER SUPPLIES

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

TASCAM!
FROM DETROIT'S PRO-AUDIO WAREHOUSE
Sound Solutions
(313) 739-7020

FOR SALE: CL&S: (8) BLT Horns $225.00 each; (8) LMFII, $150.00 each; (4) SQ60 w/Pioneer PD80I drivers, $225.00 each; Altec: (6) 944OA amps, $600.00 each; 9860 EQ, $450.00; Ivie IEI0a, $500.00; SR console 24 x 6 patchbay Altec faders I588b preamps, works well, $2,200.00. **Earl (201) 363-9062.**

DBX 142 NOISE REDUCTION. New was $825.00. Used only 5 days. Will sell for only $565.00. New RE-20 microphone was $333.00, sell for $239.00. Send payment to **Track Audio, 33753 9th South. Federal Way, WA 98003.**

12½ in. NAB 0.050 in. ALUMINUM FLANGES. This new item in stock for immediate delivery. For prices, call or write, **RECORDS RESERVE CORP., 56 Harvester Ave., Batavia, N.Y. 14020. (716) 343-2600.**

UREI TIME ALIGNED MONITOR SPEAKERS, a significant advancement in reproduction technology, may be auditioned in our demonstration studios. **Techniarts, 8555 Fenton Street, Silver Spring, MD 20910. (301) 585-1118.**

EMPLOYMENT

24 TRACK RECORDING STUDIO in the Baltimore-D.C. area seeking qualified engineer with years of experience. $20k to qualified party. **Dept. 61, db Magazine, 1120 Old Country Rd., Plainview, NY 11803.**

EXPERIENCED RECORDING ENGINEER, 8-16 track, Must troubleshoot, **TANTUS Studios, 18461 W. McNichols, Detroit, Michigan 48219,** Phone **(313) 533-3910.**

LARGE 24 TRACK Recording Studio, N.Y.C. seeking experienced maintenance engineer; preferably familiar with Neve, Studer, 3M. Send salary requirements and references to **Dept. 72, db Magazine, 1120 Old Country Rd., Plainview, NY 11803.**

SALES MANAGER
Sales manager with marketing responsibilities to handle U.S. market for foreign manufacturer of sound reinforcement and MI products. Located in New York metro area, position responsible for sales to recording studios, MI dealers and pro sound outlets. Send resume in confidence to:
Dept. 71, db Magazine
1120 Old Country Rd.
Plainview, NY 11803

BUSINESS OPPORTUNITIES

FOR LEASE: Denver recording studio. 6,000 square feet; two control rooms . . . "live" chamber. Attractive offices . . . ample parking. Centrally located near downtown. Plus equipment for sale: Audio Designs board . . . *mint*; two ampex, 440 B mono machines; two 3M, M64 2-track machines; assorted speakers, amplifiers, etc. Write or call . . . **Fred Arthur Productions, Ltd., 1218 E. 18th Ave., Denver, CO 80218. (303) 832-2664.**

RECORDING STUDIO: Immediate sale & occupancy. Partially equipped midtown NYC recording studio. Excellent acoustics and location. Wired for video. **(212) 679-5670, (203) 226-4200.**

FOR SALE: PROFESSIONAL 8-track recording studio fully equipped, whole or partnership. Contact **Ace Simpson, 130 S. Laxore, "C", Anaheim, CA 92804 (714) 828-5528.**

WANTED

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

SERVICES

CUTTERHEAD REPAIR SERVICE for all models Westrex, HAECO, Grampian. Modifications done on Westrex. Avoid costly down time; 3-day turnaround upon receipt. Send for free brochure: **International Cutterhead Repair, 194 Kings Ct., Teaneck, N.J. 07666. (201) 837-1289.**

ACOUSTIC CONSULTATION — Specializing in studios, control rooms, discos. Qualified personnel, reasonable rates. Acoustilog, Bruel & Kjaer, HP, Tektronix, Ivie equipment calibrated on premises. Reverberation timer and RTA rentals. **Acoustilog, 19 Mercer Street, New York, NY 10013. (212) 925-1365.**

