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THE SOUND ENGINEERING MAGAZINE

APRIL 1969 75c

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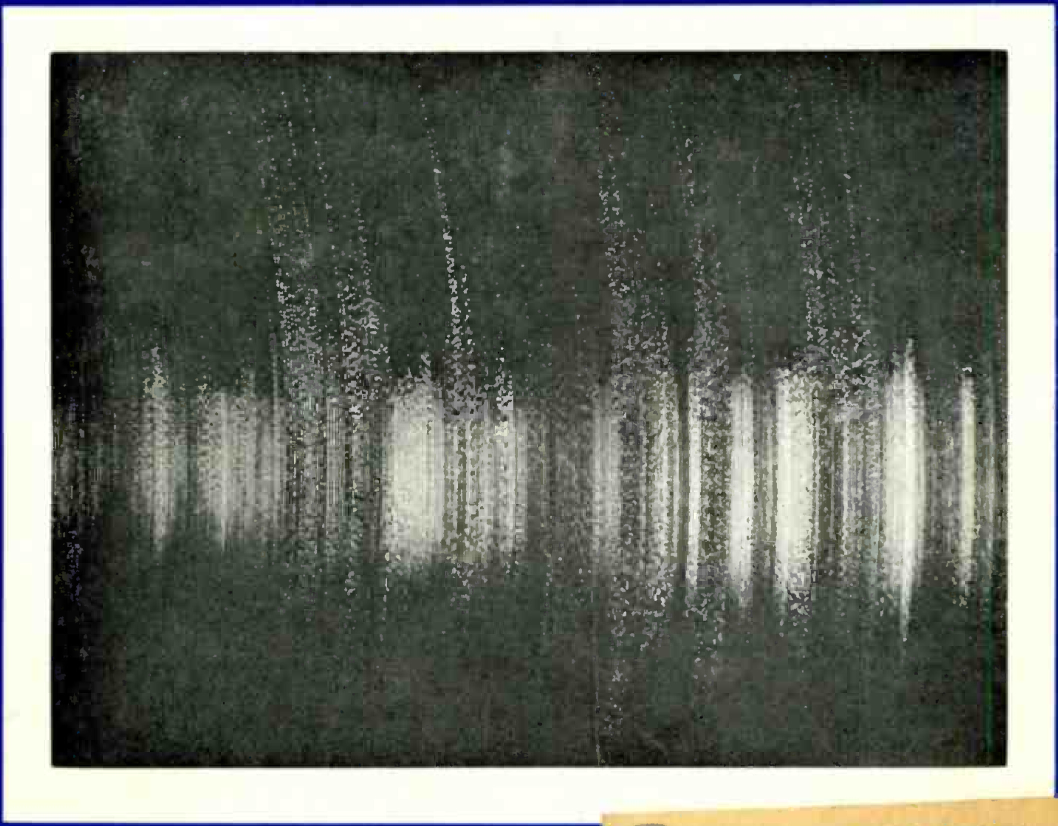

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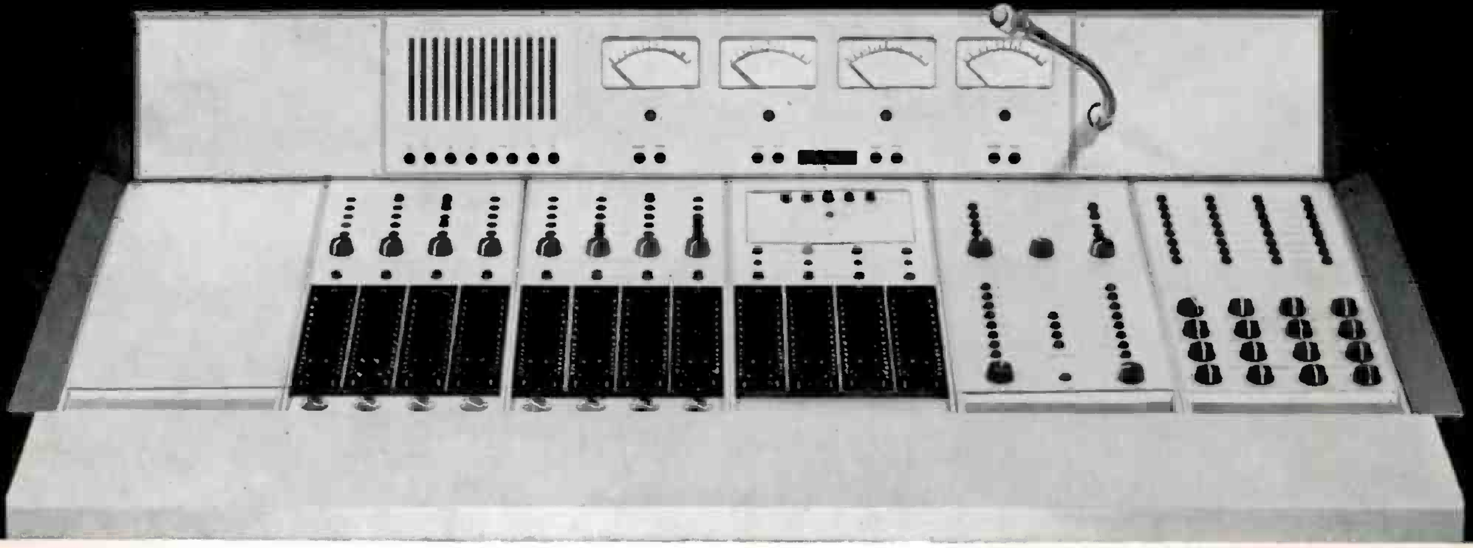

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Coming Next Month

• A highlighted enlargement of stereo record grooves. Test records make possible the perfection of what is engraved on the record. See TEST RECORDS by Arnold Schwartz (who also is author of the monthly FEEDBACK LOOP) beginning on page 21.

About the Cover

• A number of writers that have appeared here before have new articles upcoming. . . Robert C. Ehle has a new paper in the series on synthesizers. This one covers the circuitry of a power supply, a preamp, and various controls not covered in earlier installments.

Walter Jung. whose power supply article is in this issue has prepared a manuscript entitled A COMMON BASS MIXER/FILTER APMLFIEIR. His one-transistor amplifier is suitable for driving a common bass amplifier for a stereo monitoring system.

Edward Tatnall Canby is coming back with IMPLICATIONS OF THE LOW NOISE BACKGROUND which discusses areas other than the purely technical aspects of recent noise-reduction breakthroughs.

Next month we will have a picture gallery of the NAB convention recently held in Washington, D.C.

And there will be our regular columnists. George Alexandrovich, Norman H. Crowhurst, Arnold Schwartz, and Martin Dickstein. Coming in **db**, The Sound Engineering Magazine.

db
THE SOUND ENGINEERING MAGAZINE

APRIL 1969 • Volume 3, Number 4

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FEATURE ARTICLES

MONTHLY DEPARTMENTS

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Letters

The Editor:

Recent letters of comment, coupled with Ed Canby's well-written article on t.v. audio, have prompted this letter.

At this moment, the one best way to provide better t.v. audio — and in stereo — is to have the audio portion of a t.v. program transmitted on f.m. simultaneously. I believe CBS did do this within the past year. And just recently, WQXR and WNDT simulcast a concert by the Washington National Symphony. (It wasn't in stereo, but it was one hell of a lot better than listening on the tiny, tinny t.v. speaker).

In an age where people are supposedly becoming more and more sophisticated as far as things like sound are concerned, it is incredible that t.v. viewers will put up with the poor quality sound available from most sets today. Only a few manufacturers even offer the option of a proper audio take-off to feed one's high-fidelity equipment.

But the f.m. outlets (especially those of the major networks, who have been unable to put their f.m. facilities to good use, it seems) are there for the asking. And no sets must be modified.

The WNDT/WQXR effort on February 12th was unfortunate in only one aspect: it was not publicized. I only happened to notice the duplication of program material in the *New York Times*, and simply turned on both sets. I'm only sorry more people couldn't have enjoyed the program this way, but there was no advance notice, and only the briefest of announcements at the start of the broadcast.

We would be more than willing to carry the audio portion of worthwhile t.v. programs, especially live concerts. And, since many of our area's listeners cannot get clear f.m. from New York without outdoor antennas, I believe we could perform a service and set an industry example at the same time.

I'd appreciate comments from any of your readers about this concept.

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we're heading West in April.

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The Audio Engineer's Handbook

GEORGE ALEXANDROVICH

MULTI-CHANNEL RECORDING-WHY?

• Last month, I discussed the positive aspects of multi-track recording including the control it gives the studio operator and producer, and the potential advantage for improved s/n.

With all the advantages of the new techniques, there are a few *buts*. Let us start reviewing this side of the coin with the tape itself. The tape used is at least half-an-inch wide, most of the time it is 1 inch and for sixteen or twenty-four tracks, it is 2-inches wide. Forget about the editing splicer. Most of the time all you will splice is the leader tape. The wider the tape, the easier it stretches and deforms as it is being pulled over the recording heads, tape guides, and capstan. Wide tapes are noted to exhibit stretching of the outer edges, causing poor tape-to-head contact of the outer channels. Also, stretch of the tape causes phase shift at the higher frequencies. When machines and tape heads are new, these effects are hardly noticeable. But uneven wear of the tape-guiding surfaces will accentuate the problem. In video-tape-recorder transports using 2-inch tape there are vacuum ports to keep the tape snug against the guiding track in order to minimize tape distortion and provide improved tape-head contact. Using narrower tape lessens the problem but naturally tracks also become narrower. So recording level drops along with frequency response, while interchannel leakage increases along with the noise. In order to maintain the same recording standards, the width of the *track* has to remain the same. However, a variety of new developments will tend to permit the use of narrower tracks with the same results. These are: better tape (chromium dioxide), focused-gap recording using r.f. bias, and noise-reduction (Dolby system). But they are effective only to a point. With requests for more and more channels, which have reached epidemic proportions, no invention yet will permit twenty-four channels on ½-inch tape with acceptable results.

Well, we have to live with wide tape, and wide tape stretches. This is no reflection on the tape manufacturer, he does his best to keep the quality of his product to the best industry standards. In the era of single-track or even stereo one-shot recording, it was a *sin* to run the tape twice—that is, erasing a bad take and recording anew over the same piece of tape. The tape didn't run more than a few times past the tape heads including the remix or editing session.

Take a look at what happens to the tape now. We have sixteen channels. Every time we record a track we run the tape past two tape guides, idlers, tape heads, capstan, and the tape is pulling even (hopefully) with the take-up reel. Then there is fast rewind. Bad take. Rewind again. Erase the track and re-record again. How many takes does it require on the average to have one successful take? One or two. Let's not kid ourselves. Before you know it, this wide tape has traveled at least fifty times back and forth.

Now comes the remix session. You first want to hear all the tracks as they were recorded. You study them. The producer starts experimenting with controls. How many times more is the tape shuttled back and forth again — five times, ten, or twenty? What is the total wear on the tape?

Would anyone ten years ago use tape that was re-recorded and played seventy times as a *master*? Can recording tape be reused so many times without deterioration or has the myth about virgin tape disappeared? If the tape doesn't stretch or wear out, then we have been sold a lot of tape for no reason. If it is wearing out, then multi-channel record-

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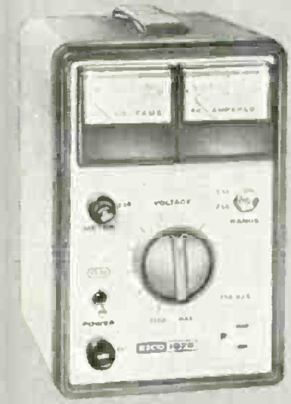

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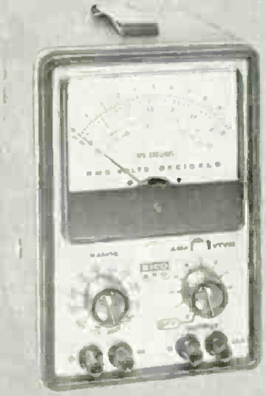

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ing is bringing serious problems into recording.

(And this does not even consider the possible effects on quality due to poor erasure, partial erasure of pre-recorded tracks by the adjacent recording fields, or misalignment.

It is possible that we are trading in the quality of the recording for the convenience of conducting sessions and extra time charges for re-recording and mixing. But we are also trading on the artistic value of the performance. Perhaps, though, producers no longer think that the successful performance of a musical group depends on gross enthusiasm transmitted from one artist to another finding its reflection in the quality of the performance.

The way I have characterized multi-track recording is somewhat exaggerated to be sure, but not so far fetched. I believe that this new tool should not deprive us of principles we have tried to adhere to; instead it should aid us in improving our ways to fulfill them. We should not use multi-track facilities to make remix session a more important event than the original take — stripping away the art of mixing. Let us also not use *musicians* as *musical synthesizers.*

Let us use all this flexibility with discretion, remembering that no matter how many tracks we pre-record they all wind up as a two-track mix or mono. Years ago, when the technology of reproducing from disc recording was at its lowest point, recordings were made directly on wax, live. What a waste of almost perfect recordings. If only we could do it efficiently now.

At times I like to draw parallels to put my thoughts across more clearly. Do you see my point if I compare multichannel recording with the attempts of a photographer to photograph a view using separate exposures of different parts of the subject, and trying to bring the details of each exposure into perfect focus. Then after all parts of the picture are completed, he tries to put them together like a jig-saw puzzle. It would take an expert to do the job right. But when the job is finished and the picture completed, would it be the same?

What is your opinion?

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A limited number of back issues of db are available to interested readers who may have missed or misplaced earlier issues. When ordering please indicate date of issue desired and enclose 75c for each copy.

