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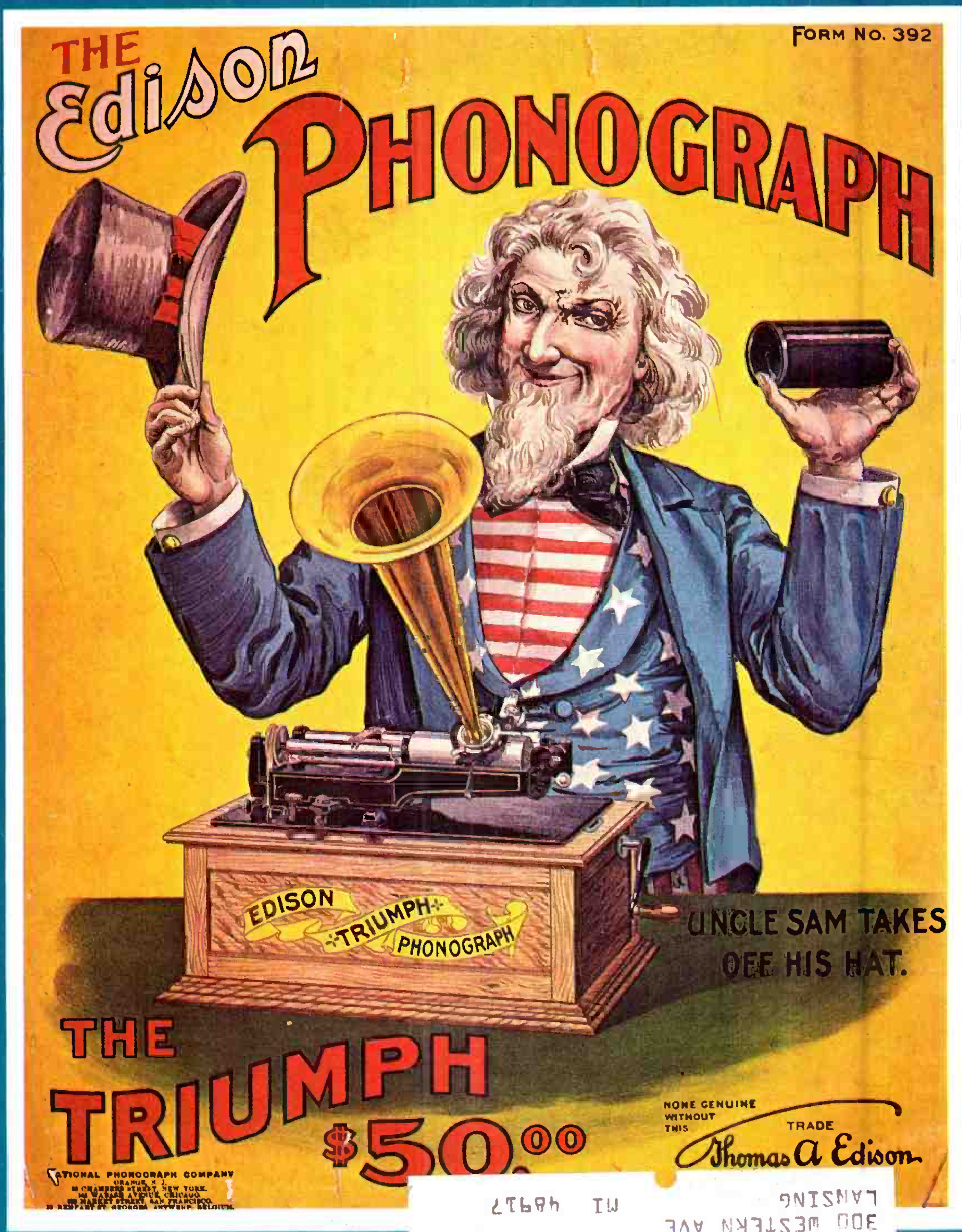
THE SOUND ENGINEERING MAGAZINE

APRIL 1977 $1.00



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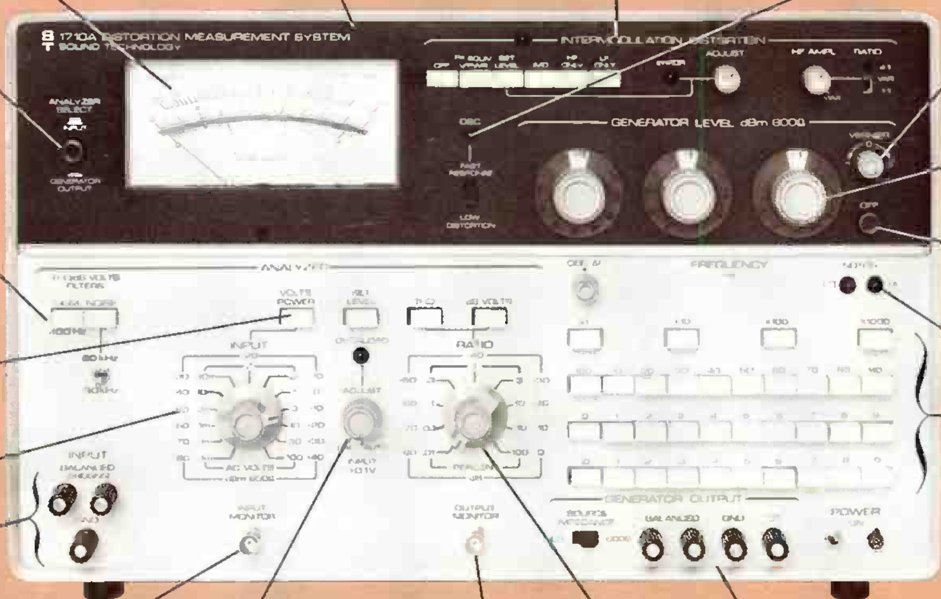

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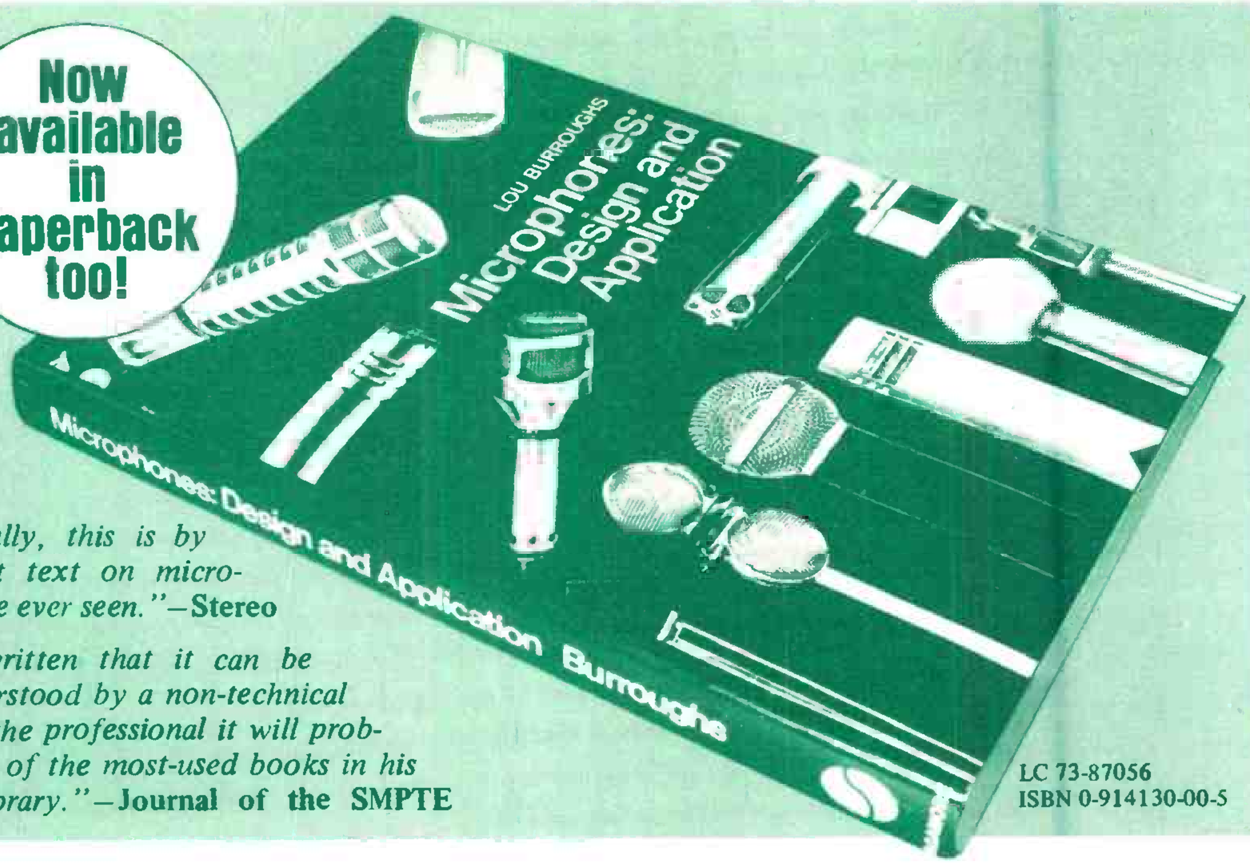

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THE SOUND ENGINEERING MAGAZINE

APRIL 1977 VOLUME 11, NUMBER 4

coming next month

In May we will explore the peculiarities of loudspeakers and preamplifiers.