AMPEX SERVICE COMPANY: Complete factory service and parts for Ampex equipment; professional audio; one-inch helical scan video systems; video closed circuit cameras; instrumentation; consumer audio; professional audio motor and head assembly rebuilding. Service available at **2201 Lunt Ave., Elk Grove Village, IL 60007; 500 Rodier Dr., Glendale, CA 91201; 75 Commerce Way, Hackensack, NJ 07601.**

JBL AND GAUSS SPEAKER WARRANTY CENTER. Full lines stocked. Instant recone service, compression driver diaphrams for immediate shipment. **Newcome Sound, 4684 Indianola Ave., Columbus, Ohio 43214 (614) 268-5605.**

MAGNETIC HEAD relapping—24 hour service. Replacement heads for professional recorders. **IEM, 350 N. Eric Dr., Palatine, IL 60067. (312) 358-4622.**

db People/Places/Happenings

• Joining **Sony Industries'** professional audio division as technical field sales manager, **James Coleman Guthrie, Jr.,** will direct professional applications and field sales for Sony's wireless microphone system, as well as professional and consumer microphones and stereo headphones. Mr. Guthrie was formerly manager of the professional products division at **Paul Seaman Co.,** San Leandro, CA.

• Precipitated by the resignation of **Harro K. Heinz,** who has elected to pursue a business opportunity of his own, **William Krucks,** chairman of the board of **Rauland-Borg Corporation,** Chicago, has assumed the additional post of president of the company. In addition, **Carl Dorwaldt** has been named to the newly appointed position of executive vice president, with responsibility for all sales, marketing and manufacturing activities.

• Incorporating a Harrison 3624 Automated Console interfaced with the Allison 65K Automation System, Studio B, part of **The Automatt** studio complex in San Francisco, is now fully automated. In addition, Studio B has undergone a complete room tuning.

• **Robert E. Harris** has been named manager of manufacturing for the **International Tapetronics Corporation** (ITC), Bloomington, Illinois. Mr. Harris joined ITC in 1978 as a mechanical design engineer.

• In a new expansion move, **Empire Scientific Corporation** has become the exclusive distributor for **EMI** brand blank audio and video cassettes in the U.S. and Canada. In addition to premium cassettes, Empire will also distribute EMI's reel-to-reel and professional tape. The tape, produced at two EMI factories in England and South Wales, will be handled through Empire's existing sales and distribution channels.

• Appointed editor of the *SMPTE Journal,* **David Howell** assumes the responsibility for publishing the *SMPTE Journal* and other SMPTE publications. Mr. Howell has been with the *SMPTE Journal* since 1972—most recently serving as assistant editor. Mr. Howell succeeds **Thomas E. King** who resigned to become editor of *RCA Engineer.*

• Promoted to the position of product manager—microphones and circuitry products at **Shure Brothers Inc., Paul F. Bugielski** will head up the product market planning and management, and technical field sales support for that division. Mr. Bugielski joined Shure in 1976, as a technical coordinator.

• **Robert Kratt,** president of **Audio Tek,** Campbell, CA, recently announced the appointment of **Timothy A. Cole** as their International and Domestic sales representative. Mr. Cole is president of **Magnetic Technology International (MTI) Corporation,** Montclair, NJ. Previously, Mr. Cole was with **Audiomatic,** for eight years.

• In a marketing and sales restructuring effort, three executive-level sales appointments have been announced by **Superscope, Inc. Norm Skolnik** has been named assistant vice president, sales, for the Western region; **Bill Steffen** has been named assistant vice president, sales, for the Central region; and **Hal Loman** holds the same position for the Eastern region. In addition, three newly appointed regional sales managers, **Joe Sanchez** (Western); **Dick Isola** (Central); and **Thomas O'Mara** (Eastern), will report to each of the three assistant vice presidents. Other appointments include: **Fred Dellar** to national product training manager for all lines; and **Bud Gehrke** to national sales manager-distributor, military and premium markets.