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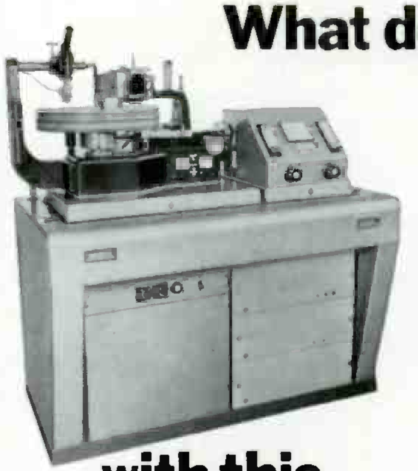
What do Neumann microphones have in common



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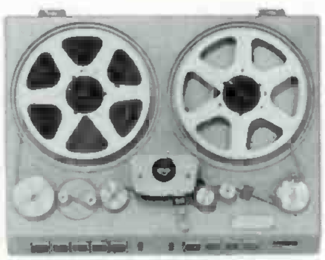

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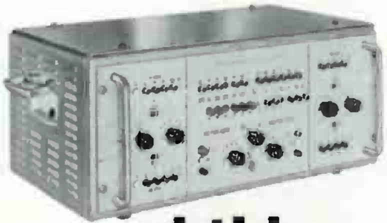

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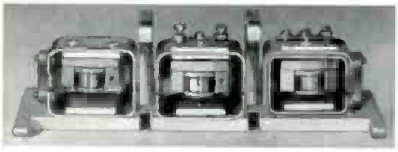

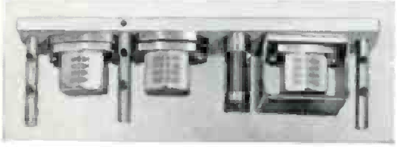

The Feedback Loop

ARNOLD SCHWARTZ

• "Modern man can no longer escape from noise. He is surrounded by a multitude of noise sources in his home, office, and place of work which in turn are under the constant bombardment of noise from aircraft, traffic, and scores of other outdoor noises. Indeed, the roar of the jet plane, expressway traffic and power mower follows him to the countryside and seashore and invades the solitude and privacy of these secluded vacation retreats."

So states a recent report of the Federal Council for Science and Technology in describing the environmental pollution problem of noise. Not all the harmful effects of noise are known. Recent investigations have discovered that exposure to high noise levels not only causes hearing loss, which is a relatively well-known fact, but other physiological and psychological damage as well. The Federal Council report states that growing numbers of researchers fear that the dangerous and hazardous effects of intense noise on human health are being seriously underestimated. There are today six million, and possibly more, industrial employees who work under conditions unsafe for hearing.

It is not always clear which sounds are objectionable. A pleasant and welcome sound to one individual can be noise to another. I recently read that a South Carolina town has a law prohibiting the practice of public gargling. To the performer the gargling sound is not unpleasant at all; the same cannot be said for other listeners in the vicinity. More serious complaints are expressed by home owners in residential neighborhoods adjacent to a jet airport, or to a neighbor who uses a power lawn mower early Sunday morning. Noise in the sense we are talking about is a sound that is either a hazard to our hearing or is objectionable for other reasons. It's meaning is not confined to the definition of random noise; that is, sound without definite pitch with energy distribution over a wide range of frequencies.

To those of us in the audio field, noise control has significance beyond that of the concerned citizen. For years we have been struggling, in the face of rising noise levels, to keep the ambient noise at an acceptably low level in broadcasting and recording studios. In a broader sense, noise measurement techniques are part of the audio field.

Some of the most difficult problems of noise control occur in and around the jet airport. I had an opportunity to learn about this problem at first hand on a recent visit to LaGuardia Airport in New York City. It turned out to be a very interesting visit, and I learned much about the problem, as well as current methods of noise measurement and control. Before describing my visit I think it would be worthwhile to review some of the basic concepts of acoustic measurements.

Sound Pressure is the variation of atmospheric pressure. The frequency of this variation is called *pitch*. The human ear, in a young person with good hearing, can detect frequencies from about 20 to 20,000 Hz. Sound pressure is measured in *microbars*. A *microbar* is defined as the pressure of one dyne (about 1/1000 of the weight of one gram) per square centimeter. Through experimentation it has been determined that, on the average, a sound pressure of 0.0002 microbar is the lowest sound pressure that a person with excellent hearing can detect. This is called the *threshold of audibility*. Engineers find numbers like this cumbersome to use and so sound pressures are measured in dB. *Sound pressure level* (s.p.l.) is a quantity which expresses sound pressure in dB relative to the threshold of audibility. Sound pressure level measurements are analogous to voltage measure-

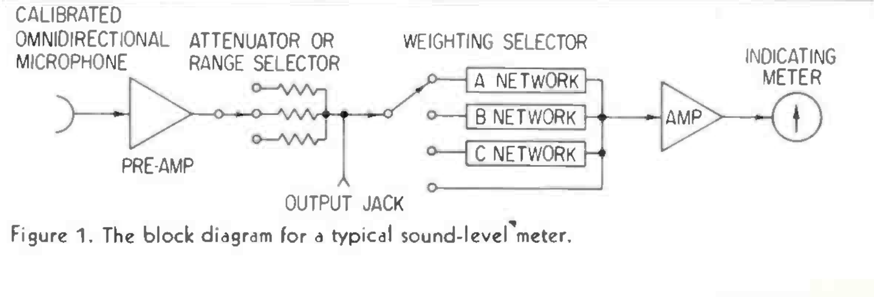

Figure 1. The block diagram for a typical sound-level meter.

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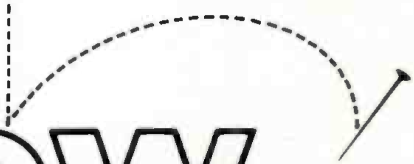

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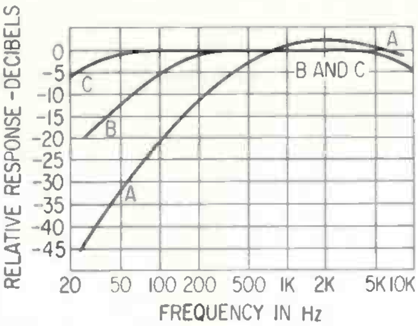

Figure 2. The electrical frequency response for the three ASA standard weighting characteristics.

ments using dB, and the SPL is determined relative to the threshold of audibility of 0.0002 microbar by the formula

$$SPL = 20 \log \frac{P}{0.0002}$$

where P is the r.m.s. sound pressure in microbars.

The s.p.l. of normal room conversation is about 70 dB. At approximately 120 dB sound will begin to produce a tickling sensation. This is called the *threshold of feeling.* At levels of 140 and greater this sensation becomes painful, and is called the *threshold of pain.*

S.p.l. expressed in dB can be handled mathematically in the identical fashion to voltage measurements. If the s.p.l. in a room is 80 dB and it is transmitted through a wall having an attenuation of 30 dB then the s.p.l. in the adjacent room is 50 dB. When adding the effects of two different sounds the dB values cannot be added directly. For example, two different sound sources at 95 dB when combined are equal to an s.p.l. of 98 dB (twice the power). Tables and charts are available which simplify the addition of sound sources.

Pure tones such as an oscillator fed to an amplifier and played over a loud speaker are sinusoidal. Musical instruments are complex waves and their energy is contained in a fundamental tone and numerous harmonics. Sounds from machinery, traffic, and air-conditioning ducts have random frequency and amplitude components, and the energy is distributed over a wide range of frequencies.

The basic instrument of sound measurement is the sound-level meter which shows the elements of acoustic measurement techniques. As shown in the block diagram of FIGURE 1, it consists of a calibrated omnidirectional microphone, pre-amplifier, calibrated attenuator, weighting networks, amplifier, and indicating meter. The sound is converted into electrical energy by the microphone, and then amplified by the pre-amplifier. The accurately calibrated attenuator acts as a range switch. Weighting networks are introduced and finally the signal is fed to an amplifier and indicating meter. Because of the characteristics of the human ear apparent loudness depends upon frequency, and the intensity of the sound. The weighting networks modify the frequency response to approximate this characteristic so that the indicating meter will be more closely correlated to subjective loudness. At lower s.p.l. the ear is less sensitive to low and high frequencies than it is at higher levels. FIGURE 2 shows the A, B, and C weighting network curves. A network, with the greatest low and high frequency attenuation, is used at low s.p.l. B network, with intermediate attenuation in these regions, is used for intermediate levels. The flattest network, C, is used at higher s.p.l. Interestingly enough, we find that the ear characteristics and other psychoacoustic phenomena often introduce problems in acoustic measurements and in the evaluation of the results.

A photograph of a typical sound-level meter is shown in FIGURE 3. The indicating meter is calibrated in dB relative to the hearing threshold. When weighting networks are used we do not speak of *sound pressure level* but rather of *sound level.* The amplified microphone signal is available at an output jack. Often the s.p.l. reading does not give us enough information. We may be looking for the noise source that is leaking into a studio but is difficult to locate. Additional clues may be found by subjecting the signal to closer analysis. This is accomplished by feeding the signal from the sound-level meter output jack to a wave analyzer, filter, or oscilloscope where its frequency components may be identified. A variety of other techniques are also used in the investigation of noise.

In next month's FEEDBACK LOOP, armed with this information on acoustic measurements, we will take a trip to one of New York's major airports to see how the problem of jet noise is handled.

Figure 3. A precision sound-level meter. Photo courtesy of General Radio Corporation.

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Theory and Practice

NORMAN H. CROWHURST

• Speaker matching seems like a simple and straightforward enough topic: just connect the unit to the appropriate impedance tapping on the amplifier, and you're in business. But it isn't quite that simple. It's often been written about — I've lost count of how many times I've covered the subject, and I've seen others' articles on the subject, too. But still there are gaps.

As the usual explanation points out, "it would be all right if loudspeakers had a nice, uniform resistive impedance at all frequencies." And most of the inconsistencies arise because it doesn't, that's true. So we could point out that a dynamic speaker has an impedance curve of which FIGURE 1 is a typical sample, and let it go at that, hoping everyone could now figure it out for themselves.

But when you buy or otherwise acquire a speaker, it doesn't come with a curve like FIGURE 1 attached to it. It comes with a physical specification, which tells you how big the cone is, etc., and an electrical specification, which tells you its impedance and its power-handling capacity. And when the impedance specification says 4, 8 or 16 ohms, as the case may be, how does that relate to its impedance curve, in a form like FIGURE 1?

We have no way of knowing. So having read a nice explanatory article that tells us how to know what we're doing in speaker matching, we forget it

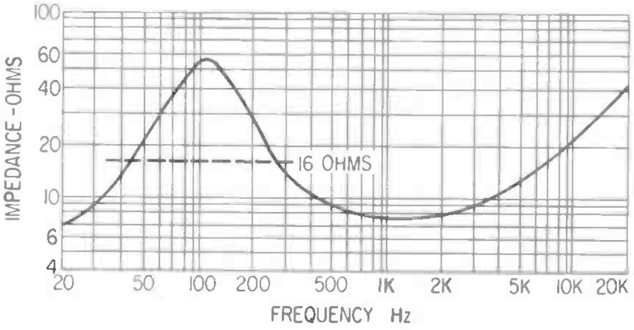
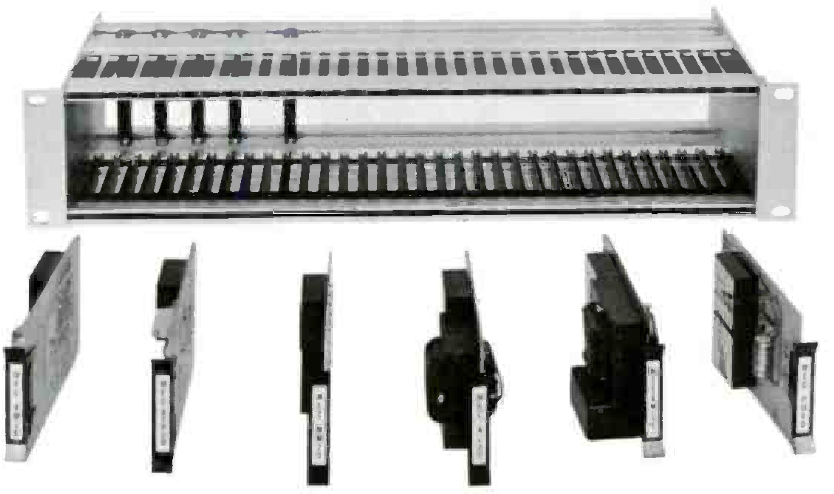


Figure 1. A Typical loudspeaker impedance curve.



this rek-o-kut b-12 gh turntable is basically unchanged for nearly 10 years

and it works, and works, and works and works and works.....

Take a look through control and audition rooms of the stations in your community and count the number of Rek-O-Kut turntables that keep going and going and going. Minimum maintenance, practically no repair. Faithful, reliable sound. Year after year after year. Ask those station engineers how long they've had Rek-O-Kut installed. You'll find some of those turntables have been around a long time.

Rek-O-Kut turntables are built to take it. They are simple in design and operation, strong in construction. If you have a Rek-O-Kut now, we'd hardly be able to sell you a replacement. But we'd like to sell you another!

specifications:

SPEEDS: 33⅓, 45, 78 rpm. NOISE LEVEL: —59db below 5 cm/sec average recorded level. MOTOR: custom-built computer type heavy-duty hysteresis synchronous motor. 45 RPM HUB: instantaneously removable by hand. PILOT LIGHT: neon light acts as an "on/off" indicator. FINISH: grey and aluminum. DECK DIMENSIONS: 14 x 15¹⁵⁄₁₆". Minimum Dimensions: (for cabinet installation) 17¾" w. x 16" d. x 3" above deck x 6¼" below. PRICE: B-12 GH Turntable $124.95. S-320 Tonearm $44.95. Optional BH Base for audition room $18.95.

rek-o-kut turntables by KOSS

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all — because there's not much choice — and connect the speaker impedance to an amplifier impedance that agrees with it, and hope for the best. In short, because it involves some effort to do otherwise, we take the manufacturer's word for the speaker's impedance. That's right, we've all done it.

As a practical matter, if you're anything like me, you've rationalized that mismatch isn't too important provided it's small — say not more than a 2:1 ratio, either way; but larger mismatches can be disastrous. But even at that, we are left with some inconsistencies.

What does a speaker's power rating mean? According to accepted standards, it means that the speaker will handle a voltage at all frequencies that would represent the rated power, if the impedance were a resistance of the nominal impedance value. Thus, if a speaker is rated at 10 watts, with 16-ohms impedance, the first step is to find what voltage represents 10 watts in 16 ohms.

The formula is $V = \sqrt{WR} = \sqrt{10 \times 16} = \sqrt{160} = 12.6V$. So the speaker should handle 12.6V r.m.s. at all frequencies within the band for which it is rated, without distortion, buzzes, rattles, etc. That's an ideal interpretation, and any unit so rated should test out. But not too many people take the trouble to make the test.