- In Low Frequency Sound Reproduction, Michael Rettinger details the requirements necessary to bring up bashful bass sounds.
- John Maxwell tells, in Noise of Sources, exactly why the s/n of preamplifiers in real life never matches their specifications.
- Translated from a German magazine comes a definitive discussion of The Transient Behavior of Microphones, by Stephan Peus.

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about the cover

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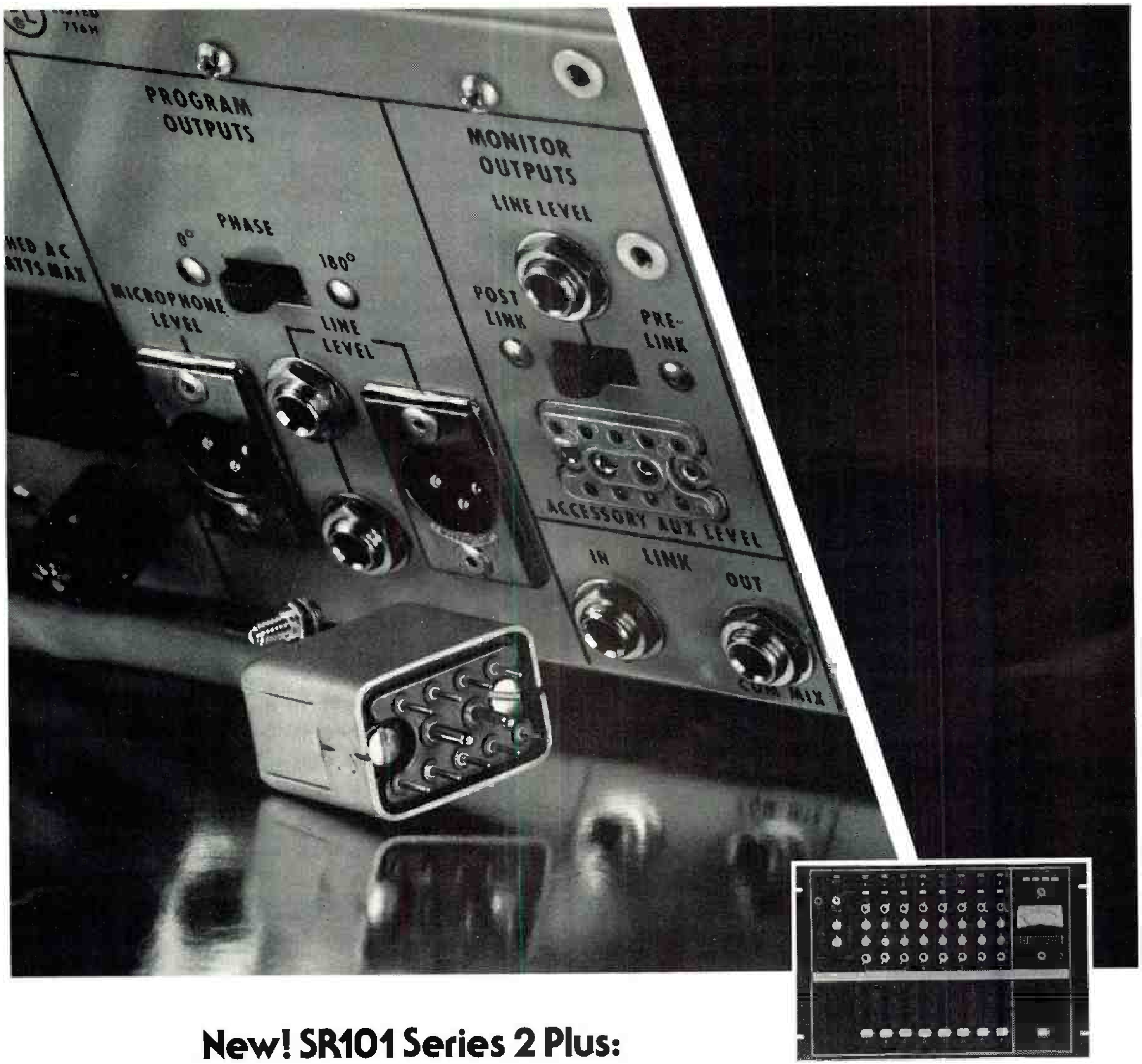

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MAY

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9 **National Video Production Workshop** (Sony) Hoffman Electronics, 800 W. Pico Blvd., Los Angeles, Ca. 90015. (213) 749-3311.

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10-13 **A.E.S. Show.** Los Angeles, Ca. Hilton Hotel. Contact: AES.. 60 E. 42nd St., NYC 10017. (212) 661-8528.

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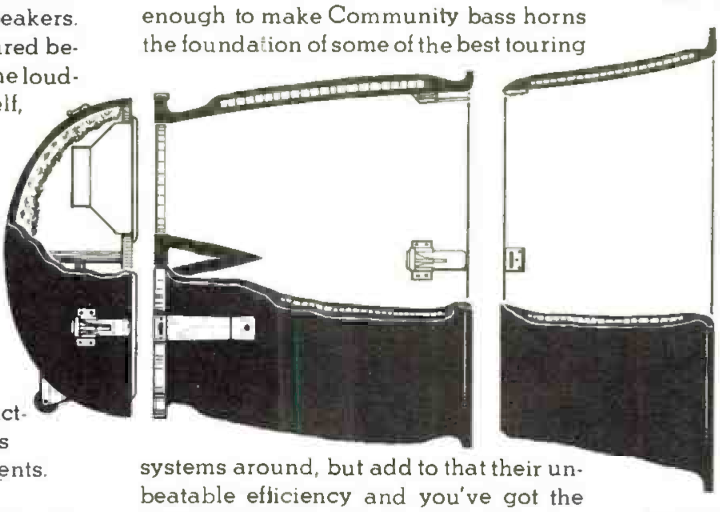

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PATRICK S. FINNEGAN

A. M. Monitoring Problems

• The modulation monitor should provide us with reliable information about the carrier modulation during programming and yield accurate results when we are performing tests of the transmission system. There can be component failures in the monitor, as well as incorrect calibrations or operations, which produce erroneous indications. Faults in the transmitter itself may produce misleading indications on the monitor. This month we will discuss some of the problems of monitoring and testing the system.

RF INPUT LEVEL

Almost all of the functions in the monitor depend upon the audio output of the detector for their correct operation. The audio coming from the detector is determined by the rf input level to the detector. Maintaining the correct rf input to the detector is very important for the accuracy of the monitor.

There are two aspects of level control that must be considered: the amount of rf which is fed into the monitor, and the amount of rf fed into the detector. The monitor feed can be checked out with an oscilloscope and then taps changed in the transmitter so that this level does not exceed the amount specified in the manual for that monitor—excessive power at this point will burn out cable terminating resistors (if used) and the monitor input potentiometer. Once the feed amplitude is checked to be within specified limits, the input control on the monitor should be adjusted so that the carrier level meter on the monitor reads 100 (without modulation).

POWER CHANGE

Although the rf level into the detector must be constant, many stations operate at a different power level at night than they use during the day. These power changes can be very substantial; for example, 5 kW day—1 kW night, 1 kW day—250W night, etc. Where a special receiver is used ahead of the monitor, the AGC action will usually maintain the output reasonably constant over a 12 dB input

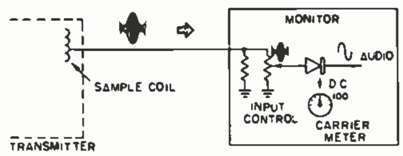


Figure 1. Adjust sample coil taps to keep feed within specs. Then adjust input control so the carrier meter indicates 100.