SUBSCRIPTION RATE CHANGE

Effective with the September, 1979 issue of **db—The Sound Engineering Magazine** there will be a change in the subscription price. The new rates will be:

Domestic	
1 year	— $ 9.00
2 years	— $16.00
3 years	— $22.00
Canadian	
1 year	— $10.00
2 years	— $17.00
3 years	— $23.00
Foreign	
1 year	— $18.00
2 years	— $32.00
3 years	— $40.00

• Upon the resignation of **Sterling B. Sander** as president of **James B. Lansing Sound, Inc., Herbert Paige** has been appointed acting president of JBL, and will continue to serve as president, U.S. High Fidelity Group, for **Harman International Industries.** In addition, **Steve Rand** was named vice president for domestic sales and **Bernard Girod** appointed to the newly created position of executive vice president for finance at JBL. Previously, Mr. Rand held a variety of key marketing posts at **Marantz/Superscope,** where he most recently served as assistant vice president, audio markets.

• **QUAD-EIGHT** of North Hollywood has appointed **Don Hudson** as their new vice-president of operations. With sixteen years of industrial experience at the executive and managerial level under his belt, Mr. Hudson previously served as director of operational planning for **Altec Lansing Corporation.**

• **UMC Electronics Co.,** of North Haven, Connecticut, has appointed **David M. Kelly** to the post of sales and marketing manager for the Broadcast Products Division. Previously, Mr. Kelly was an associate with the **Chapman Company** of Atlanta, Georgia, a nationwide broker of radio and tv stations.

• A grant of $1 million has been awarded to **New York University** by **Warner Communications Inc.,** toward the creation of a modern center for communications studies for the University's School of the Arts. The new facility, to be named the **Warner Communications Center,** will become a permanent home for the School's Institute of Film and Television—accommodating 1,250 students. A major component of the center will be a cinematheque theater, accesible to the public, where film classics and works by Institute students can be screened. Other facilities will include three television studios, two shooting studios, two mixing/dubbing/recording studios, an acting studio, nine screening rooms, three theaters, a sound stage, forty editing rooms for film and videotape and a complete complement for the study of still photography.

FOR THE SMALL STUDIO OWNER WITH BIG IDEAS.

If you're a small studio owner, you may have a problem: your ideas are far beyond your present equipment.

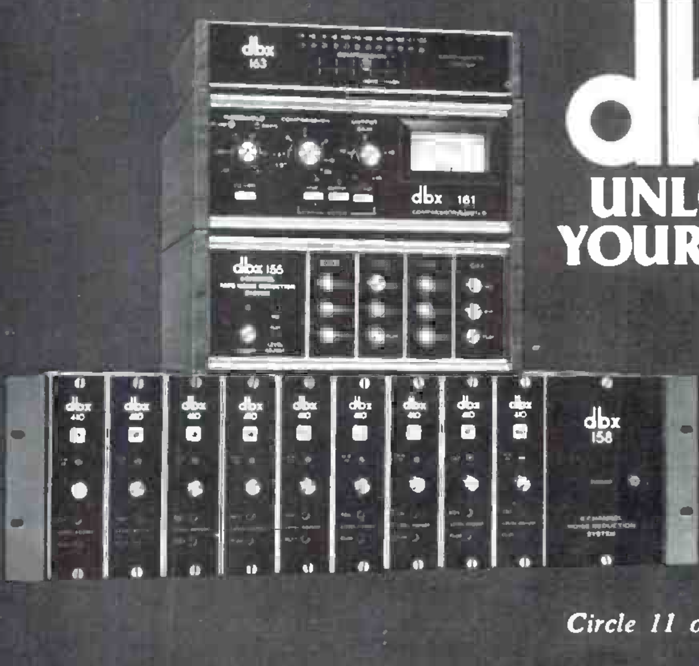
Maybe you're an engineer, dreaming of an automated 24-track studio. Maybe you're a producer, searching for "the next big thing." Maybe you're an artist, trying to land a record contract. What you need is something that will get you from where you are to where you'd like to be.