Ten watts at a single frequency is a lot of sound, unless the speaker is extremely inefficient. Manufacturers know this, and so they may or may not be too fussy in applying this test. In any event, who's going to listen to a speaker that way? Nobody!

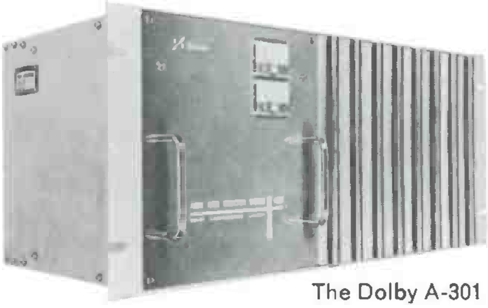
Practical 10-watt signals are the kind of output that a 10-watt amplifier will deliver on program. Neglecting any difference between sustained power output and music power output ratings, *i.e.* assuming the two output ratings are identical, this means that maximum power is a program signal with a peak power of 20 watts, or 17.9V across 16 ohms.

This is the same peak voltage as would occur with a single sinusoidal frequency of 10-watt rating, with an r.m.s. voltage of 12.6V. And across a resistance of 16 ohms, the peak power would be identical. But across a complex impedance, such as a loudspeaker presents, the situation is a little different, as it is also for the amplifier.

This may not be such an easy, or scientifically determinable test, as sweeping a single tone through the frequency band at maximum power. But it's more representative of working conditions. And a lot of systems that would never pass the sweep frequency at maximum power test will pass a test using full output power on program, with a good representative variety of program.

On the amplifier, the situation can perhaps be explained a little more definitely than with the speaker's imped-

"We depend on the Dolby System for noise-free, low distortion classical tape masters," says Israel Horowitz, Director of Classical Artists and Repertoire and W. L. Barneke, Executive Engineer of Decca Records, New York.



The Dolby A-301

"The noise reduction qualities of the Dolby System are well-known", says Mr. Barneke, "but equally important is that Dolby processed tapes have a cleanness and lack of distortion that greatly enhances the realism of our classical productions."

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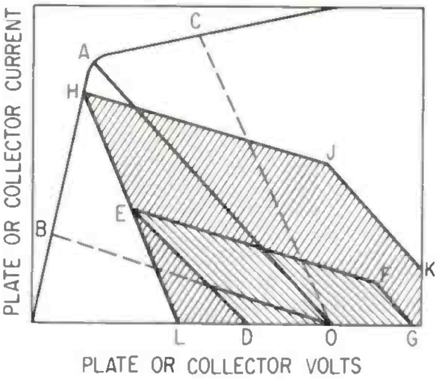


Figure 2. Applying a composite load to output transistor or tube characteristics (see the text).

ance. FIGURE 2 represents the area of some plate or collector characteristics for an output stage of class-B type. The curve starting from bottom left and going up through points B, H, A, C to the top, is the maximum drive line, for the tube or transistor (the curve is more like a transistor's, but not too unlike a pentode tube).

The optimum load line, for this half of a class-B output, is OA. This is the load that a resistance load of design value, connected to the output, would present to this tube or transistor. As a single, resistive impedance, it may deviate between something like OB, which represents a higher impedance, and something like OC, which represents a lower impedance.

Matching is the process of making the actual impedance of the speaker, or whatever the power is used to drive, "look like" the load line OA in FIGURE 2. The question comes, what impedance on an impedance curve like FIGURE 1 should be the one that looks like OA?

Because amplifiers are designed essentially as constant-voltage output devices — that is, the voltage output for a given output is essentially fixed — the output current depends on the impedance. The lower the impedance, the more the current. So the standard that has been adopted for rating loudspeaker impedance is that it should be the lowest, or close to the lowest, value on the curve.

On this basis, the impedance of the speaker whose curve is shown in FIGURE 1 would be 8 ohms. Most modern speakers adhere to this, although it's a good idea to check a speaker out, to be sure. Even some time after the standard was established, many manufacturers were following another practice: naming the speaker impedance after an average value, which in this example might be 16 ohms.

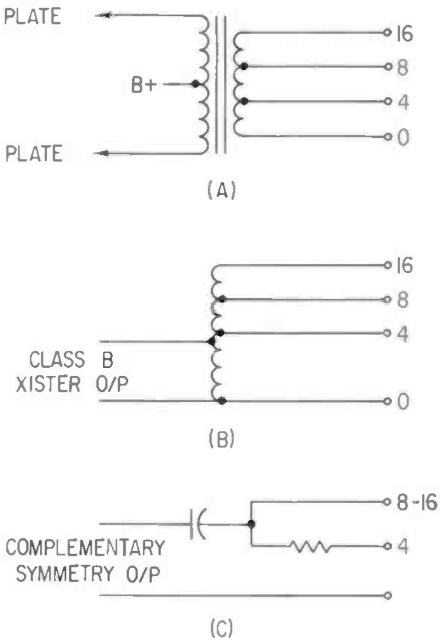
In the latter case, the impedance may deviate on either side of its nominal value. If the speaker is fed with a single sine-wave frequency that is swept through the frequency range, the load line, approximated as resistive, may then shift between OB (which would be its impedance at about 110 Hz) and OC (which would be its impedance at about 1,000 Hz).

At OB, 110 Hz, the speaker is more sensitive, because of its resonance, and it gets slightly more voltage than the load line OA represents (measured horizontally along the voltage scale). At OC, the speaker is less sensitive, and the voltage swing is reduced to about half, without appreciable increase in current swing (measured vertically on FIGURE 2).

So by this test, loading the amplifier with such a speaker will reduce the power available without distortion. But on a direct comparison with a speaker rated according to the standard, this one may appear to deliver more power, relatively distortion free. The constructions on FIGURE 2 show why.

We have assumed that the peak power is made up of three representative frequencies. First a note at about 110 Hz makes the part of the load line OB drawn in solid line (not the dashed part) effective. The other half of all these load lines will be carried by the other tube or transistor as we are looking at a class-B output.

Then another frequency at about 250 Hz produces an added load line at an angle parallel to OA. This opens out the solid part of OB to fill an area bounded by DEFG, and shaded with lines parallel with OA. Finally, the third frequency, in the region of 1000 Hz, further opens out the loading area along lines parallel with OC, to fill the boundary marked



(A)

(B)

(C)

Figure 3. Different methods of providing output matching.

Because accuracy of reproduction is essential, AR-3a speaker systems are used by Connoisseur Society.

For their Vienna recording sessions with internationally distinguished Czech pianist Ivan Moravec, Connoisseur Society brought AR-3a speaker systems from their New York facility. Earlier recordings by Moravec on Connoisseur Society records have received awards for outstanding technical and musical excellence. The newest release in the series is record CS 2010, piano music of Debussy and Ravel.

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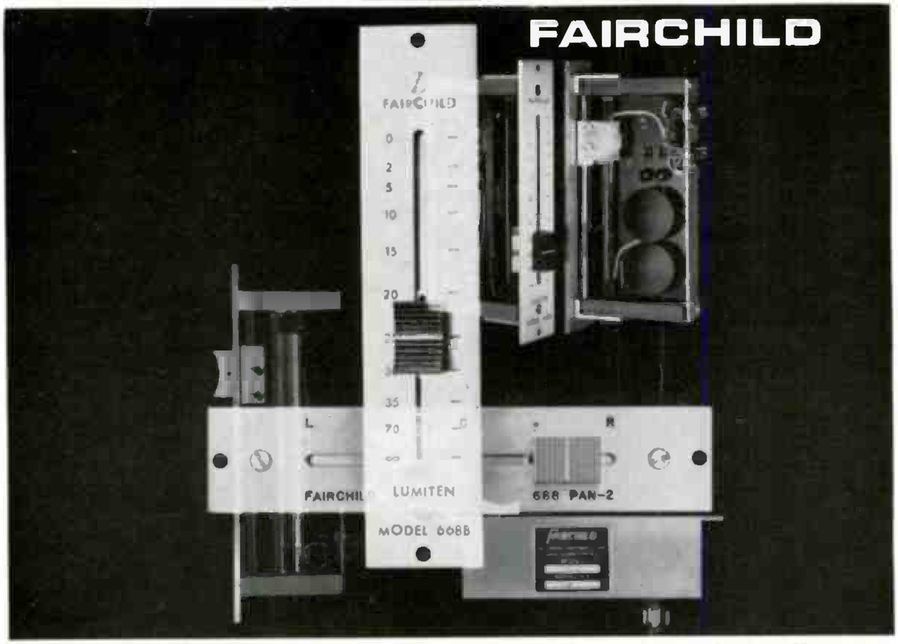

out as LEHJK (and back by completing the area in the curves for the other tube or transistor).

Altogether, the area occupied by this composite loading effect, is not much different from a full-size ellipse along a major axis represented by OA (strictly this is a half axis, because we are examining class-B operation). So the total power delivered comes close to being the maximum the amplifier will deliver, when the parts of the waveform at different frequencies are put together.

If the nominal impedance is made the lowest, or near the lowest measured impedance, then OA will be the slope of the steepest component, instead of OC. Obviously the amplifier will deliver much less power to this loudspeaker on a composite signal, although on a single swept sine-wave the power is seriously limited with the first speaker, except in the region of 250 Hz, where it matches.

FIGURE 3 shows different ways of achieving matching, in different amplifiers. At A is the time-honored output transformer. At B, the same idea is applied, but with an autoformer, for transistorized amplifiers. And at C is the method used in many transistorized amplifiers that have no output transformer: a resistance is used to pad out the load when a lower speaker impedance is used, largely to protect the transistors from excessive current.

With the traditional circuits shown in A and B, using a different tap often doesn't seem to make very much difference, either to the sensitivity (loudness for a given volume setting) or to the maximum power available before distortion shows. Sometimes it does make an apparent difference. This depends on whether the change is straddling optimum condition, as our discussion of FIGURE 2 did, or whether it is working altogether further from a true match, for example when a 16-ohm speaker is connected to a 4-ohm tap.

In the arrangement shown at C, using the 4-ohm tap will always reduce both sensitivity and apparent output power. But it may be necessary to protect your output transistors against being blown unnecessarily. And in this kind of amplifier, the output transistors are usually the most expensive components in the whole thing. So you'd better do as you're told!

MOVING?

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DEPARTMENT OF AMPLIFICATION

A number of sharp-eyed readers caught what our copyreaders missed in Ronald Pesha's **Electronic Telephone Patch** story. The drawing accompanying the story, which appeared in the January issue on page 22, contained two errors which are explained in the correction shown in FIGURE 1. The area within the dotted ellipse is now correct both as to the inclusion of the switch and capacitor in the telephone-line output.

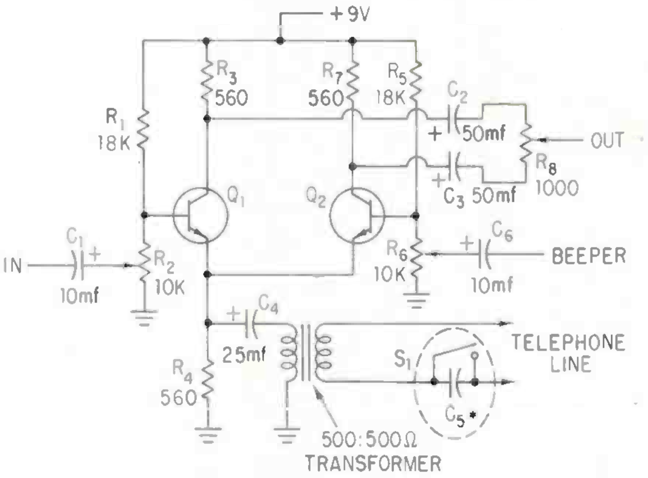

Figure 1. This is the correct schematic that should have appeared in January on page 22.* C5 should be at least 3 mFd non-electrolytic, 200V.

If it is desired to operate the circuit without connection to a beeper, Q_2 should have its base go through a 'lytic of approximately 1 mFd value to ground. Mr. Pesha tells us that this should *not* be done unless no beeper connection is made.

There have been some field reports of distortion and difficulty in obtaining a good null at the output of the unit. Unless the two transistors are almost identical it becomes impossible to achieve linear operation from each. This is because the two transistors are coupled for d.c. by the common emitter resistor R_4 in FIGURE 1. By using separate emitter resistors as shown in FIGURE 2, matching becomes much less critical. In this way the emitter resistors are still coupled for a.c.

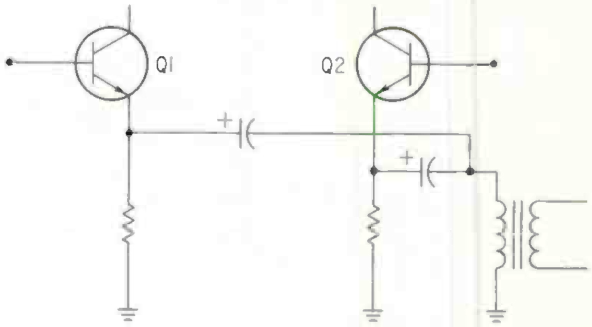

Figure 2. This alternate emitter configuration for the circuit in Figure 1 makes matching of the two transistors far less critical.

Editorial

IT'S THAT TIME of the year again for shows. We've just come back from the NAB Convention. This most exciting affair was held in Washington, D.C. While a good deal of the equipment shown is outside the audio field (ranging from t.v. prompters to antenna masts), there is still much to report. Consoles, recorders, components, et.al. galore.

One of the most exciting things to see, though, was a video product. RCA unveiled a video tape changer. The video tape is placed in cartridges, and the changer works — carousel fashion — to play short spot after spot. But it was the audio scene that commanded our prime attention. We will have a picture gallery report of the products seen in next month's issue.

At the same time that the NAB was in Washington, an incredible bit of scheduled had the IEEE Exhibition in New York City. Our assistant editor Richard Lerner reports that once again the IEEE is outside the audio scene. If you need components that can carry you reliably to the moon, the IEEE is the place to go. But, for the broadcaster, the recordist, and the sound reinforcement man, the IEEE show holds no professional interest.

A few days after you receive this we will be heading west for the California side of the Audio Engineering Society's semi-annual exhibition and convention. Just turn to page 30 for a complete run-down of the papers, maps of the exhibition rooms, and, of course, days and hours for the show. We hope you will all be there and that you will stop by on the mezzanine to say hello to us.