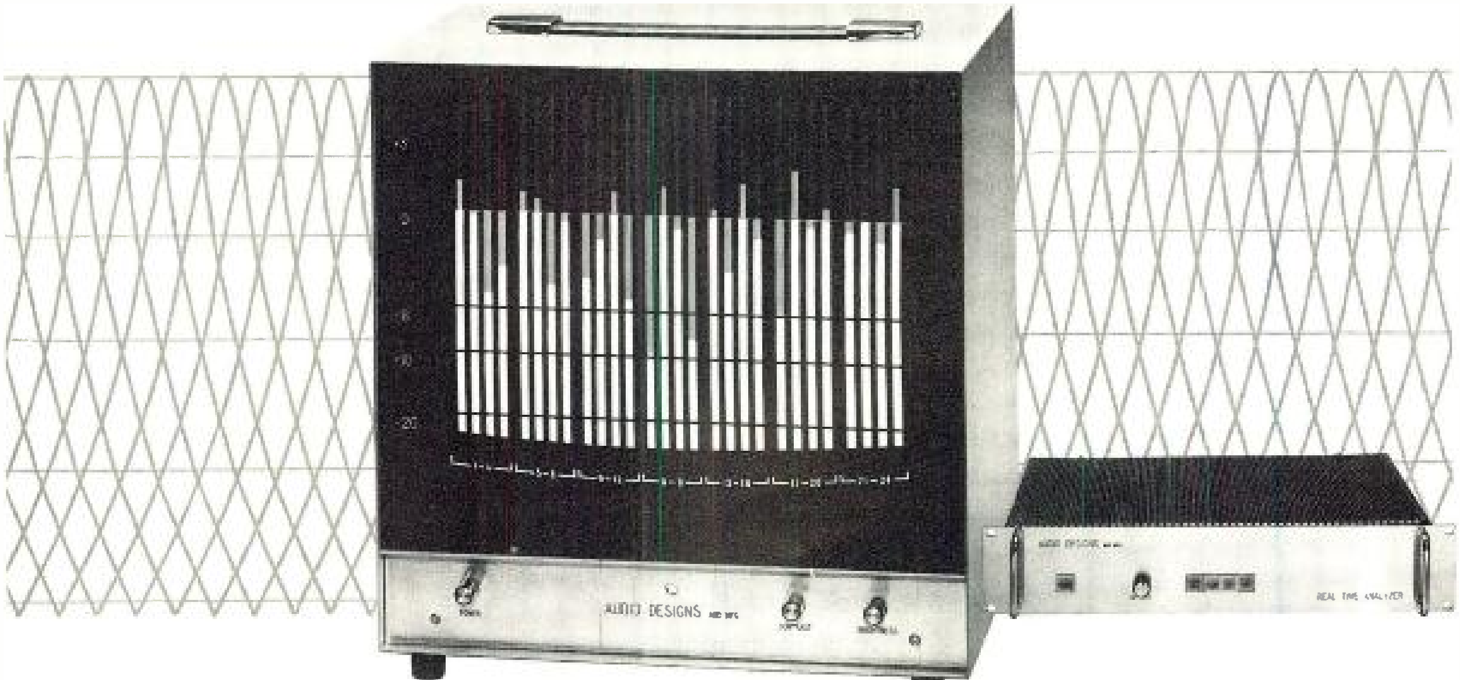
change. Late model transmitters incorporate an automatic circuit to do this, with a direct feed to the monitor. Older model transmitters do not have the automatic correction and must be adjusted manually at the monitor.

The automatic circuit in the transmitter is usually a relay and a wirewound potentiometer. If the relay fails to operate it is quickly obvious because the monitor shows some drastically different indications. A more common but lesser problem occurs when the wirewound potentiometer straddles a couple of the wires in the pot and produces an erratic output that changes the monitor input only a few per cent, but throws the monitor indications off this same amount. The best cure for this problem is to change the tap on the sample coil in the transmitter until a position is found where the pot can operate at a more solid position.

CARRIER SHIFT

Carrier shift is a transmitter problem that can produce inaccurate modulation indications on the monitor. The shift can be either positive or negative, but the most common variety is negative carrier shift. Many of the older transmitters exhibit considerable carrier shift when being modulated at high levels with superprocessed audio. Carrier shift is basically a decrease (or increase) in the average carrier power during modulation, and it has essentially the same effect on the monitor as lowering the rf input level control to the detector by the same amount. If carrier shift is a problem with your transmitter, here is a way to check out its effect on the

NOW! See what you hear



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monitor indications of modulation.

Observe the rf signal coming out of the transmitter on an oscilloscope, set the monitor input to 100 on the carrier meter, and then modulate the transmitter to 100 per cent negative with an audio tone. Increase the modulation level until the two negative envelope peaks just "kiss"—this is 100 per cent negative modulation. (Assume the transmitter has 5 per cent negative carrier shift.) The carrier level meter on the monitor will now indicate 95 instead of 100, which you had set previously. The modulation meter will indicate about 95 per cent modulation, and if you check the flasher circuit, it will indicate 95 per cent modulation. Thus, the monitor indicates 95 per cent modulation, yet the 'scope verifies the fact that the carrier is 100 per cent modulated! If the station is operating with this amount of carrier shift, the technicians should be alert to the fact that when the monitor indicates peaks of 95 per cent that is 100 per cent modulation.

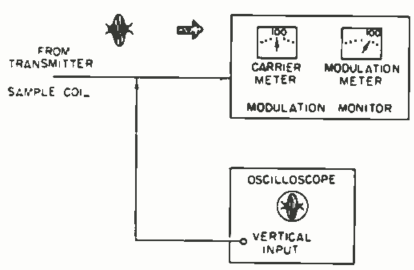
Operational problems can occur if the operator is not alert to the effect on modulation indications caused by carrier shift. In the example just discussed, if the operator should observe that only 95 per cent is shown on the monitor, he may try to increase the modulation up to 100 per cent indication by increasing the audio input to the transmitter. This would now overmodulate the transmitter, cause channel "splatter" and increase distortion.

When carrier shift develops in a transmitter that normally exhibits very little shift, the carrier level meter will indicate this and should warn the operator that troubles have developed or are brewing in the transmitter. The p.a. tube may be going sour, or a solid state p.a. module is defective or some similar problem is present.

LINEARITY

Poor linearity in the transmission system can create problems in monitoring, as well as in the audio signal itself, and it can also be an indicator of problems that are brewing, but at this stage are only showing up as poor linearity. (Our concern here is for the input/output signal amplitude fidelity,

Figure 2. A setup to measure the effect of carrier shift on monitor indications.