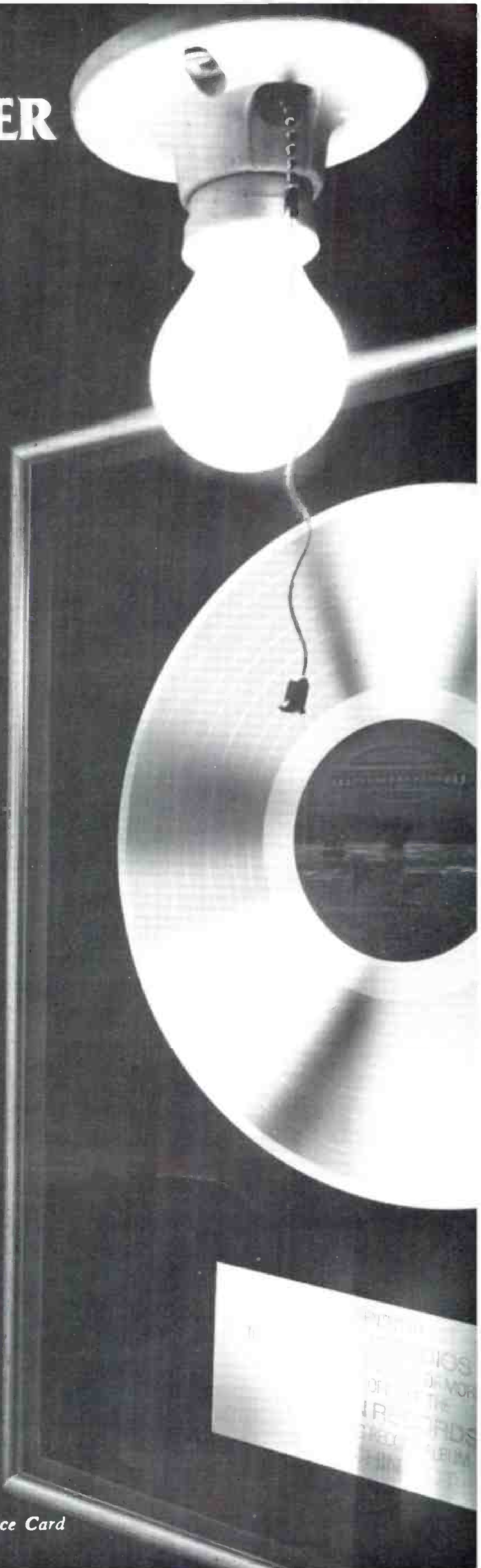
Sound impossible? Not to us. At dbx, we're committed to make professional recording technology available to anyone with the determination to make use of it. We make a line of rack-mountable signal-processing devices designed and priced especially for the small studio.

Our tape noise reduction systems, the 155 (4-channel, switchable), the RM-155 (8-channel, switchable) and the 158 (8-channel, simultaneous), all offer the same 30 dB noise reduction and 10 dB headroom improvement as our state-of-the-art units and are fully compatible with them. They enable you to make master quality tapes, instead of demos, on your present equipment.

Our 161 and 163 compressor/limiters feature true RMS signal detection, which closely resembles the response of the human ear, and feed forward gain reduction, which allow for infinite compression capability. The 163 employs "Over Easy" compression, the most natural-sounding you've ever heard, and its "one knob" operation is the simplest around.