For those that can't make the westward trek, we will have a picture gallery report, when we come back. L.Z.

Test Records

ARNOLD SCHWARTZ

The many and varied professional test records are herewith detailed so that anyone involved with the recording or play of discs will better know the utilization of this important measurement tool.

Records are made and played primarily for a vast audience of non-technical people whose judgments of the technical excellence of the recordings are purely subjective. Nevertheless the components of this subjective evaluation can almost always be closely correlated to a set of objective measurements. The professional test record provides a rapid, accurate, and inexpensive way to make these kinds of measurements. For example, frequency response can tell us much about the coloration of a recording. By utilizing available test records, a recording or playback system can be accurately adjusted and periodically checked. In fact, the disc recording engineer can make a routine frequency response check of his entire system — from tape to disc — in minutes by using a reliable test record as the basis for his calibration. The broadcaster can set up and check his disc playback equipment quickly and accurately with the use of the available test records. Professional test records are

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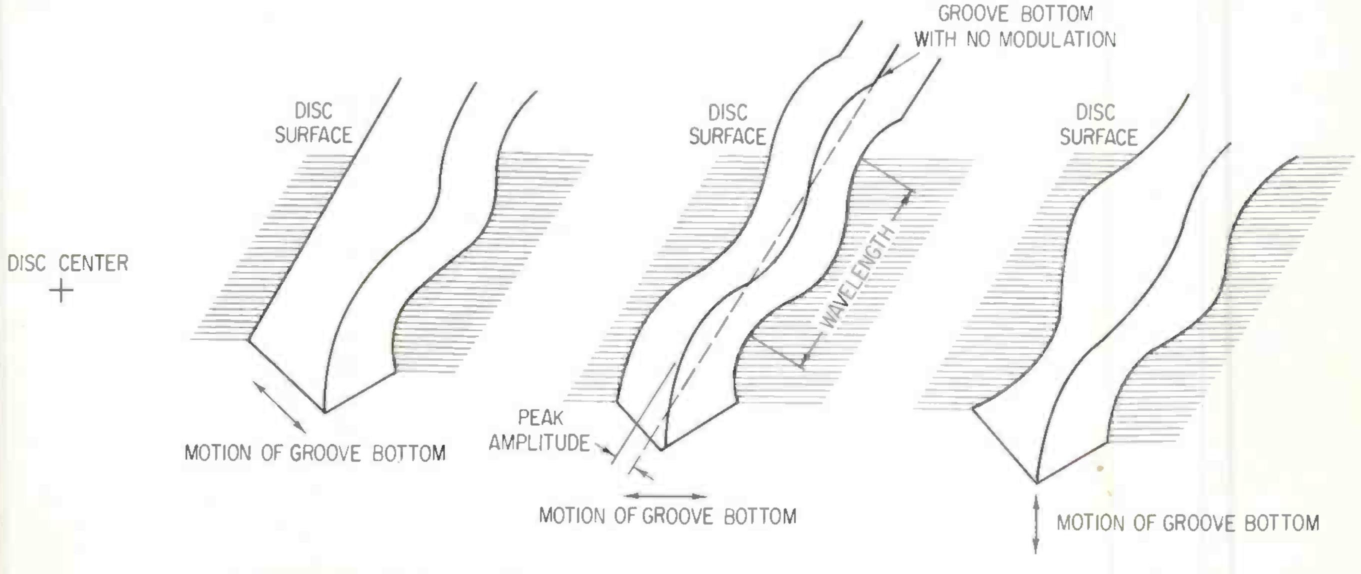
Arnold Schwartz is president of Micro-Point, Inc., manufacturers of recording styli. He was previously associated with CBS Labs where he was instrumental in the design of their test record series.



(A) LEFT CHANNEL MODULATION (B) LATERAL MODULATION (C) VERTICAL MODULATION

Figure 1. The static characteristics of a sinusoidal waveform in a disc groove.

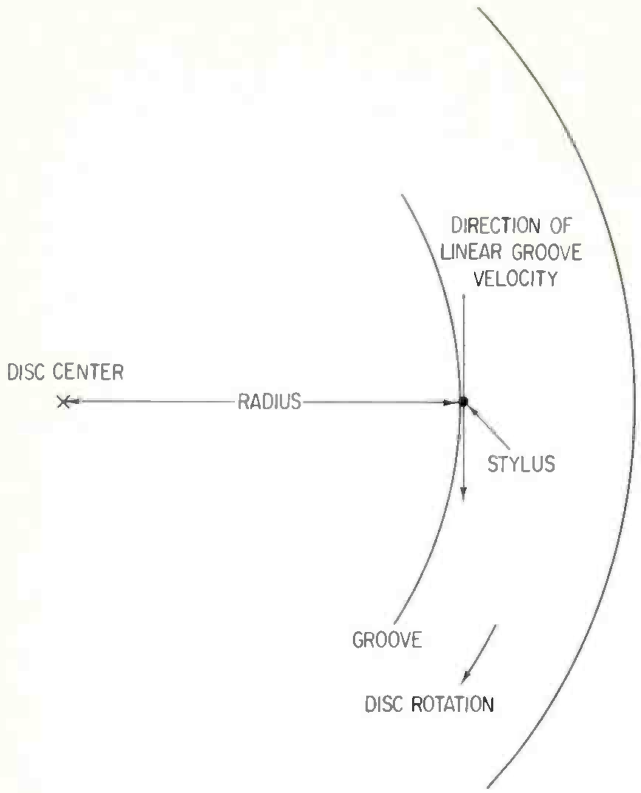


Figure 2. Linear groove velocity of a disc.

carefully calibrated so they can be relied upon when making the numerous measurements and adjustments necessary to have recording and playback equipment in top-notch condition.

Test records serve many purposes, and are used by the following groups; recording studio engineers, broadcast engineers, pickup manufacturers, research oriented professionals, and home hi-fidelity enthusiasts. This, in part explains the wide variety of test records, and the variations in technical specifications describing them. This article will deal primarily with those aspects of test records which are of immediate and practical value to the recording studio and to the broadcaster. In order to better understand test-record specifications and test-record utilization, we will start with a very brief discussion of disc recording principles.

DISC RECORDING FUNDAMENTALS

Modulation on a disc can be described by two alternate sets of characteristics; the *static* and the *dynamic*. Static characteristics are those that can be determined by direct visual observation of the recorded disc. Dynamic characteristics are those that best describe the input and output of the recording and playback process. The two sets of characteristics overlap, and are really two ways of looking at the same thing. Test record specifications can refer to either set of characteristics. Later on in this article we will demonstrate some of the relationships between them.

Static Characteristics. Three important static characteristics of a sinusoidal waveform are shown in Figure 1.

Modulation direction. In stereophonic recording we can have left-channel, right-channel, lateral, or vertical modulation. In monophonic recording only lateral modulation is present. In either left- or right-channel modulation the direction of the groove bottom is 45 degrees to the surface of the record. When both channels are equal in amplitude and recorded in-phase, the resultant direction is lateral (monophonic), and the motion of the groove bottom is parallel to the record surface. When both channels are recorded out-of-phase we have vertical modulation and the direction of the groove bottom is perpendicular to the surface of the record. In this and the following discussions we can just as easily talk about the direction of a groove cross section of constant width (which supports the playback stylus) as we do about the groove bottom.

Amplitude is the displacement of the groove bottom in the modulation direction. Peak amplitude (usually called "amplitude") is the maximum distance the groove bottom is displaced in the modulation direction from its mean position (see Figure 1B). The groove bottom is in its mean position when no modulation is present (quiet groove).

Wavelength is the linear distance covered by one complete cycle of the wave.

Dynamic Characteristics*:* If we now take our recorded disc and rotate it at a constant rotational velocity we then add the ingredient which transforms the static characteristics into the dynamic. The dynamic characteristics include linear groove velocity, frequency, and modulation velocity.

The **linear velocity** of the record groove at the point of contact with the recording or playback stylus is in a direction perpendicular to the record radius drawn to that point of contact (Figure 2). The linear groove velocity depends upon the rotational speed, and the record diameter.

When the groove is moving at a given linear velocity the recorded wavelength will determine the number of cycles of modulation that the pickup will scan each second — which is the **playback frequency.** For example, let us say that the wavelength is 0.004 inch, and the linear groove velocity is 20 inches per second. Since there are 250 wavelengths in each one inch section of groove length the pickup would scan 20 x 250 wavelengths each second — or the frequency would be 5,000 Hz. From the point of view of the recording process, the recording stylus is vibrating at a rate of 5,000 cycles each second, and the disc is moving past the stylus at a velocity of 20-inches-per-second. The length of each recorded cycle would be 20/5,000 = 0.004 inch.

From a playback viewpoint the **modulation velocity** — or simply **velocity** — refers to the velocity of the groove bottom away from and towards the position of the groove centerline if no modulation were present. Referring to Figure 3 the groove bottom of a laterally modulated groove is shown (although single channel or vertically modulated groove would serve equally well as an example). If we imagine the groove moving in the direction of the arrow due to linear groove velocity, an observer looking down at the centerline of the moving groove would see that centerline move right and left alternately. As point A passes the observer the velocity of the groove bottom is maximum to the right. As point B passes the observer the velocity of the groove bottom in the modulation direction is zero for an instant and the motion of the groove is actually parallel to the linear groove velocity. As point C passes the observer the velocity is again maximum but in the opposite direction from Point A. The maximum instantaneous velocity, as represented at points A and B, is called the *peak velocity*. The r.m.s. velocity is 0.707 of the peak velocity and is analagous to the relationship of r.m.s. voltage to peak voltage.

Velocity and amplitude are related by the formula:

$${}^{v}\mathrm{peak} = {}^{2\pi f a}\mathrm{peak}$$

${}^{v}\mathrm{peak}$ = peak velocity
f = frequency
${}^{a}\mathrm{peak}$ = peak amplitude

Another way of expressing the peak velocity is in terms of the wavelength (λ), and the linear groove velocity (V_g):

$${}^{v}\mathrm{peak} = \frac{2\pi V_g}{\lambda}\,{}^{a}\mathrm{peak}$$

This confirms the earlier statement that static and dynamic characteristics are directly related.

TEST RECORDS

Listed below are the tests available on test records which have direct and practical application for the recording studio and the broadcaster.

1. Standard reference level
2. Frequency response
3. Crosstalk
4. Pickup tracking
5. Turntable performance
6. System phase and balance

Because of the large number of test records available, we have limited our discussion to the CBS Laboratories series, the RCA series, and the NAB test record as representative examples.

Standard Reference Level: A recorded single-channel peak velocity of 5.0 centimeters/second at 1000 Hz is the *standard reference level*. (At this velocity and frequency the peak single-channel amplitude is 0.8×10^{-3} centimeters). When both channels are modulated in phase (lateral) or out-of-phase (vertical) the resultant peak velocity is 3 dB greater or 7.0 cm./sec. Standard reference level test bands can be left channel, right channel, lateral, or vertical.

There is some confusion between the *standard reference level* and the maximum level. Standard reference level means just that: *i.e.* it is an arbitrary reference to which any given recorded level can be related. It is not the maximum level that can be recorded or played back, nor does it have any fixed relationship to these maximum levels. Maximum recorded levels are determined by the power-handling capability of the cutter head and the associated electronics, and by the geometry of the recording stylus. Maximum playback levels are determined by the pickup and tone-arm dynamic systems, and by the geometry of the playback stylus and record groove. The maximum level for a particular record playback set of conditions can, however, be related to the standard reference level.

CBS Laboratories test record series has standard reference level bands on the following records:

STR 100; left and right channel
STR 130; left, right, and lateral
BTR 150; left, right, lateral, and vertical

The NAB Test Record has a lateral standard reference band. The RCA records 12-5-49 (lateral), 12-5-50 (lateral, 11-5-51 (lateral), 12-5-75 (vertical), and 12-5-77 (left, right, lateral) refer to a "reference level" which is approximately 2.1 dB below *standard reference level*, or 3.9 cm./sec. peak single-channel velocity.

The standard reference level band is used for absolute calibration of the playback and record systems. With the pickup on the appropriate standard reference level band, the playback gain is adjusted; each channel separately for stereophonic systems. The output signal level is set at 0 vu, 1 volt, or 0 dBm — whichever level is the conventional standard signal or power reference used in your system. The calibrated playback can then be used to calibrate the recording system. The recording channel gain is adjusted; each channel separately for stereophonic systems. The gain is adjusted so that a specified signal input — 0 vu, 1 volt, or 0 dBm — to the recording channel will modulate the disc at the standard reference level as measured on the calibrated playback system. A lateral reference level band can be used to calibrate a stereophonic playback system. The lateral modulation is then considered as left and right channel modulations being present simultaneously. Unless otherwise specified, all levels will be referred to in dB relative to the standard reference level.

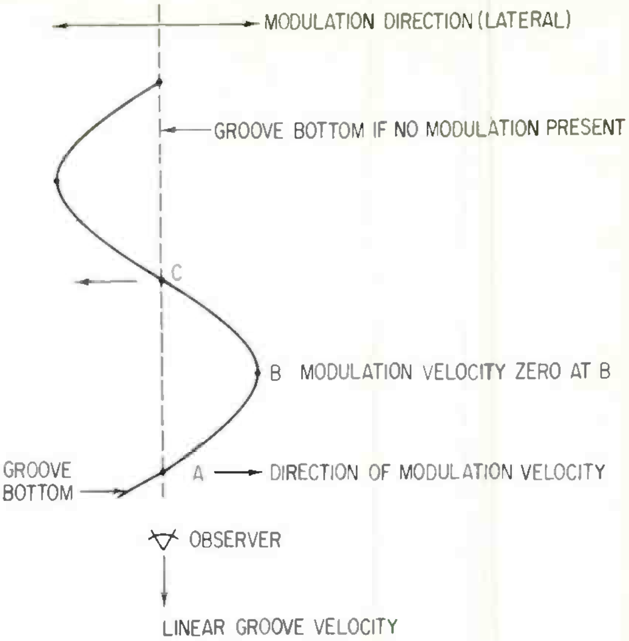


Figure 3. A diagram of the modulation velocity of a disc.