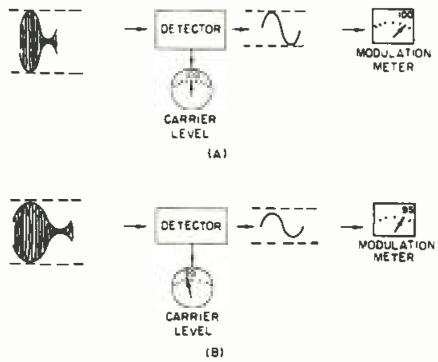


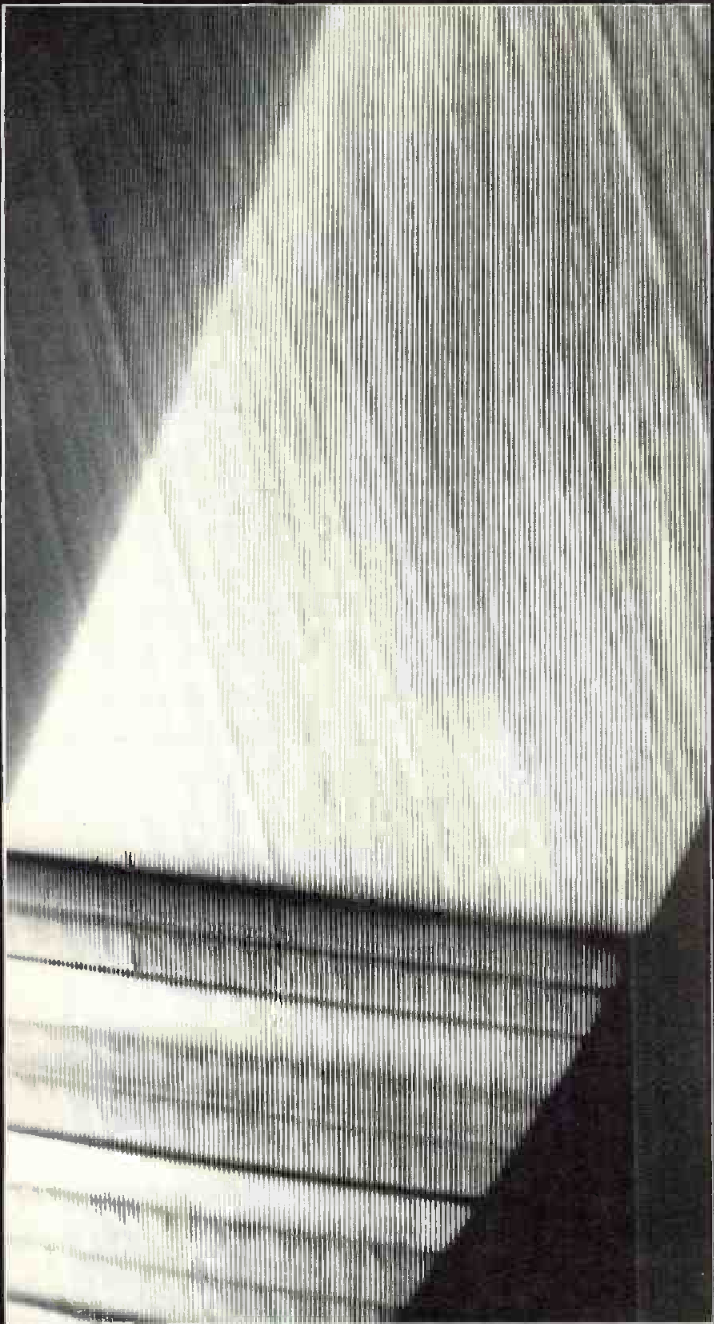
Figure 3. Negative carrier shift has the same effect on a monitor as adjusting the input control to reduce rf input to detector. (A) Without carrier shift. (B) With 5% negative carrier shift.

rather than the asymmetrical modulation technique.) The audio recovered in the monitor should have the same amplitude fidelity as the audio which goes into the transmitter; otherwise there is non-linearity in the system. An oscilloscope with good linearity itself can be used to check system linearity, indicating whether the non-linearity is in the transmitter or in the monitor.

Set up the oscilloscope to observe the unmodulated rf out of the transmitter. The 'scope is going to be used as the monitor, so line up the rf signal peaks with horizontal graticule lines on the cro face. Select a line for the zero axis of the rf carrier and then at least four main divisions above and below this zero axis. There should be a half division line or mark between each main horizontal line. Center the rf trace so that the peaks are exactly on main line 2 above and main line 2 below zero center. Be careful to maintain the zero axis on this center horizontal line. Set the carrier level meter on the monitor to 100. Introduce audio tone directly to the transmitter behind the processors.

Modulate the transmitter to 100 per cent negative modulation and use the 'scope as the modulation indicator. Align the peak to peak amplitude of the waveform with the +4 and −4 horizontal lines of the graticule. Both sides of the waveform are symmetrical, so it is only necessary to work with one side, but keep it centered on the axis. With the 'scope indicating 100 per cent modulation, the modulation meter should indicate 100 per cent (0 dB) also. This is the calibrating point.

Now reduce modulation until the peak envelope is at + 3.5 lines; this is 75 per cent modulation and the monitor should indicate 75 per cent (−2.5 dB) modulation. Again lower the modulation until the positive peak is at +3 lines; this is 50 per cent modulation



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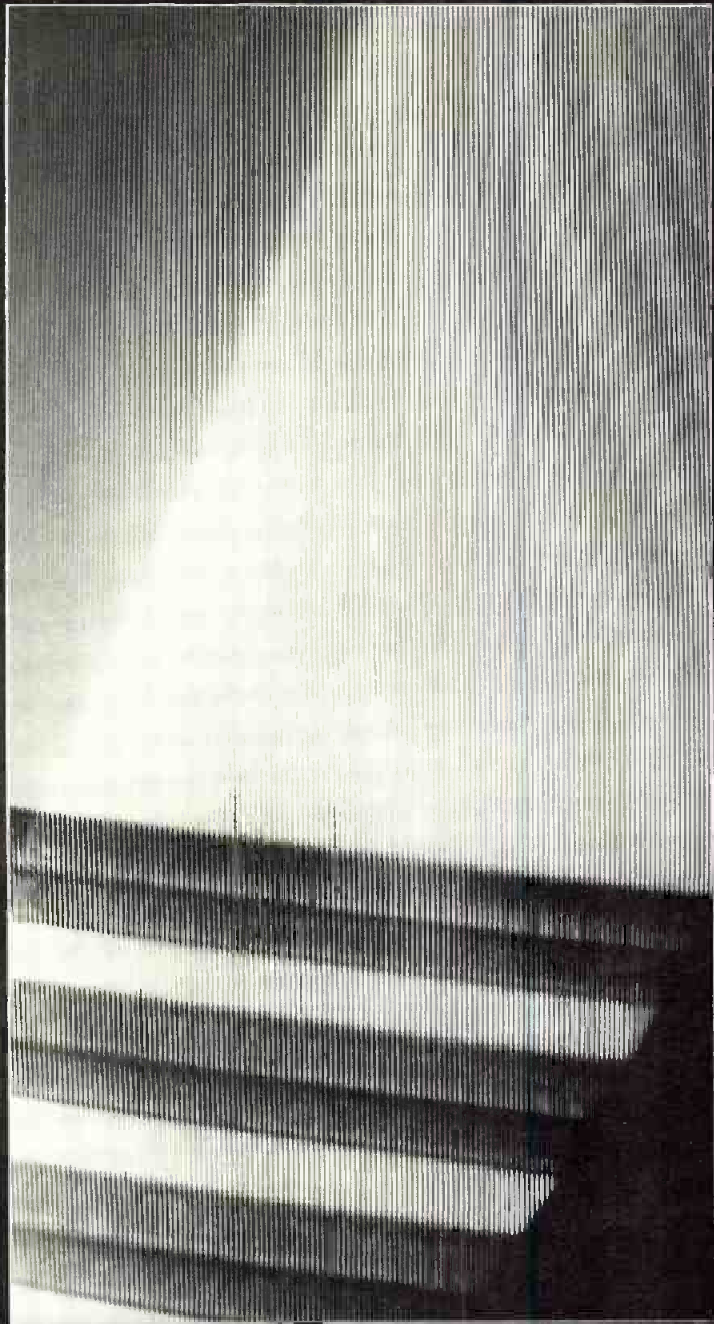

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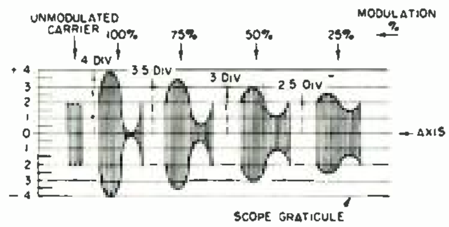


Figure 4. Use the oscilloscope graticule to determine the modulation percentage.

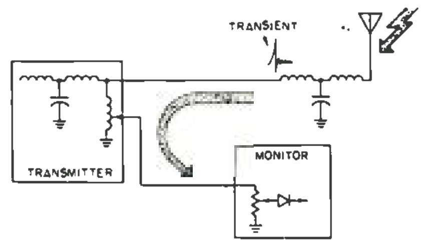


Figure 5. Transients from lightning discharges can damage the detector diodes.

and the monitor should indicate 50 per cent (−6) dB modulation. Reduce the modulation still further until the peak is now at + 2.5 line. This is 25 per cent modulation and the monitor should indicate 25 per cent (−12 dB) modulation. The linear system will require those dB changes in the audio for equivalent percentages of modulation. So compare notes—if the audio input levels do not agree with the required dB changes, then there is nonlinearity in the transmitter. But if the transmitter is linear and the modulation meter does not agree with the 'scope percentages (and the dB's), then there is a monitor problem.

TRANSIENTS

The monitor which taps directly into the output circuitry of the transmitter for its feed is susceptible to damage from transient surges caused by lightning discharges down the tower. The tuned circuits and line losses will reduce the effect, but a strong surge may get through and either damage or destroy the detector diodes. The transmitter need not be on the air for this to happen. It can occur in the middle of the night when the station is off the air. So if there has been a severe electrical storm and the monitor is now acting erratically, showing low indications or none at all, check out the detector diodes.