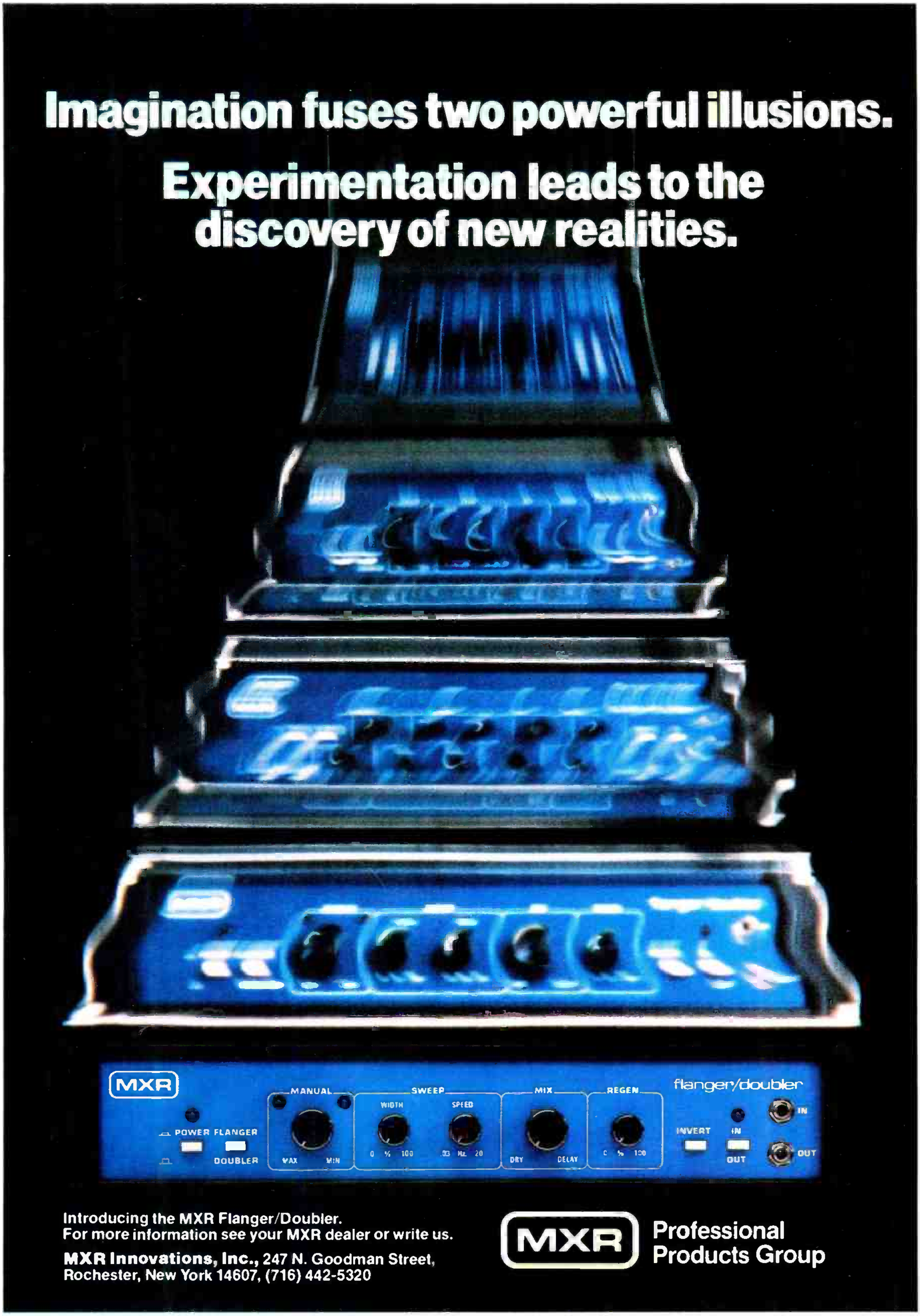
We can't guarantee our products will make you a star. But if you've got the talent, they'll take you as far as you want to go. dbx, Incorporated, 71 Chapel Street, Newton, MA 02195 617-964-3210.





dbx
UNLOCK YOUR EARS

Circle 11 on Reader Service Card



Circle 12 on Reader Service Card