Frequency Response: The recorded velocity or amplitude of a frequency-response test band is related to the frequency by the recording characteristic. In a constant-velocity characteristic, the recorded velocity is constant at all frequencies. Similarly, a constant-amplitude characteristic has constant recorded amplitude at all frequencies. A combination of constant-velocity constant-amplitude characteristic is frequently used, and the RIAA or NAB is of this latter type.

Frequency response tests can be recorded as spot frequencies, or as a sweep or glide tone. Spot frequency recordings have a series of frequency bands which are spaced at uniform intervals in the frequency range covered. The sweep frequency band employs a continuously varying tone which covers the entire frequency range. Sweep frequency bands require specialized recording apparatus to be fully utilized. For the recording studio and broadcaster the frequency response test using the RIAA (NAB) recording characteristic is most useful since the standard playback electronics have the RIAA playback characteristic. The output of an ideal playback system (pickup and associated electronics) with RIAA playback characteristic will be flat when playing a frequency response test band with the RIAA recording characteristic.

CBS Laboratories test record series has frequency response test bands with the RIAA characteristic on the following records:

- STR 130; left, right, and lateral spot- and sweep-frequency bands covering the range of 20-20,000 Hz at −14 dB.
- BTR 150; Left, right, and lateral spot frequency bands covering the range of 50-15,000 Hz at −14 dB.

RCA test record series have the following records with the RIAA characteristic:

- 12-5-49 (10 in.) lateral spot frequency band covering the range of 15,000 to 10,000 Hz at −20 dB, and 10,000 to 30 Hz at −16 dB.
- 12-5-50 (12 in.) similar to 12-5-49
- 12-5-51 (7 in). similar to 12-5-49 but at 45 rpm
- 12-5-75 (10 in.) similar to 12-5-49 but a vertical recording

The NAB test record contains the following frequency response test bands with the RIAA characteristic:

- Lateral spot frequency band 15,000 to 30 Hz at −14 dB.
- A second band contains 60-second duration tones at 100, 1000, and 10,000 to facilitate system adjustment.

CBS Laboratories has a frequency-response test (STR 100) which has a constant amplitude (20-500) and constant velocity (500-20,000) characteristic. RCA has a series of frequency response tests using a constant-velocity characteristic (12-5-67, 12-5-71, 12-5-73). By using these characteristics, substantially higher recorded levels are possible. Better signal-to-noise ratios and more stable readings result. However, the output will not be flat when played with the RIAA playback characteristic. The "flat" position available in some disc recording studios should be used when making measurements with this type of characteristic.

The frequency response test bands are used to measure the response of the playback channel, whether on initial set-up or on routine check. The output level at 1000 Hz is used as the reference level (0 dB) and the relative levels at all the other frequencies are recorded in tabular or graph form. A sample of a typical response test, and the results when converted to tabular form, is shown in FIGURE 4. We call this our calibration curve.

Once the playback system frequency response has been determined, the recording system can be calibrated. We now know that the ideal recording (*i.e.* our test record) has the response characteristic, as in our typical case, shown in FIGURE 4. Therefore each recording channel should be adjusted so that the playback response of a test recording will be as close as possible to that of the calibration curve. A quick and accurate check of the entire recording/playback chain can be made by recording a test tape with the same frequencies that are on the test record. The tape is played, recorded on a disc, and then played back. Any deviations from the pickup calibration curve can then be plotted as deviations from the ideal flat response.

Lateral frequency response test bands can be used to measure the performance of stereophonic pickups. However, at frequencies below 100 Hz and above 8-10 kHz the results are not always reliable due to pickup crosstalk.

Crosstalk: Stereo standard reference level and stereo frequency-response test bands provide a means for measuring pickup crosstalk. Crosstalk is a measure of the loss of stereophony. When left channel only is modulated, the right-channel crosstalk signal is measured in dB below the left-channel output. The reverse procedure is used to measure the left-channel crosstalk.

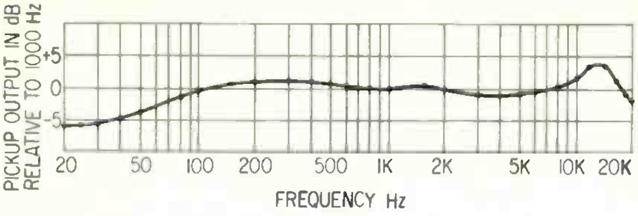


Figure 4. A typical pickup's frequency response. The test record is the CBS STR 130 in this example, only the left channel is shown. Response is plotted relative to 0 dB at 1000 Hz.

Pickup Tracking: Tracking refers to the ability of the playback stylus to maintain continuous contact with the groove walls in the presence of modulation. When, due to high modulation levels, the playback stylus is only intermittently in contact with the groove walls, audible distortion will occur. On rare occasions the pickup can be thrown completely out of the groove, although this is not likely in modern pickups. Harmonic and intermodulation measurements can be used to determine the distortion caused by mistracking. Measurements made with appropriate equipment is preferred but critical listening can provide reasonably accurate results.

The test record provides, with either single-tone or two-tone recordings, successively higher levels of modulation. The pickup output will sound normal or undistorted at low modulation levels. When the critical modulation level is exceeded, beyond which the pickup cannot track, the output becomes noticeably distorted. This then is the maximum undistorted level that can be played back by the pickup.

CBS Laboratories Test Record STR 100 and STR 111 provide single-tone tracking tests with the levels calibrated in peak amplitude. The STR 111 also contains two-tone intermodulation tests calibrated in peak amplitude. The levels on the STR 100 are from 0.001 to 0.005 centimeters in lateral and vertical modulation. The STR 111 levels are from +6 to +18 dB re 1.12 x 10^{-3} cm. lateral, and from +6 to +12 dB for vertical modulation.

RCA test record 12-5-37 (7 inch 45 rpm) and 12-5-39 (12 inch, 78 rpm) have two-tone intermodulation bands for pickup tracking tests. The first disc has lateral modulation from 3.5 to 18 cm./sec. The second disc has lateral modulation from 4.3 to 27.1 cm./sec.

Turntable performance: Turntable rumble can be measured by playing the pickup on a quiet groove and measuring the pickup output relative to the standard reference level. For increased accuracy a low-pass filter with a cut off around 300 Hz should be used. CBS Laboratories BTR 150 and the NAB Test Record have a quiet band for this purpose.

Wow and flutter can be measured with a Wow and Flutter meter. A 3000 Hz tone is provided on the CBS BTR 150, the NAB Test Record, and the RCA 12-5-65, for this purpose.

System Phase and Balance: A system phase and balance check is used to verify the following: channel balance, the fact that in-phase signals are present at the playback system output for lateral recordings, and the fact that out-of-phase signals are present at the playback system output for vertical recordings. RCA 12-5-77 and the NAB Test Record provide phase and balance tests. Similar tests are available on CBS records in the form of left, right, lateral, and vertical standard reference level bands.

Considering its modest price, and the wide range of tests it makes available, the test record is a real bargain.

Electronic Surveillance Equipment

[redacted]

ROALD D. WORTHER

In this revealing paper, the author describes two commonly used surveillance devices. He also details some of the work in ultra-miniature componentry that has made them possible.

IMAGINE A COMPLETE TAPE RECORDER no larger than an average cigar. Consider that this recorder will operate for thirty minutes, has a 100-5000 Hz over-all response, contains a sensitive built-in omnidirectional mic (concealed as the cigar band) and automatic volume control.

That was last year's device! A recent development of our department just released for field use has reduced the recorder to a coat button — the cord holes of which conceal the mic entry. The recording time is now expanded to forty-five minutes. Thickness is down to approximately 1/8th inch and the tape cartridge contains the d.c. power supply so that a change of cartridge ensures a fresh surge of power. I will describe the recorder presently.

Industrial (and other kinds) espionage customers want such devices. But there are times when even this button is too large. At other times, the physical presence of the individual with the recorder is not possible. For these occasions, we have worked for years on ultra-miniature sending systems. A variety of r.f. frequencies are used depending on what the customer believes will avoid detection.

The spy movies have indoctrinated you, no doubt, with the idea of a martini olive with a toothpick-like antenna. These inventions live only in the minds of science-fiction writers, for the espionage field could never live with so easily discovered a device. One bite and you would know!

Less dramatic and more practical systems are needed. Obviously, no single pickup/transmitter is suitable for all situations. Let me describe one popular one. Where an unattended surveillance device is needed to monitor a room or area we use a complete system that is roughly the size of a six-penny nail. With such a device, we can literally hammer it into a wall so only the head shows. With less than 1/16th of an inch exposed it is not likely to be discovered.

We recently used six of these units in a large attendance hall. This enabled our receiver, located about ¼-mile away to completely monitor the room. We could hear whispered private conversations no matter where in the room the caucus was held.

We generally use an unused frequency for the area in the f.m. broadcast band. In this way, our transmissions are virtually undetected by conventional r.f. snoopers.

THE SYSTEMS

I will first describe the button tape recorder's construction and circuitry because, I believe, this will be of prime interest to the readers of this magazine.

(Publisher's note: As the following originally scheduled pages were being placed on the presses, we were visited by agents of the United Network Command for Law Enforcement who confiscated the page plates, giving the reason of international security. We have been unable subsequently to reach author Worther. One of our most valued pressmen is also missing and we can only assume that he was the informant agent.)

Roald D. Worther is senior engineer for miniaturization design with an intergovernmental agency. He is widely acknowledged for his contributions to the field.

A Protected Power Supply

WALTER JUNG and RICHARD GROOM

The authors describe a practical power supply for audio amplifiers that is electronically regulated and is equipped with circuit-breaker protection.

A COMMON PROBLEM associated with audio power amplifiers is a means of automatic electronic short-circuit protection. Such protection is mandatory, both with respect to the output-driver transistor group, and as much, if not more so, with respect to the ultimate load. Although quite adequate and thorough means of protection for the amplifier itself have been described.[1] little if any means other than simple fuse mechanisms have been forwarded as speaker protection. Faced with the unthinkable horror of fusing a multi-hundred-dollar speaker system if a transistor were to short (a remote but not impossible probability) the following approach to an electronic power supply protector was devised.

Walter Jung and Richard Groom are engineers in the electronic design department of Maryland Telecommunications (MTI) of Cockeysville, Maryland.

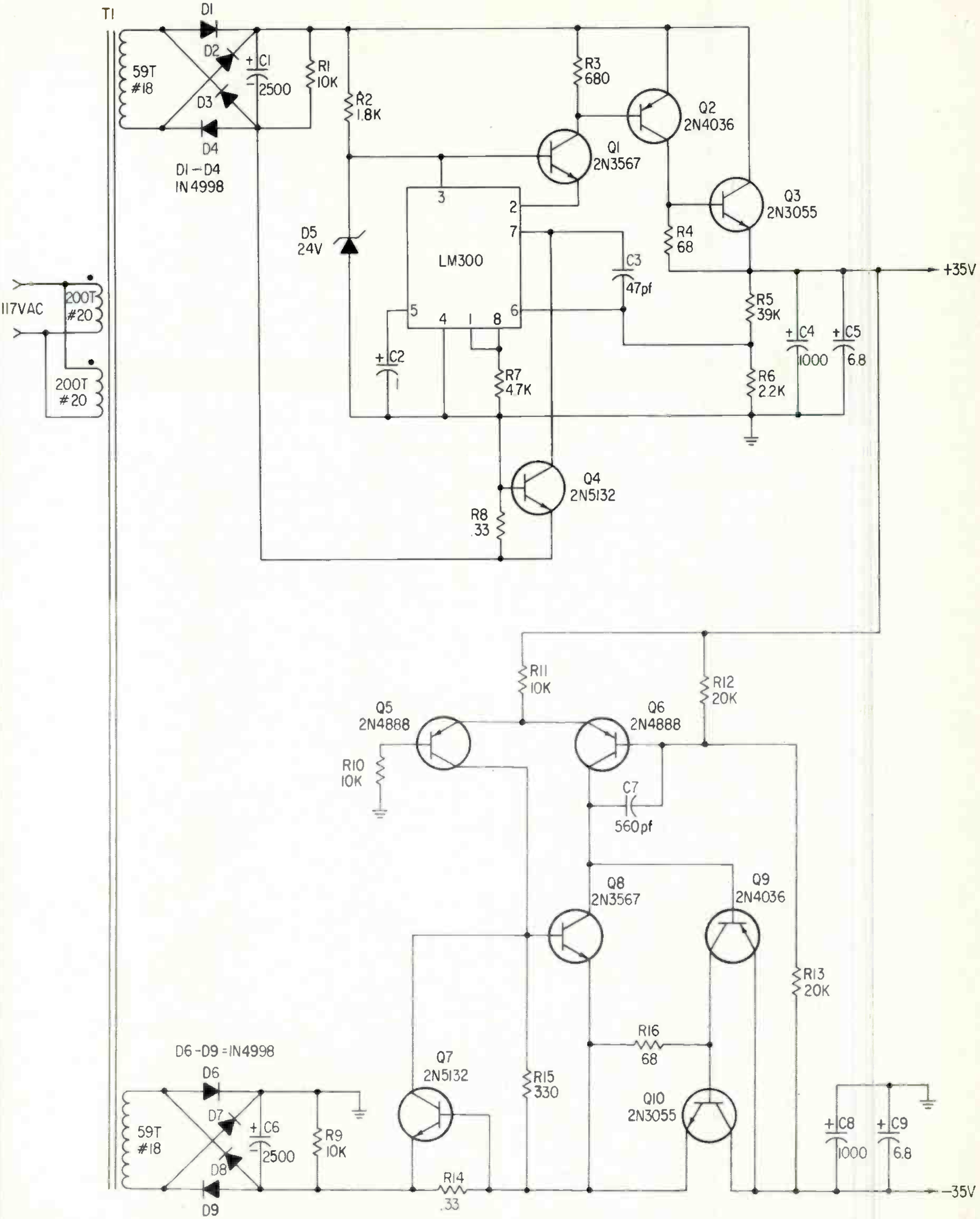


Figure 1. The complete power supply circuit described in the text. The lighter-shaded portion (the minus supply) is part of the system but can be eliminated if a plus-voltage-only circuit is needed. All resistors are in ohms; all capacitors in µF unless otherwise noted. Transformer T1 and the integrated circuit LM300 are detailed in the text and on the parts list.