PEAK FLASHER

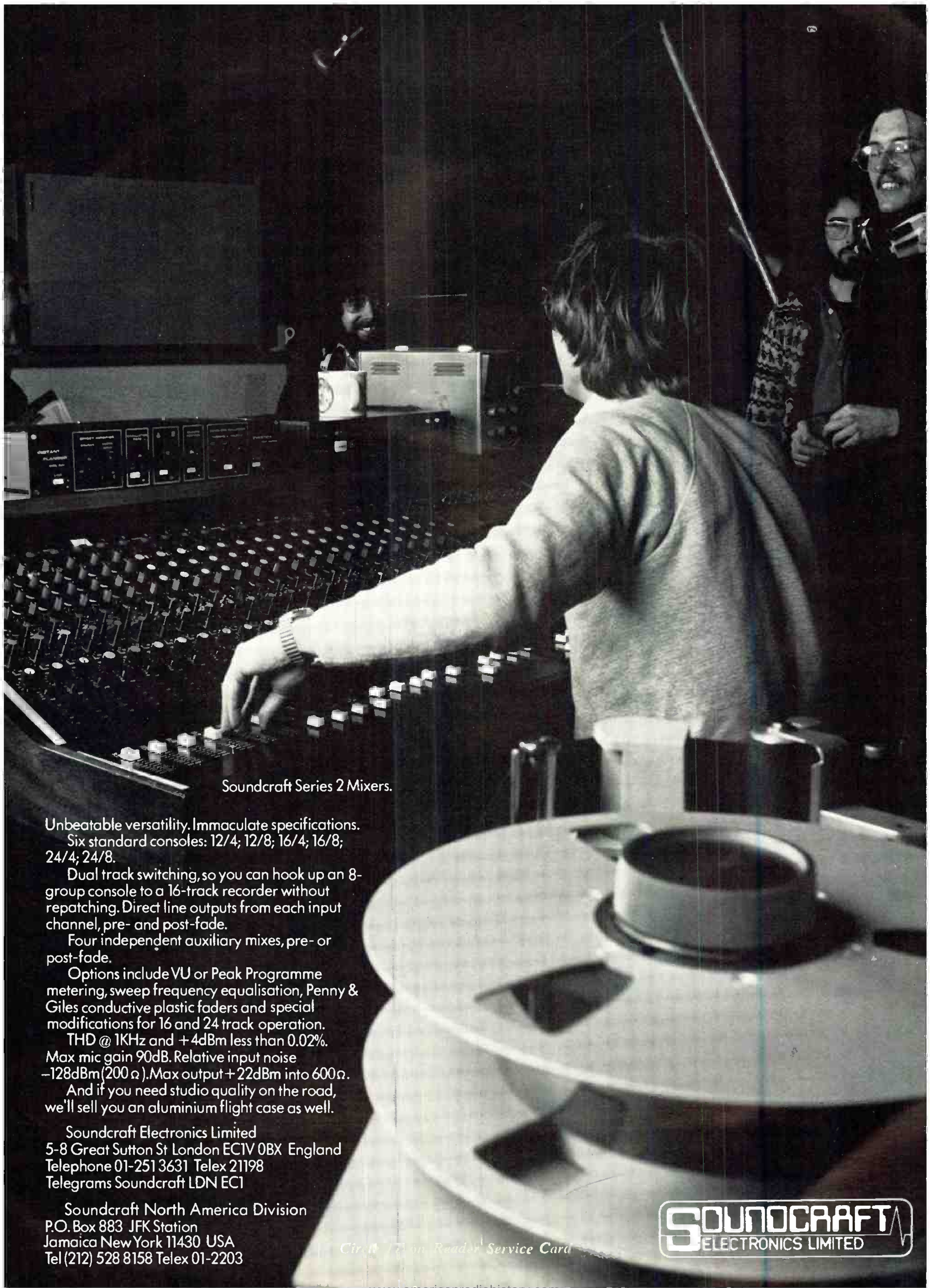
The peak flasher and the modulation meter will not always agree during program modulation. This is a normal situation and it is the reason for the peak electronic flasher. The modulation meter circuit has special damping and ballistics, so there must be a series of peaks in a time span for it to build up to read a peak value. The peak flasher will indicate any peak that exceeds its threshold setting. But if the modulation is a sine wave, then the peak flasher and the modulation meter should agree. If they do not, calibration is called for, as per the instruction manual.

MODULATION METER

The response of the modulation meter circuit must be within ½ dB across the audio band of 30 Hz to 10 kHz (to meet FCC requirements). You can check the response curve of this circuit by use on an oscilloscope and tone modulation of the transmitter. Select a modulation percentage that will be easy to identify and maintain on the 'scope. Set the reference tone as you would in running response measurements in a proof run. We are doing the same thing, but are now using the 'scope as the modulation monitor. By keeping the modulation percentage the same for each tone as indicated on the 'scope, the transmitter's response variations will not enter into the consideration. As you make each tone test and set it to the modulaion percentage you decided upon, compare the indications on the modulation meter. If they do not track within ½ dB across the audio band to 10 kHz, some maintenance is called for in the monitor.

SUMMARY

There are many problems which can beset the monitoring function of the a.m. station. We have only had space to discuss a few of them here. The modulation monitor is an operational test instrument, and as such, it is no different than any test instrument that measures equipment in the shop or workbench. Results depend upon the accuracy of the instrument, the procedures used, and correct interpretation of the results. The operator should look upon the monitor in this light. ■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• My recent columns, or what I have been saying in them, have got me talking to radio station owners and managers. One of the typical responses is that t.v. has cornered whatever educational market there is and it is so much better, or more something or other, than radio could ever hope to be. So why try to be a poor cousin, on radio?

How much educational t.v. have you watched? Or have the radio people who fire this question at me watched? Of course, the biggies, for a long while, were *Sesame Street*, and *The Electric Company*, programs put on the air by Children's Television Workshop, funded by the U.S. Office of Education, or various foundation grants.

They have stayed on the air a long while because the visual effects intrigued tiny tots and not-so-tiny tots, and the producers could persuade the funding agencies they were doing a good thing, that as a result schools would benefit by receiving children better conditioned to learn. Instead, the "experts" are reluctantly concluding that what they receive are children conditioned to ever more idiotic cartoons on Saturday morning shows. Kids of all ages, yet!

They are being forced to conclude that both these preschool focused efforts and the Television Classroom of the Air type of thing have been grossly over-rated. Well, maybe there are some good educational programs on t.v., but they are far between. If we examine the medium a little more critically, the reason is not difficult to see. And the reason I mention it here is that it leaves the door wide open for radio—things that readers of this magazine could get themselves into.

But isn't it possible to communicate far more by t.v. than could ever be conveyed by radio? People who ask that question do not realize that communication is not the most important ingredient in good education: involvement is.

INVOLVEMENT

We have seen it in the classroom, and we have experienced it in the classroom. The teacher or lecturer who has quite a polished performance, perfected over years of repetition: you watch and what he is teaching seems so plain, so simple—until later, you try to use it, or apply it. Then you find you cannot remember how he did it or what he showed you.

For entertainment, that is fine; there is no reason why you should remember what entertained you. The purpose is enjoyment. But when you want to learn, you need to be involved so that **you** do it, not the teacher; so that you exercise your *own* mind rather than just following something that seems too simple to need exercise.

If someone drives you from one place to another over a complicated route, you may be talking about something and pay little attention to where he makes the turns. Then if you are asked to find your own way over the same route, you get lost. But if you know that later you are going to have to find your own way, when you go with the man who knows, you pay careful attention to landmarks.

To do this, you become involved. You are no longer "just along for the ride." When you are shown something on t.v., the professional has little difficulty making it look easy. And you have little incentive to try it along with him—in fact, it is difficult to do so. You need eyes and ears to watch him, so how can you at the same time do it yourself?

This is where, although you may not think of it that way, radio actually has an advantage over t.v. Your listener has, or should be encouraged to get, a workbook, or some other visual that he can manipulate and thereby become in-

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volved in the learning process. He is no longer just watching and listening, a captive audience He is learning to do what you describe to him.

VISUAL AIDS

You, or your graphic arts people, prepare the visual part and have it reproduced by whatever process is least expensive for the quantities involved. And you design it with certain parameters in mind, just as you design any other kind of program that is to hold the listeners' interest. You must picture how the whole range of listeners will react.

For your program to get off the ground, your audio must tell enough about the visual device to make the listener feel he wants to be able to try it while you talk to him. He does not have it now, and the best he will be able to do is get it by, say, this time next week. So the program must convey enough to let him know that he could do it if only he had the visual part—in fact he should nearly be able to "get it" without the visual.

Good, you've got that listener in mind. But now, as soon as you get going, you will also have listeners who have the gizmo, visual in whatever form. While you are interesting those who don't have it yet, you must not bore those who do. You need to stimulate them to follow through, so they find it as intriguing as they thought they were going to when they decided to obtain it.

You now have two steps of the learning process in mind. But if you do only that, your listeners may soon tire of it. They have found out what it is now and are looking for some other novelty to catch their interest. As well as doing those other two things, you must maintain their interest so they will be wanting to hear the next program you air.

Is that all? Not quite. If you organize your material too tightly that way, it will be fine for those who start at the beginning and never miss a program. But if someone misses a program, he will find himself lost when he listens to the next one. What this says is that each program should aim to be self-contained so that anyone who is interested in the subject will get something from it, even if he has not studied all the prerequisites to be able to get everything possible from it.

SEQUENCE

As I have commented before, the traditional way to organize an educational course is in a prescribed sequence so that every lesson depends on many of the lessons that came before it. When a course is organized this way, taking it out of sequence makes learning very difficult.

So, in addition to the requirements we have already mentioned, that the material should be at least comprehensible to a newcomer, that it should interest both those who have the visuals and those who will still want to get them, it should not bore someone who has taken more advanced material before.

That sounds like a tall order, but it is easier than you think. One of the reasons that make it difficult is language itself. When I first started to write, I used the kind of English that I had learned in school. I had learned about simple sentences, compound sentences, and complex sentences. So for one thing, I sought to use some of each, to show that I knew how. But there was another factor: if you use compound sentences, your reader, or listener, is apt to mentally "cut you off" before your sentence is finished. And if you use a complex sentence with the conditional part, or qualifier, last, he will overlook it, accepting the first part as an absolute statement.

For example, suppose you say, "You should never go out on a Sunday if it rains." The "if it rains" is apt to get overlooked. So the safe way, to avoid its being overlooked, is to put the qualifier first: "If it rains on Sunday, you should not go out."

That sounds simple enough. But now, particularly in technical writing, if you follow that practice your sentences can get quite long, to make them "safe." Suppose I am writing, as I have done, about cathode followers, or emitter followers. To make my statement, I have to get a number of qualifiers in before I say what it is I want to convey.

The condition I am writing about uses a low current, smaller than the peak output current at the impedance I want it to be. It also uses the full base or grid swing, as input. Then it has a high cathode or emitter resistor, to which is a.c.-coupled a much lower impedance. Now, having strung those conditions together in a suitable complex sentence, what I want to say is that the feedback I calculated I would have is no longer there and that the low distortion figure I expect will go out the ceiling.

Faced with trying to say all that in one sentence, it says that either cathode or emitter followers distort under conditions the reader or listener gets tired of listening to before I am through. In that case, if he "knows better," that followers are inherently low-distortion devices, then obviously I am wrong! Or else the sentence becomes so in-

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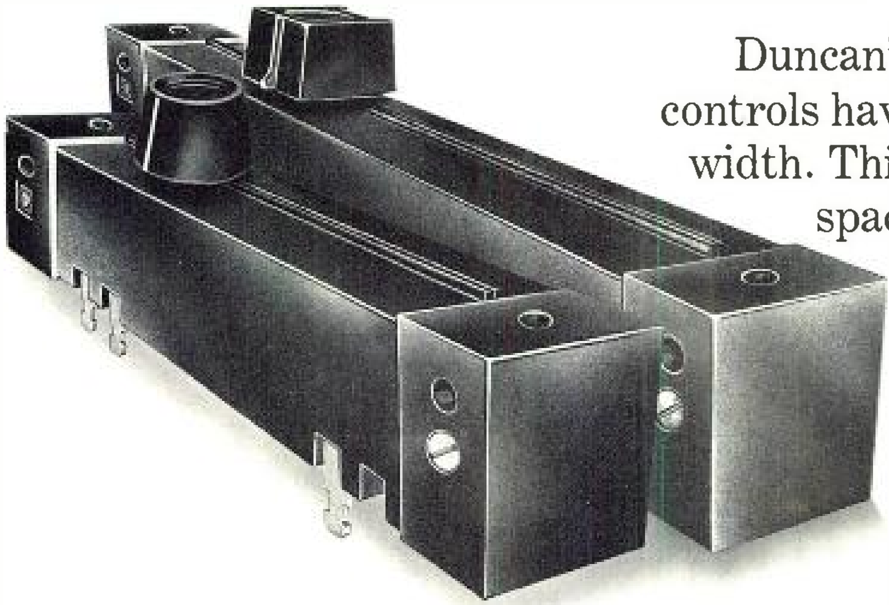

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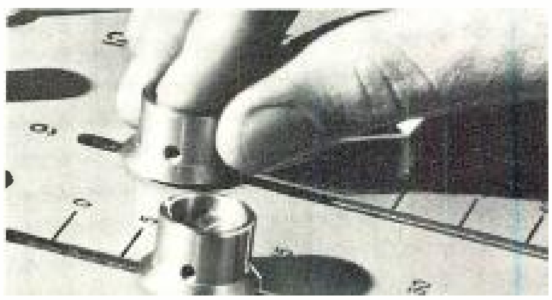

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volved before it says what I started out to say, the reader or listener never gets there. Either way, my sentence structure defeats my object.

How did I learn better than that? I encountered a certain good editor, who liked what I had to say, and had the persistence, some of the time at least, to puzzle it out. He would read me one of my own long sentences, which still seemed plain enough to me because I wrote it. But then he would say, "Maybe I am dense. If not, a lot of my readers are. Would you tell me what you are trying to say?"

So then, in much shorter sentences, I would break it down, and explain it to him, step by step. "Good," he'd say, "I can understand that. Now why don't you write it like that?" That was a tremendous step forward. I drilled myself on doing that, without him telling me to. Is that all? Not quite.

What he was saying, in a sense, was "Be conversational." But good conversation has one advantage the writer, or even the radio speaker or teacher, does not have: it is two-way. To revert to the emitter follower example: suppose I start by saying that, under certain circumstances, an emitter follower can distort very badly.

I am assuming that my reader or listener will hang on to find out what the circumstances are. Now, having said that bit, I may get sidetracked and omit to complete a description of the circumstances. So he will get the impression that an emitter follower is a high-distortion device by nature. When that happens in conversation, he may say, "But I thought an emitter follower. . . ." Thus he gives me the opportunity to correct myself.

CONVERSATIONAL WRITING

The trick, in good writing, if it is to result in teaching and even more so where it takes the form of audio, is to simulate good conversation. Do not try to avoid ever being misunderstood, even for a moment. That was my mistake that my editor friend pointed out to me. Instead, make sure you hold the reader's interest so he will not get left stranded with a misunderstanding.

In audio, as you might use it on radio, you can interrupt yourself with " 'Just a minute there,' you say," and then you have the listener raise an objection that may or may not already be in his mind. Either way, you maintain his interest to see what the answer is. He sees what the objection is and what the answer is and gets it straight, step by step.

That sort of thing does not go quite so well in writing, as yet anyway, but it does very well in audio. You can indicate voice inflection, if you are writing a script, to simulate a different person asking the question. Or if you can manage it, you can change the pace by using a group of people. Choose individuals with distinctively different voices, preferably some male, some female, to add to the contrast.

Then write the script, just as you would a dramatic presentation, keeping each one in character—not forgetting that being inconsistent can sometimes be a character—so that various of your listeners will identify with your "live audience" students. In this way you can simulate the responses or reactions of individuals with different learning style: the coldly rational, the emotional or intuitive, and so forth.

This way, you will usually know whether your material is any good before it goes on the air simply by how well your actors can get into their parts. And incidentally, here you are better off to have people who do not know the subject matter and thus must learn it as they act it.