The circuit is a dual-output, fully-regulated power supply with short-circuit protection in both positive- and negative-output legs. In addition, the negative output regulator is slaved to the positive output which insures that the voltages will always be equal and opposite. Although the circuit may appear complex and expensive at first glance, a major portion of the semiconductors are very economical plastic types and efficient use is made of a low cost i.-c. voltage regulator in a configuration which extends its voltage range and improves regulation characteristics.[2] Aside from the obvious benefit of the short circuit protection, the superlative regulation characteristics of the circuit provide the virtues of improved ripple rejection, independence from line-voltage changes and a low dynamic-output impedance allowing full audio power to be realized continuously. In a stereo configuration, this also allows independence of power from one channel to the other and vastly reduced crosstalk.

CIRCUIT DESCRIPTION

The positive voltage regulator will be described first since it serves as a reference for the negative regulator and is responsible for over-all circuit stability.

Raw d.c. voltage is provided from a full-wave bridge rectifier, D_1-D_4 and capacitor C_1. The negative leg of this rectifier goes to ground through short-circuit current-sense resistor, R_8 (function to be described later).

The positive unregulated voltage is applied to the network of Q_1 to Q_3, which comprises a series regulator configuration. This combination is driven by the LM300 i.c. which provides the voltage gain necessary for regulation. R_5 and R_6 serve as the output voltage sensing network, feeding a sample of the output voltage back to the i.c. to maintain closed-loop regulation.

Q_4, in conjunction with the aforementioned R_8, serves as the overload protection for the positive voltage regulator. Load current passing through R_8 develops a voltage drop which is impressed across Q_4's base-emitter junction. When load current is sufficiently high to reach Q_4's base-emitter threshold of 0.65v (such as in an overload condition), Q_4 turns on and clamps pin 7 of the LM300 which turns the regulator off and reduces the output voltage. When the short or overload is removed from output, normal operation is restored. For a more detailed explanation of this circuit, the interested reader is referred to Reference 2.

The two output capacitors across the regulator output serve two differing purposes. A large electrolytic (C_4) is necessary to supply the heavy peak currents demanded by large signal outputs from the amplifier. Otherwise the overload protection would activate on signal peaks and clip the waveform unnecessarily, severely limiting the power output. This allows the overload network to sample average d.c. current and a true fault will still be detected. A low-inductance, high-frequency bypass such as a tantalum (C_5) is necessary to lower the high frequency output impedance of the regulator and suppress oscillations in the r.f. region. If a good high-frequency characteristic electrolytic is used for C_4, the need for C^5 is obviated.

The negative voltage regulator uses a similar bridge rectifier and capacitor-input filter, consisting of D_6 to D_9 and C_6.

The composite pnp pair of Q_9 and Q_{10} form a series pass configuration similar to that of Q_2 and Q_3 in the positive regulator. This series pair is driven by a ½ of a pnp differential amplifier, Q_6. As mentioned previously, the negative output is compared to the positive voltage and forced to follow in a 1:1 relationship by R_{12} and R_{13}. Q_5 serves as the other input to the differential pair, its input being grounded. Since balanced operation of a differential amplifier requires that the inputs be virtually zero, it can be seen that the basc of Q_6 will be zero volts thus the + and − voltages are always maintained equal and opposite.

A unique contribution to circuit performance is provided by Q_8, which serves as an active collector load for the differential amplifier. The high collector impedance of Q_8 causes the voltage gain of Q_6 to be extremely high (several thousand), much more than a simple resistive load.

Additionally, the full differential gain of Q_5 and Q_6 is realized by driving Q_8's base from Q_5's collector, a connection not normally utilized. Aside from its high gain characteristics, this circuit also has high suppression of input ripple (60 dB) due to the constant current action of Q_5 and Q_6 feeding Q_8. It will also work with input potentials of only 1 to 2 volts more negative than the output because of the active drive of Q_8 to the Q_9 and Q_{10} combination.

The overload protection for this regulator is provided by an identical transistor-resistor pair, R_{14} and Q_7. In this case Q_7 removes drive from Q_8 by shunting away the drive from Q_5, causing the output voltage to be removed. Again, recovery is automatic after overload removal, as in the positive regulator.

A power-supply regulator protector combination has been described with several desirable features for audio power amplifier applications. Although the amplifier circuits used with this power supply have not been described, they are generally similar to that of Reference 3, which describes a high power d.c. coupled split-supply power amp. Utilization of the overload technique with single supply a.c. coupled amplifiers is equally valid, of course.

REFERENCES

[1] Daniel R. von Recklinghausen, *Protection of Amplifiers*, **Journal of the Audio Engineering Society**, Vol. 16, #11.

[2] Walter G. Jung, *Voltage Regulator Has Extended Range, Remote Shutdown*, **The Electronic Engineer**, March, 1969.

[3] *Direct Coupled 50 Watt Audio Amplifier*, **Delco Radio Application Note #43**, December, 1968.

BIBLIOGRAPHY

1. R. J. Widlar, *Monolithic Voltage Regulator*, **Application Note AN-1, National Semiconductor Corporation**, November, 1967.
2. R. J. Widlar, *New Uses for the LM100 Regulator*, **Application Note AN-8, National Semiconductor Corporation**, June, 1968.

SPECIFICATIONS

Ripple: Since ripple is a function of load current, and load current will vary according to different applications, a more realistic figure to characterize regulator performance is *line regulation;* this is the output voltage change per volt of input change. Measured figures for this regulator were less than 0.5 mV/V. Using a rough figure of 5 volts peak-to-peak input ripple, this translates to 2.5 mV p-p output ripple.

Regulation (output): Load regulation figures are approximately 10 mV output change (measured with a ΔIo of 1 amp). This figure is proportional to the output voltage; that is lower voltages, such as +15 V for instance, will reflect better regulation figures due to less division of the output change by R_5 and R_6. Equivalent output impedance (a good figure of merit) is:

$$\frac{\Delta Eo}{\Delta Io,} \text{ or } \frac{0.01V}{1A} = 10 \text{ millihenries.}$$

Imax: Short-circuit current is calculated from the Vbe of Q_4 or Q_7 (0.65V) and the R_8 to R_{14} value. In this circuit it is roughly 2 amps. Exact values of limit current are difficult to maintain because of the non-precision of low-value resistors. In selecting different values for R_8 to R_{14} use:

$$Rsc = \frac{0.65V}{Isc}$$

where Isc is the desired limiting value.

Aside from short-circuit current, the absolute current limit (design limit) is governed by the heat sink for Q_3 and Q_{10}, rather than a pure current standpoint. The 2N3055's are extremely rugged devices and their ratings with that of the heat sink specified will allow a full 2 amp output current up to an ambient temperature of 70 deg. C.

Voltage changes: To scale the output for different voltages change R_5 to fit the equation:

$$R_5 = \frac{Eo - 1.8V}{0.82mA}$$

Precise adjustment will necessitate a pot for a portion (10 per cent of R_5) if this is desired.

The negative regulation will automatically follow in a 1:1 relationship.

Of course the power transformer secondary voltage must be adjusted to suit the new output level; that is beyond the scope of this article.

Cost Estimate: The major component cost (exclusive of hardware, p.c. board, etc.) is approximately $40 using a single-piece pricing. The prices are based on the Allied Radio Corp. catalog from which most of the componentry is available.

PARTS LIST

Resistors

R1, R9	10K, 1W, ±10%	Allen Bradley or Equivalent
R2	1.8K, 1W, ±10%	
R3	680, ½W, ±10%	
R4, R16	68, ½W, ±10%	
R5	39K, ½W, ±5%	
R6	2.2K, ½W, ±5%	
R7	4.7K, ½W, ±10%	
R8, R14	.33 IRC BWH	
R10	10K, ½W, ±5%	Allen Bradley or Equivalent
R11	10K, ½W, ±10%	
R12, R13	20K, ½W, ±5%	
R15	330, ½W, ±10%	

Capacitors

C1, C6	2500 or more uf @ 75VDC — Sprague 36D252F075AC2A, Mallory CG252U-75K1
C2	1 µf, 20V tantalum — Mallory TAC Series
C3	47 pf polystyrene — Mallory SX Series
C4, C8	1000 µf, 50V electrolytic — Mallory MTV Series
C5, C9	6.8 uf, 50V Tantalum — Kemet Series
C7	560 µf polystyrene — Mallory SX Series

Diodes

D1-D4, D6-D9	1N4998 — Motorola
D5	24V, 1W Zener, ±20% 1N4749 Motorola 1R24 Solitron

Transistors

Q1, Q8	2N3567 National,
Q2, Q9	2N4036 RCA
Q3, Q10	2N3055 Solitron, RCA, Silicon Trans. Corporation
Q4, Q7	2N5132 National,
Q5, Q6	2N4888 Fairchild

Integrated Circuit

LM300 National Semiconductor Corporation

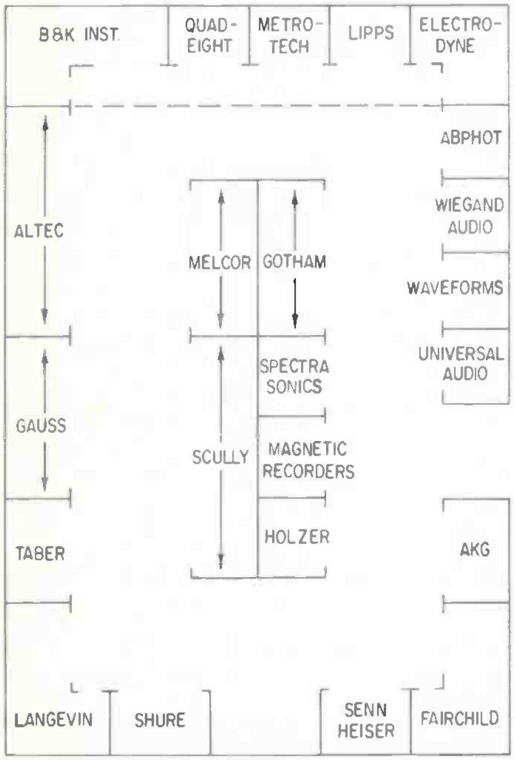
Transformer

A. For those with winding facilities:
  Laminations:
    EI-125, 29 gauge, grain-oriented
    M-6 material, quantity — approx. 140 prs.
    Arnold or Thomas & Skinner, Inc.
  Bobbin:
    Nylon — rectangular window 1¼ x 2″
    American Molded Products
  Wire:
    #20 & 18 AWG magnet wire, Heavy Formvar insulation
    #18 lead wire, assorted colors
    Essex Wire
  Misc.:
    Hardware, tape, Kraft paper, varnish

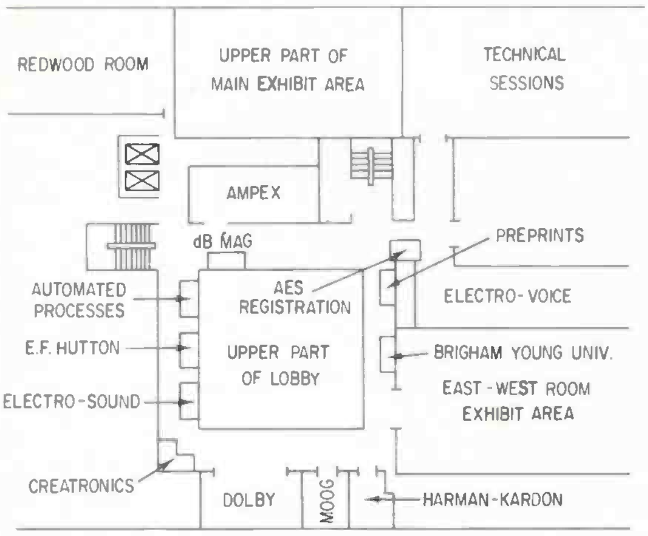
B. For less fortunate souls:
  Signal Transformer #68 — 2 dual 34VRMS secondaries each rated at 2 amp, primary 117 Va.c.
  Heat Sink for Q3 - Q10
    Wakefield NC641 or equivalent

Source:
Charles Hock
Hamilton Electro Sales
8809 Satyr Hill Road
Baltimore, Md. 21234

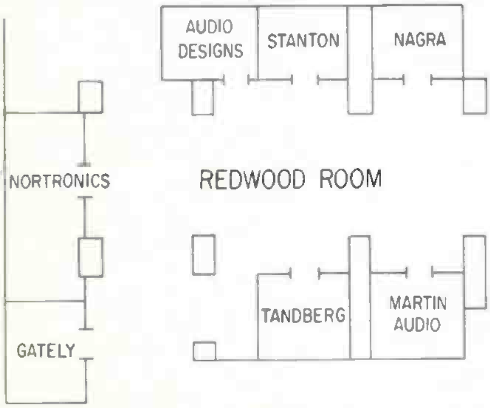
36th AES Convention

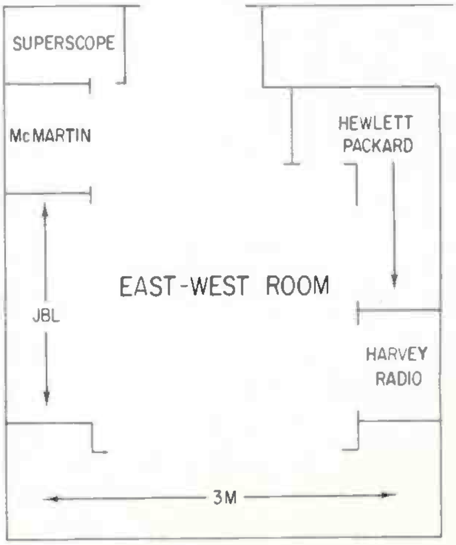


MAIN EXHIBIT AREA (BLOSSOM ROOM)



MEZZANINE FLOOR





QUICK SUMMARY

REGISTRATION

Mezzanine, Monday, April 28 through Thursday, May 1, 1969
9:30 A.M. to 8:00 P.M.

BANQUET

Aviation Room, Wednesday, April 30, 1969
Social Hour — 6:30 P.M.
Banquet — 7:30 P.M.