You have all seen the t.v. show where an actor recites some mathematical formula that is obviously gibberish to him, but he tries to pretend he is the mathematical genius? Well, if you have done your work right, that will never happen to your script. If it does, you had better rework it! ■

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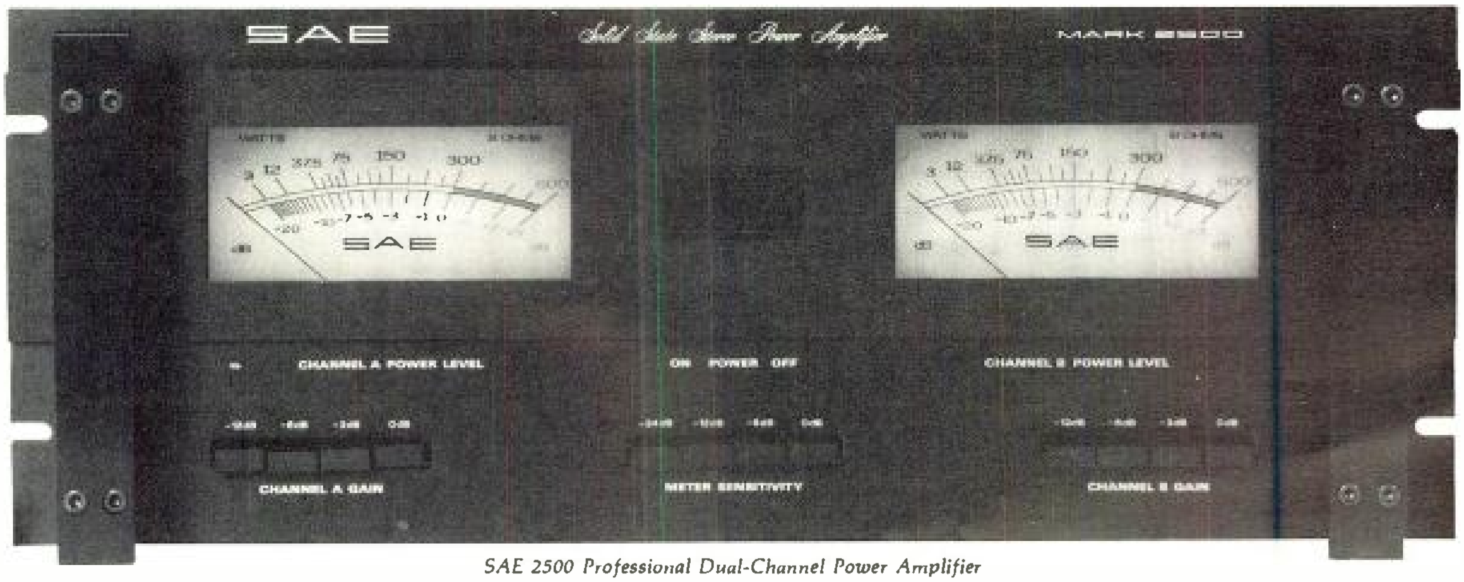

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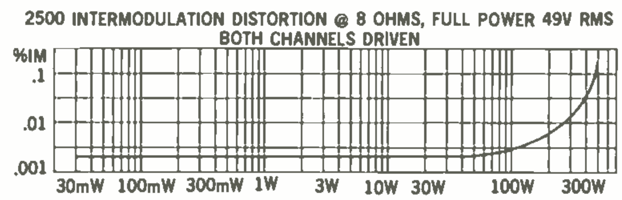

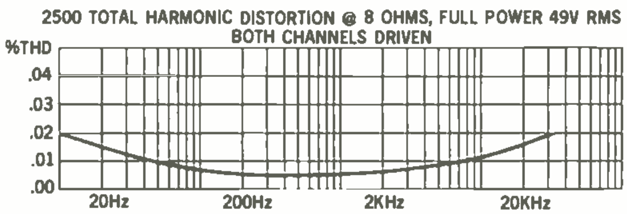

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Glossaria Interruptus

• When any new book is published, the first edition invariably contains a typo here and there that is discovered after the book is on the shelves, much to everyone's surprise. Needless to say, my own opus is no exception; but even more disastrous, I found out—too late! —that the editor had removed a sizeable portion of the glossary, no doubt to save himself a few pennies.

So, since he never reads the **Sync Track** anyway (for good reason, Ed.) I take this opportunity to set things right, by offering the missing information. This is merely in keeping with **db**'s policy at this time of year, when we offer the readership a little something extra, beyond the limits of our traditional level of scholarship. However, those who have not yet bought the book are honor-bound not to read this column. Besides, without the book, it won't make much sense anyway. (I have the book, and it still doesn't make any sense. Ed). Here then are the deleted words.

Echo Return—A tape sent back by a client, because the reverberation drowns out the soloist.

Adaptor Kit—An assortment of two-way connectors, allowing you to join together any possible combination of mis-matched plugs, except the two you have in your hand.

Tape Delay—What happens when you ask your supplier for an emergency shipment of blank recording tape.

Balanced Line—An engineer's explanation of why there is too much distortion on the tape. The explanation is a 50:50 blend of sense and nonsense.

Unbalanced Line—An explanation that is so ridiculous, not even a producer would believe it.

Bi-directional Characteristics — A groupie who could go either way. Sometimes called a.c./d.c., which refers to two different kinds of bias.

Discrete Quad—A quad system in which the rear channels are so low in level, the listener thinks he is listening to stereo.

Out-Take—Trying to get one of the background vocalists into your car after the session.

Cocktail Party Effect—A production aid for out-takes.

Auto-Locator—What you may need if the cocktail party effect is overly successful.

Direct Pickup—Something to try when the cocktail party effect doesn't work.

Dispersion—What happens to the road crew when it's time to pack up.

Perfect Take—The one that was just erased.

Depth Perception—Trying to figure out what the producer really knows about recording.

Coercivity—Ability to talk the producer into paying for dinner.

Recovery Time—After a session, the time it takes until you can once again hear normal conversational levels.

Background Noise—The soloist's opinion of everyone else.

White Noise—Everyone else's opinion of the soloist.

Black Box—Any signal processing device that the engineer doesn't understand.

Dolby Tone—A calibration tone that is omitted on Dolby-encoded recordings.

Reference Level—The point at which your meters peg.

Dyne—Eating out, as opposed to sending for sandwiches.

Energy Transfer—Getting someone else to do the heavy work.

Envelope Follower—Trying to track down your paycheck.

Free Space—Renting the studio to an artist who will pay you as soon as the record is released.

Incoherent Signals—Simultaneous mixing instructions from the artist and the producer.

the sync track (cont.)

Live Recording—Any session in which fifty percent of the musicians are able to stand up without being supported.
Microbar—What the engineer keeps behind the console.
Phantom Power Supply—On a remote session, a power supply that someone forgot to pack.
Headroom—When designing a studio, leaving space for the plumbing.
Tension Switch—What happens when it dawns on the producer that there are two minutes left in which to record five minutes' worth of music.
Horn Loading—Drowning out a lousy vocalist by bringing up the brass.
Peak Clipping Level—The studio rate beyond which the client begins to realize he is being had.
Crosstalk—The way a producer speaks when the session begins dragging.
Optimum Monitoring Position—The point in the control room at which the most favorable listening conditions are measured. Often found midway between the glass partitions separating the studio from the control room.
Room Equalizer—A device for screwing up the frequency response of the electronic system, until it is almost as bad as the room in which the system has been installed.
Specification Sheet—A collection of irrelevant data, usually presented in a format that implies the device has universal application.
Owner's Manual—The same data, rearranged to show that the device has little or no application.
Training Manual—A lengthy description of the device, written so that it may be understood by anyone who already knows how the device works. Others will find it incomprehensible. ■

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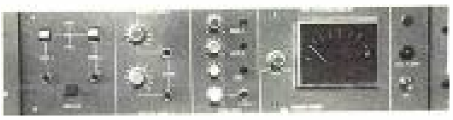
RECORDER/REPRODUCER

● 16-track, 16-channel Model 90-16 recorder handles one-inch tape at 15 in. sec. with optional dbx encoding. The combination record-reproduce head allows full reproduce frequency response in the sync mode; two other heads are erase and monitor. A transport system offers full i.c. circuits for feather-touch performance; a tension servo motor maintains constant tape flow, with motion-sensing mechanism eliminating accidental tape spills and stretch. Also offered are an a.c. servo-controlled, direct-drive capstan capable of variable speed operation of ± 30 per cent and electronic breaking to the play mode from either fast mode. Selection buttons allow source calibration, recording, overdubbing or sync, reproduce, and monitor activation as well as monitoring combinations and switching of the optional dbx package. The output select and function select panel can be removed and located near the mixer console.

Mfr: TEAC
Price: Under $12,000.
Circle 51 on Reader Service Card

TWIN PHONE HOOKUP



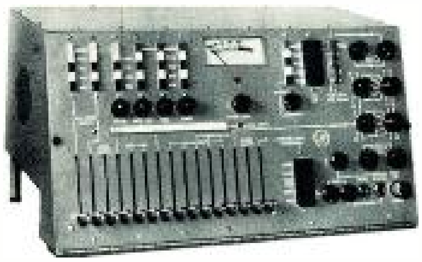
● Two channels are provided on this twin phone hookup, permitting holding on one line while the other is live. Directional routing is voice operated by the studio's send output. Connections to and from the studio are all balanced, floating, and at a nominal zero level. The send input is high impedance and both receive outputs are suitable for normal bridging loads; a standard ppm is built in to monitor levels. Amplifier bandwidths are restricted to speech only on both send and receive and clamps prevent any damage to the system by an incoming 80 volt ring should either of the input switches have been left in the live position.