TECHNICAL SESSIONS

Aviation Room, Monday, April 28
10:00 A.M. — **Amplifiers & Audio Circuits**
1:30 P.M. — **Transducers**
8:00 P.M. — **Audio Systems (To be held at A&M Studios)**

Tuesday, April 29
9:30 A.M. — **Acoustics & Hearing**
1:30 P.M. — **Music & Speech**
7:30 P.M. — **Noise**

Wednesday, April 30
9:30 A.M. — **Disc Recording**
1:30 P.M. — **Tape Recording**

Thursday, May 1
9:30 A.M. — **Signal Processing** — Panel Discussion
1:30 P.M. — **Instrumentation**
7:30 P.M. — **Sound Reinforcement**

EXHIBITS

Monday thru Thursday, April 28 thru May 1, 1969
Monday & Tuesday — 1:00 P.M. - 9:00 P.M.
Wednesday & Thursday — 1:00 P.M. - 5:00 P.M.

THE PAPERS

AMPLIFIERS AND AUDIO CIRCUITS

Monday, April 28, 10:00 A.M.
Aviation Room
Chairman: PAUL SPRANGER
Altec Lansing, Anaheim, California

Design Considerations of Low Noise Audio Input Circuitry — A. Douglas Smith, Shure Brothers, Inc., Evanston, Illinois

Transmission Lines in Studios — O. Everett Wiedmann, LTV Research Center, Anaheim, California

An Unusually Flexible OP AMP Mixing Console — Lyle Fain, Fedco Audio Labs, Providence, Rhode Island

Bridging The Audio Limiter Gap — James J. Noble and Robert James Bird, Altec Lansing, Anaheim, California

Automatic Presence Equalizer — Richard G. Allen, Emil L. Torick and Benjamin B. Bauer, CBS Laboratories, Stamford, Connecticut

Low Noise Replay-Preamplifier for Professional Audio Recorder — Zoltan Vajda, University of Minnesota, Minneapolis, Minnesota

TRANSDUCERS

Monday, April 28, 1:30 P.M.
Aviation Room
Chairman: B. R. BEAVERS
LTV Research Center, Anaheim, California

A New User-Oriented Professional Unidirectional Microphone — Robert B. Schulein, Shure Brothers Inc., Evanston, Illinois

A New Underwater Earphone — Louis A. Abbagnaro and Benjamin B. Bauer, CBS Laboratories, Stamford, Connecticut

Loudspeaker Phase Characteristics — Richard C. Heyser, Cal. Tech. Jet Propulsion Laboratory, Pasadena, California

The Meaning of Quantitative Loudspeaker Measurements — Charles McShane, Acoustic Research, Inc., Cambridge, Massachusetts

Loudspeaker Voice Coils — John King, Cleveland Electronics, Cleveland, Ohio

Design Parameters of A Dual Woofer Speaker System — Edward M. Long, Ampex Corporation, Elk Grove Village, Illinois

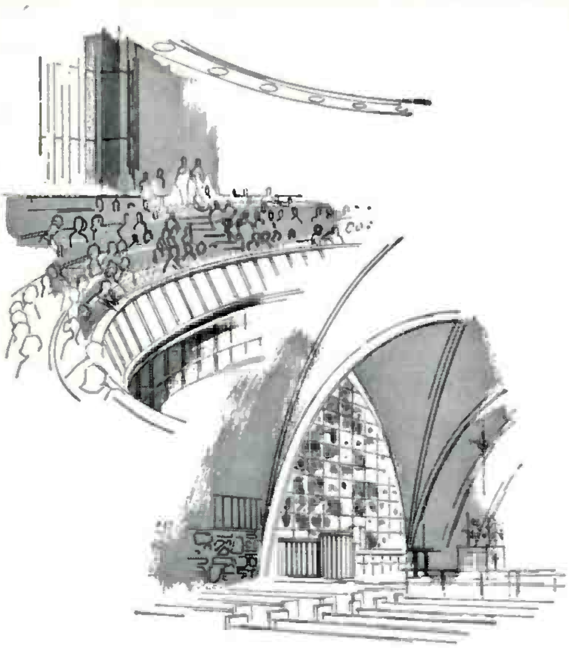
An Improved Theatre Type Loudspeaker System — John K. Hilliard, LTV Research Center, Anaheim, California

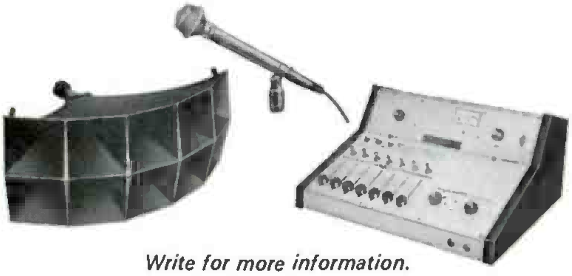
Recent Developments in High Frequency Drivers and Horns for Auditorium Sound Reinforcement — William L. Hayes, Altec Lansing, Anaheim, California

AUDIO SYSTEMS

Monday, April 28, 8:00 P.M.
A&M Studios, Sunset Blvd. & La Brea, Hollywood, Cal.
Chairman: JACK PURCELL
Purcell & Noppe & Associates, Inc., Reseda, California

A Directional Communications Receiver for Underwater Swimmers — Guy V. Love, Emil L. Torick, Benjamin B. Bauer, CBS Laboratories, Stamford, Connecticut





A Recording Console for the Needs of Tomorrow — Robert A. Bushnell & J. Jerrold Ferree, Bushnell Electronics Corp., Van Nuys, California and United Recording Corp., Hollywood, California

A Comparison of the Performance of V. U. and Peak Reading Meters — Richard D. M. Negus, Capitol Records, Inc., Los Angeles, California

A Description and Tour of the New A&M Studios — Howard Holzer, HAECO, Larry Levine, A&M Records and Jerry Christoff, Paul F. Vaneklasen & Associates

ACOUSTICS & HEARING

Tuesday, April 29, 9:30 A.M.
Aviation Room

Chairman: MARK B. GARDNER
Bell Telephone Laboratories, Inc., Murray Hill, New Jersey

An Experimental Sound System for the Hollywood Bowl Used in 1936 — Arthur R. Soffel, LTV Research Center, Anaheim, California

Talking and Listening in Verbal Communication — Importance of Specifying Parametric Values — Mark B. Gardner, Bell Telephone Laboratories, Inc., Murray Hill, N.J.

Sound Reproduction in the Home — Harry F. Olson, RCA Laboratories, Princeton, New Jersey

Acoustics of Multipurpose Auditoriums — Vern O. Knudsen, University of California at Los Angeles, Los Angeles, California

The Ear As An Instrument for Determining the Quality of Musical Tones — Harvey Fletcher, Brigham Young University, Provo, Utah

Tuesday, April 29 — 1:30 P.M. — Meeting of USASI-S4 Standards Committee on Sound Recording. See Hotel Bulletin Board for room number.

MUSIC AND SPEECH

Tuesday, April 29, 1:30 P.M.
Aviation Room

Chairman: JAMES CAMPBELL
University of California, San Diego, La Jolla, California

New Music Buildings — The Sonic Environment — Gerald Strang, California State College at Long Beach, Department of Music, Long Beach, California

Loudness Meter — R. A. Hackley, H. F. Olson and D. S. McCoy, RCA Laboratories, Princeton, New Jersey

Some Recent Developments in Computer-Generated Tone Qualities — J. C. Risset, Bell Telephone Laboratories, Inc., Murray Hill, New Jersey

A Music Department, Born: 1 July 1966; Died: ..... — James L. Campbell, Department of Music, University of California, San Diego, La Jolla, California

NOISE

Tuesday, April 29, 7:30 P.M.
Aviation Room
Chairman: KARL S. PEARSONS
Bolt Beranek and Newman, Inc., Van Nuys, California

Transportation Noise Source — Richard C. Potter, Wyle Laboratories, El Segundo, California

Plumbing Noise Control — Ronald McKay, Bolt Beranek and Newman, Inc., Van Nuys, California

Updating and Interpreting the Speech Interference Level (SIL) — John C. Webster, U. S. Navy Electronics Laboratory, San Diego, California

Human Phase Sensitivity to Impulsive Signals — Sanford Fidell, Bolt Beranek and Newman, Inc., Van Nuys, California

Procedures for Evaluating Damage Risk from Exposure to Noise — Karl D. Kryter, Stanford Research Institute, Menlo Park, California

Evaluation of Ear Protection Devices — John E. Parnell, PNP Associates, Reseda, California

DISC RECORDING

Wednesday, April 30, 9:30 A.M.
Aviation Room
Chairman: FRANK E. PONTIUS
Westrex, Hollywood, California

A Tape-to-Disc Mastering System Featuring Unique Control and Monitoring Facilities — Jack K. Williams, Pacific Recorders and Engineering, Solano Beach, California

A New and Improved Solid State Driving System for the Westrex 3D & HAECO SC-1 Stereo Cutterheads — Howard S. Holzer, HAECO, Van Nuys, California

The First All Solid State Stereo Recording Package for Disc Recording — Stephen F. Temmer, Gotham Audio Corp., New York, New York

Performance Characteristics of the Commercial Stereo Disc — John M. Eargle, RCA Record Division, New York, New York

The Dynamic Range of Disc Records — Daniel W. Gravereaux and Benjamin B. Bauer, CBS Laboratories, Stamford, Connecticut

Automatic Record Pressing — William S. Bachman, Columbia Records, Milford, Connecticut

TAPE RECORDING

Wednesday, April 30, 1:30 P.M.
Aviation Room

Chairman: KEITH O. JOHNSON
Gauss Electronphysics, Inc., Santa Monica, California

A Simple Tailoring Machine for Philips Cassettes — James B. Wood, General Recorded Tape, Inc., Sunnyvale, California

Magnetic Tape Testing and Interpretation — Klaus E. Naumann, BASF Computron, Inc., Bedford, Massachusetts

The Measurement of Medium-Wavelength Flux on a Magnetic Tape Record — John G. McKnight, Ampex C & E Products Div., Los Gatos, California

A Simplified — Hysteresis-Loop Model of the AC Biased Magnetic Recording Process — Zoltan Vajda, Hungarian Radio & Television. At present, Dept. of Electrical Engineering, University of Minnesota, Minneapolis, Minnesota

An Examination of Dropouts Occurring in the Magnetic Recording and Reproduction Process — William Van Keuren, Jet Propulsion Laboratories, California Institute of Technology, Pasadena, California

Design Improvements Applied to the Fairbanks Time Alteration Device for Recorded Sound and Uses of the Time Alteration Technique — Wayne Graham, Discerned Sound, Hollywood, California

SIGNAL PROCESSING

Thursday, May 1, 9:30 A.M.
Aviation Room

Chairman: WILLIAM G. DILLEY
Spectra Sonics, Ogden, Utah

A series of five separate panel discussions designed to broadly encompass the signal processing chain from microphone to tape machine. Individual sessions, composed of both manufacturers and recording engineers will conduct panel discussions followed by audience/panel participation.

MICROPHONE: David Roone, *Metromedia Producers Corp., Los Angeles, California,* **Thomas May,** *Columbia Records, Hollywood, California,* **L. R. Burroughs,** *Electro-Voice, Inc., Buchanan, Michigan.*

EQUALIZATION/FILTERING: Lawrence Levine, *A & M Records, Hollywood, California,* **H. Philip Iehle,** *Atlantic Records, New York, New York,* **John P. Jarvis,** *Universal Audio Division of UREI, North Hollywood, California.*

COMPRESSION/LIMITING: Richard Welch, *Bonneville International, Salt Lake City, Utah,* **DeWitt F. Morris,** *United Recording Division of UREI, Hollywood, California,* **Charles F. Swisher,** *Christopher Jaffe & Associates, Inc., San Francisco, California*

REVERBERATION/ECHO: John Neal, *Western Records Division of UREI, Hollywood, California,* **Richard Stumpf,** *Universal Studios, Universal City, California,* **Stephen F. Temmer,** *Gotham Audio Corporation, New York, New York.*

TAPE MACHINE: Thomas Hidley, *T. T. G., Inc., Hollywood, California,* **Hamilton Brosious,** *Scully Recording Instruments Corp., Bridgeport, Connecticut,* **C. Dale Manquen,** *3M Company, Camarillo, California,* **Leon A. Wortman,** *Ampex Corporation, Redwood City, California.*

INSTRUMENTATION

Thursday, May 1, 1:30 P.M.
Aviation Room

Chairman: BERNARD KATZ
B&K Instruments, Inc., Cleveland, Ohio

Reliability in Production Testing of Loudspeaker Components and Systems — Donald S. Schroeder and Edward M. Long, Ampex Corporation, Elk Grove Village, Illinois

Automated Frequency Response Measurement — Allen E. Byers, United Recording Electronics Industries, North Hollywood, California

Crosstalk Measurements on Magnetic Recording Heads — Robert E. Barbour, Nortronics Co., Inc., Minneapolis, Minnesota

Real Time Spectrum Analysis — David Rose, Hewlett-Packard, Palo Alto, California

Real Time Spectrum Analysis as a Tool in Acousta-Voicing — Don Davis, Altec Lansing, Anaheim, California

The Seven Deadly Sins of Instrumentation — E. John Wootten, B&K Instruments, Inc., Cleveland, Ohio

Instrumentation Techniques Used for Performance Evaluation of Hearing Aids — Erwin Weiss, Beltone Electronics Corp., Chicago, Illinois

On the Objective Testing of Circumaural Hearing Protectors — R. H. Campbell, David Clark Company, Inc., Worcester, Massachusetts

SOUND REINFORCEMENT

Thursday, May 1, 7:30 P.M.
Aviation Room

Chairman: CHARLES F. SWISHER
Christopher Jaffe & Associates, Inc., San Francisco, California

A Sound Reinforcement System for Multiple Conference Rooms — Melvin S. Draper, The Boeing Company-Space Division, Huntsville, Alabama

Location of Loudspeakers in Sound Reinforcement Systems — Don Davis, Altec Lansing, Anaheim, California

A New Music and Sound Effects System for Theatrical Productions — Dan Dugan, American Conservatory Theatre, San Francisco, California

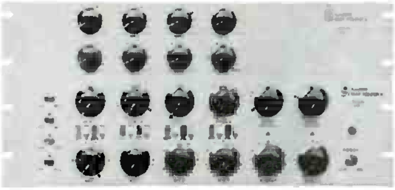
Comparison of Room-Loudspeaker Response in Well-Behaved Reverberant Rooms to the Response in an Anechoic Environment — James Long and William Raventos, Electro-Voice, Inc., Buchanan, Michigan

Design Innovations in a Modern Portable Sound Reinforcement System — Stephen W. Desper, Beach Boy Entertainment Enterprises, and Robert L. Bennett, Quad-Eight Sound Corporation, Hollywood, California

Sound Amplification System for the San Diego All American Stadium — Wilfred A. Malmlund and David L. Klepper, Bolt Beranek and Newman Inc., Van Nuys, California

New Products and Services

ECHO MIXER/EQUALIZER



- This combination of a stereo echo mixer, model EM-7 and an accessory four-channel equalizer, model EQ-7 allow complete processing of the audio input signals. Both echo and low and high equalization may be added to create special effects. This is ideal for a broadcast station seeking to create its own identifiable sound. The EM-7 handles up to eight inputs, four line and four mic. They are switch-selectable from the front panel. The inputs are assigned to four mixing channels where the processed signal may be forwarded to either or both output channels. Mixers may be stacked for greater input capability. The EQ-7 plugs directly into the mixer to permit the addition of up to 15 dB of boost or cut at 20 Hz and 20 kHz on four channels independently and simultaneously. Amplification within the unit makes up for the equalizer insertion loss.

Mfr: Gately Electronics
Circle 32 on Reader Service Card

SUPER-POWER AMPLIFIER

- Named the DC300, this stereo amplifier will produce 300 watts sustained power from each channel at 4 ohms. With 70% efficiency at full power, there is little heat produced. The specifications that follow are all based on continuous commercial service: True direct-coupled design; i.m. distortion under 0.05% from 1/100 of a watt to 300 watts, harmonic distortion under 0.02%; phase error less the 10° at 10 kHz; output ±50 V or 35 V r.m.s.; 300 watt sustained power from d.c. to 20,000 Hz; s/n is 100 dB; guaranteed short- and mismatch-proof, no thumps at turn on. The amplifier is considered suitable as a driver for any kind of transducer needing high power at low distortion.

Mfr: Crown International
Price: $685
Circle 55 on Reader Service Card

INSTRUMENT MODULES

- Field engineers should be interested in these new miniature instrument modules. Model 5246A is an audio distortion analyzer. Distortion can be measured at eight frequencies, including those required in FCC proof-of-performance reports. Resolution is 0.1% full scale with line level input. Model 514A is similar but an audio oscillator module is included. Model 5146A equips an engineer with a compact hand-carry unit for measurement of gain, loss, response, impedance, distortion, and noise.

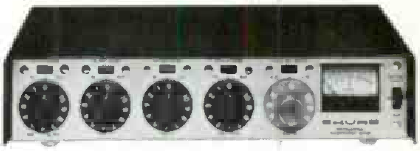
Mfr: Waveforms, div. of U.R.E.I.
Price: 5246A — $500; 5146A — $700
Circle 53 on Reader Service Card

TRANSCRIPTION EQUALIZER

- Dependable passive equalization is offered with these new broadcast equalizers for the newer high-impedance stereo cartridges. The model 808-A has a dual channel input with a single channel output. The 810-A is a complete two-channel stereo unit. Either one provides four equalization curves. The output of these devices can be connected to standard low-level mic inputs on the console, eliminating the need for additional preamplification. Input is 47,000 Ω with 50-, 150-, or 250-Ω balanced or unbalanced output at a level of —61 dBm with 5 mV input at 1 kHz.

Mfr: Gray Research
Price: 808-A — $69.75;
810-A — $97.50
Circle 58 on Reader Service Card

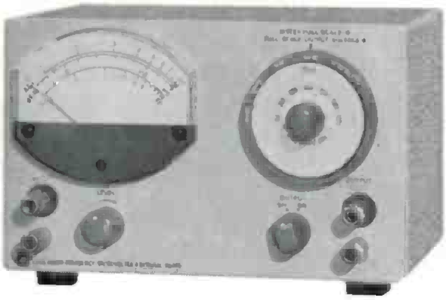
PORTABLE MIC MIXER



- Model M67 is designed for studio and remote location as a single, complete, compact console—or as an add-on mixer for expanding existing facilities. It provides four low-impedance balanced mic inputs and one line output. There is also a mic-level output. The built-in vu meter is illuminated and calibrated for +4 and +10 dBm out. Extremely low noise is claimed, along with r.f. rejection; wide, flat frequency response; headphone monitoring provision; and low-cut filters on each input position. Power may be had from a.c. or battery. There is an automatic switchover to battery if the a.c. should fail.

Mfr: Shure Bros., Inc.
Price: $147.00. battery supply—$12.60
Circle 33 on Reader Service Card

MICROVOLTER



• The model 1346 audio-frequency microvolter will convert almost any sine- or square-wave, noise, tone-burst, or other generator for operation as a calibrated-output source. In conjunction with an appropriate oscillator it can function as a source for any a.c. waveform from 0.1 μV to 10 V with a spectrum up to 100 kHz. A meter indicates the output of a continuous attenuator, which is applied to a 20 dB-per-step output attenuator. A total of 140 dB attenuation is provided by the two controls. The unit is not line operated, permitting it to float in a test setup as may be necessary to sum the output of the microvolter with another signal. An on/off switch permits the output to be reduced to zero without disturbing other controls or shorting the output; output impedance remains at 600 Ω.

Mfr: General Radio Corporation
Price: $250
Circle 54 on Reader Service Card

MODULAR CONSOLE

• Operational amplifiers are used to offer custom sophisticated features in this modular console. The AM 1648 has up to 16 inputs and 4 program channels and provides complete simultaneous stereo mixing including 4 individual pan puts. As a mix-down console, the system provides individual pan pots for each of the 16 inputs. The system can be assembled in modular fashion. You can start with 12 input modules and expand later to 16 with plut-in simplicity. Each input contains a slider control, 6 frequency-reciprocal equalizations, mic/line selection, individual pan pot, illuminated push buttons, and a solo feature that never interrupts recording circuits.

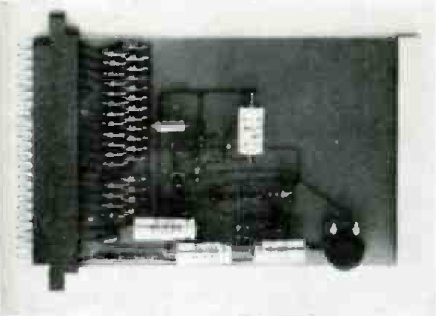
Mfr: Langevin
Circle 57 on Reader Service Card

PORTABLE TAPE RECORDER

• The new model 770 is an a.c./d.c. seven-inch reel, portable stereo tape recorder with several special features. Foremost is Sony's SNR noise-reduction system which provides noise-free playback of all recorded tapes by automatically reducing the gain of the playback amplifier during quiet passages. Other features include a ServoControl motor with built-in vari-speed tuning, built-in rechargeable nicad battery pack, and three speeds. Meters are provided for modulation measurement, a scrape-flutter filter is included, and low-impedance mic inputs use Cannon connectors. Mic and line mixing can be done. There are two forms, the 770-2 has four heads—two-track erase, record and playback, plus a four-track playback deck. The 770-4 is equipped with four track play/record/erase and an extra two-track play head. Important specifications are a 20-22,000 Hz overall response at the highest speed of 7½ in./sec. Wow and flutter is under 0.09 per cent at this speed, signal-to-noise is 58 dB (two track) and 56 dB (four-track). With the noise-reduction system switched in these figures become 64 dB and 62 dB respectively. Weight is 24 pounds.

Mfr: Superscope Inc.
Price: $750
Circle 36 on Reader Service Card

MIXING NETWORK



• A new 16-channel mixing network packed on a single plug-in card is now available. The model 692MNNL provides a mix for up to 16 inputs into one bus without gain loss. The card consists of a passive mixing network followed by the amplifier that makes up the lost gain and provides an additional gain of up to 20 dB. It accepts any source impedance of 600 Ω or lower and the number of inputs does not affect the output level. The card provides an interchannel separation of 70 dB or better. Since no inductive components are used, the card can be mounted near comparatively strong magnetic fields.

Mfr: Fairchild Recording Equipment Corp.
Price: $85
Circle 56 on Reader Service Card

REVERBERATION

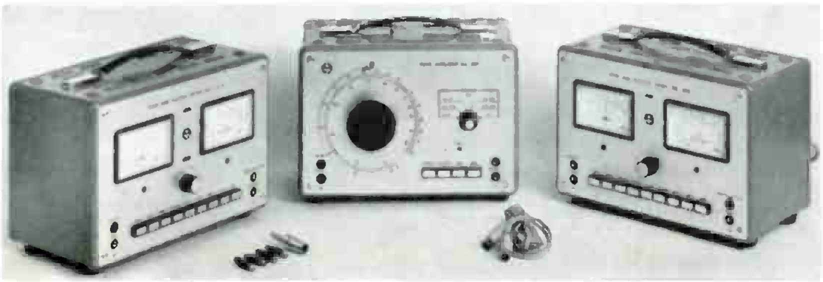
• In a relatively compact unit, a mechanical delay line, exciter, and equalized output amplifier — including a power supply — is offered. The model CV 571 has continuously variable reverberation time by means of a damping device, adjustable from the front panel. The delay line is carefully isolated against mechanical vibrations and several units can be mounted, one above the other, in a standard 19-inch rack. Input is 500 Ω balanced or unbalanced; input level is +6 dBm with no overload before +15 dBm; output is 50 Ω balanced or unbalanced at a level of +6 dBm into a load of 300 Ω; s/n is approximately 60 dB; and reverb time is adjustable from 0 to 3 seconds.

Mfr: Sennheiser Electronic Corp.
Price: $455
Circle 59 on Reader Service Card

FLUTTER ANALYZERS

• Three new solid state units are offered, of which two are flutter meters and the third is a precision wave analyzer able to determine the frequency of the offending flutter. Both of the flutter meters have separate meter indications for drift — the deviation from correct speed, and flutter content in percentage. Both instruments have a self-contained 3150 Hz oscillator which permits the recording of the test signal as well as calibration of the metering section. Both weighted and unweighted measurements can be made. Any input level above 30 mV can be used without the need for level adjustment. The model ME-102b unit has a relay that prevents erroneous readings from insufficient input signal level. It also provides switching between 300 Hz and 3150 Hz to accommodate both international and U.S. frequency standards. Flutter between 1 Hz and 315 Hz is metered. The ME-301 wave analyzer provides precision continuous tuning between 1 Hz and 330 Hz making possible exact diagnosis of the source of flutter. Filter steepness of more than 40 dB/octave, self-contained amplifier for loss-free operation, and means for self-calibration are features of this unit.

Mfr: Woelke, dist. by Gotham Audio Corp.
Price: ME-104 — $365
ME-102b — $460
ME-301 — $780
Circle 60 on Reader Service Card



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People, Places, Happenings

Vink

- **Pieter C. Vink** has been elected president and chief executive officer of **North American Philips Corporation.** He succeeds **Pieter van den Berg** who has been elected chairman of the board of directors. Mr. Vink had been president of the former **North American Philips Company, Inc.,** which was merged with **Consolidated Electronics Industries Corp.,** to form the new corporate structure.

- **Mervin Kronfeld** has been appointed general sales manager for **Nortronics Company, Inc.** Before assuming his new position, he was director of international marketing, in which capacity he recently established sales offices serving all of Northern Europe. He previously has set up a regional office for the New York metropolitan area after joining the company in 1967. Three other men have been promoted at Nortronics. **Len Unger** is now a staff industrial engineer, **Willy Schrepfer** is pilot production engineer, and **Kenneth Faulkner** becomes a procurement engineer. Nortronics is the United States' largest manufacturer of magnetic audio tape heads.

- **Joseph Rabushka** became the national sales director of **Rectilinear Research Corp.** as of November 1 of last year. Mr. Rabushka has had wide experience as a retailer having managed both **Harmony House** and **Thalia** in New York. Mr. Rabushka will work with **Martin Gersten,** general manager and technical director of the company since September of 1967. Before coming to Rectilinear, Mr. Gersten owned and operated a sound-recording studio and was chief engineer of **WNCN** radio in New York.

- Add to your calendar the dates of **July 14th to the 18th** for the **third annual Brigham Young Audio/Recording Seminar** to be held at the **Brigham Young University** campus in Provo, Utah. There will be lectures, discussions, demonstrations, and an equipment exhibition. Reservations should be made by contacting Dean Vanuitert, 140 Herald R. Clark Building, Brigham Young University, Provo, Utah 84601. Call (801) 374-1211, ext 3761.

Walker

- **Saul A. Walker** and **Donald L. Richter** have been appointed to senior executive positions at **Automated Processes, Inc.,** manufacturers of professional audio systems and components. Mr. Walker has been named vice president and director of engineering. He previously held a similar position at **Digital Electronics Inc.** Mr. Richter, appointed sales manager for audio systems, was formerly with **Melcor, Inc.** and **RCA's Victor Record Division.** He is the inventor of RCA's **Gruveguard** record, and holds additional patents pertaining to dynamic equalization systems. Both men are residents of Long Island, New York. Automated Processes is located in Farmingdale, New York, also on Long Island.

Richter

Stevenson

- **Craig Stevenson** has been appointed marketing manager of the professional audio division of **Harman-Kardon, Inc.** In an announcement by the firm's president, **Walter Goodman,** Mr. Stevenson's background in c.a.t.v. system operation, plus lengthy field experience as a technical representative were described as reasons for his appointment. Mr. Goodman continued: "Craig (Stevenson) has worked closely with sound contractors which gives him a clear understanding of their particular requirements." Mr. Stevenson comes to H-K from **Jerrold Electronics Corporation** where he served in the capacity of assistant manager of the company's operations division.

Wagner

- Veteran radio and television personality **Jack Wagner** has been named executive producer — a and r for the newly formed recording division of **Superscope Inc.,** according to an announcement by Superscope president **Joseph S. Tushinsky.** The company, exclusive distributors of **Sony** tape recorders and related equipment, recently announced the formation of a recording division to produce commercial recordings.

The Altec monitor/playback speaker has a new big brother: the 9845 Senior.

When we introduced our Model 844A, (now recoded as Model 9844A), Compact Monitor/Playback Speaker System about a decade ago, broadcast, recording, television and radio engineers quickly adopted it as the standard of excellence and comparison.

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We think it's the finest Monitor/Playback system available. As a critical audio engineer, you will agree.

Get the whole story by asking for data sheet AL-1756 on the Senior Monitor/Playback Speaker System. Write Altec Lansing, 1515 South Manchester Avenue, Anaheim, Calif. 92803.

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