Mfr: Tweed Audio
Circle 52 on Reader Service Card

RECORD/PLAYBACK PREAMP

● Modular monaural RP-85 preamplifier accommodates tape speeds from 1⅞ to 15 in./sec. in ⅛ to full track formats. Low speed version, designated RP-85L, provides special equalization for use with cassette or open reel logging application. Mixing facilities are universally matched for line and microphone inputs as well as line and monitor outputs. Independent line and cue amplifiers permit monitoring without loading the program output. Self-synchronizing bias permits multi-channel operation, including stereo monitoring. There are two isolated d.c. outputs for continuous or record-mode controlled voltage for external relay or lamp operation.
Mfr: Telex
Price: Under $260.
Circle 53 on Reader Service Card

MIXER/MASTER CONTROL



● Especially applied to t.v. studios, Model MS-105 mixes high and low level sources. The device incorporates the functions of slating, group mastering, auditioning of mics and high level sources. It features a reverb circuit, variable equalization, studio warning light, compression, testone, voice-over "ducking," intercom, cuetone, straight-line faders, and stage paging. The unit can be mounted in a 7 in. desk arm, rack, turret, tabletop or used as a portable machine. Master control permits airing a program while prerecording another.
Mfr: Ultra Audio Products
Price: $1,595
Circle 54 on Reader Service Card

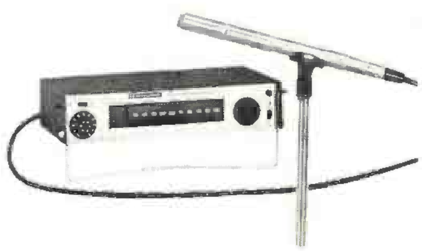
SOUND LEVEL METER/ANALYZER

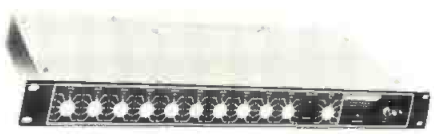
● Multi-function Model 1982 can be used for precision sound level measurements, octave-band analysis, and peak and impulse noise measurements. No plug-in filter sets or other equipment is needed. The device features digital and analog displays. The digital display can be operated so that it tracks the fluctuating noise levels or it can be set to display and hold the level of a specific event or the maximum measured level while the analog meter continues to track ambient levels. The unit meets ANSI Type I standards and spans the range of 30 to 140 dB in four 50 dB steps, and ten octave bands from 31.5 Hz to 16 kHz.
Mfr: GenRad
Circle 55 on Reader Service Card

products & services (cont.)

ANALYZER/EQUALIZER

● Analyzer system M615AS includes the M615 analyzer with built-in pink noise generator, ES615 analyzer microphone, tilt bracket and carrying case. The system also includes the SR107 equalizer, which provides adjustment of tonal balance on an octave-by-octave basis. Two rows of leds on the M615AS indicate frequency response level over ten octave bands from 32 Hz to 16,000 Hz. The equalizer's filter controls are adjusted until the analyzer's corresponding high and low leds turn off. Flat or 3 dB/octave roll-off above 1 kHz curves may be selected. The analyzer features input and microphone overload leds, microphone input attenuator, and pink noise output, input level and hi/lo controls. The omnidirectional measurement microphone is designed specifically for use with the analyzer. The SR107 equalizer has ten rotary controls that cover the audio spectrum from 31 to 16,000 Hz with boost and cut flexibility.
Mfr: Shure Bros.
Price: M615AS: $429.00
SR107: $250.
Circle 56 on Reader Service Card





ELECTRONIC FILTER

● An expanded operational temperature range and extended power voltage required are features of this manufacturer's improved electronic filter, Model 505. Designed for use as an active crossover network with power amplifiers for Bi/Tri and quad amplification systems, Model 505 accepts two inputs and provides four outputs, essentially two filters on a printed circuit card. The unit is available in 19 standard frequencies; custom frequencies are optional.
Mfr: Spectra Sonics
Price: $109.
Circle 57 on Reader Service Card

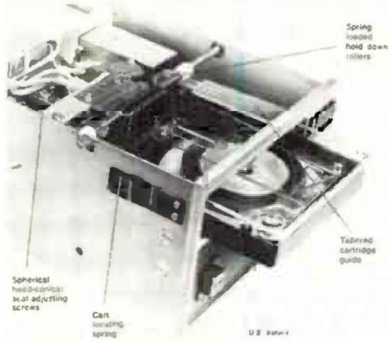
STEREO MIXER

● Seven-channel stereo powered mixer PA 700 handles 120 watts rms per channel, 20 Hz to 20 kHz response with claimed less than 0.1 per cent total harmonic distortion. The unit features two nine band graphic equalizers; input attenuation for each channel, variable from 0 dB to −40 dB; high and low eq.; stereo pan; monitor send (pre output slider); effects send; slide output level control for each channel. The master section contains control for effects level, effects return, effects pan, reverb contour, reverb return, reverb pan, A & B main output sliders and monitor output level slider. A jack with level control and two vu meters are included.
Mfr: Peavey Electronics Corp.
Price: $749.50.
Circle 58 on Reader Service Card

CONCERT MONITOR

● Two 10 in. speakers are combined with a high frequency tweeter in a cabinet shaped so that it can be placed at several angles, depending on its use and position onstage. Each enclosure has its own volume control and will handle 50 watts rms. The unit is a two-way speaker system in a ported bass reflex enclosure.
Mfr: Sunn Musical Equipment Co.
Circle 59 on Reader Service Card

CARTRIDGE TAPE MACHINE



● Available in two basic sizes for use with all NAB A, B, and C-size cartridges, these stereo machines are designed to enhance stereo phasing from cartridge to cartridge. Spring-loaded rollers provide repeatable location of each cart's left-corner post, a special tapered cartridge guide allows each cart to contact the roller squarely and feed smoothly, and a locating spring positions the cart against the right hand guide for squareness in relation to the heads. The machines feature spherical head/conical seat adjusting screws to provide uniform, positive azimuth adjustment with the heads immune to movement from external sources, as well as pancake hysteresis synchronous motors.
Mfr: UMC Electronics Co. (Beaucart)
Circle 60 on Reader Service Card

MICHAEL RETTINGER

Control Room Acoustics

The source of the finished audio product, the control room requires correct architectural and interior design for consistent sound.

WITH THE PREVALENT practice of multi-track music recording, studio control room acoustics have come to be considered equal to, and by many recording engineers more important than, the acoustics of the studio in which the musical program originates. This is due to the striven-for greater sales appeal of the final mix obtained in the control room compared to the original studio rendition. When 16, 32, or even 64 music tracks are electronically combined, the significance of any one track diminishes; it is the union of the tracks which chiefly determines the commercial success of the final product. This condition is obviously also true with "synthetic music" generated by Moogs and other devices, where no studio is involved, and the mixing room becomes the final composer enclosure for a program (if we exclude any tonal and level corrections in the disc-mastering room).

From the many control rooms in which I have made tests, I have learned that very few are alike. They vary in their volume from 2,000 to 10,000 cubic feet, in their absorptivity from 0.2 to 0.8, and in their appearance from wood sheds to elegant salons. Strangely, any one of them may provide satisfactory mixing conditions to its console operator; the trouble lies in that his product does not often sound the same to him in different enclosures. One might be tempted, therefore, to ask why is there no uniformity, no standardization in the industry in the manner in which monitoring room and theater electroacoustic standards have been established in the motion picture industry through the efforts of the Research Council of the Motion Picture and Television Producers Association, which standards were recently submitted to ISO (International Standards Organization) for consideration. The answer must lie in the condition that while there are only six major motion picture producers in the United States, there are several thousand music recording establishments, many without elaborate disc recording facilities, where music tracks from other studios are often mixed with songs or individual renditions recorded on their own premises.

REQUIREMENTS FOR UNIFORMITY

In the following it is attempted to summarize the acoustic requirements for control rooms of music recording studios to achieve greater listening uniformity among them and, at the same time, establish superior acoustic or hearing conditions in them based on theory as much as my own experience in this field. No attempt will be made to gild the lily by considering special acoustic devices such as Helmholtz resonators, turning vanes for increased sound diffusion, helium-filled rubber balloons for a similar pur-

Well known to **db** *readers, Michael Rettinger is an acoustical consultant from Encino, California.*

Type of Space	Recommended PNC	DB-A
Studios	20	30
Concert Halls	20	30
Control Rooms	20	30
Bedrooms	25	35
Living Rooms	30	39
Churches	30	39
Schools	35	45
Hospitals	35	45
Restaurants	40	48
Stores	40	48

It is intended that the noise level measurements are to be made in the empty enclosure, with the air-conditioning system operating. The PNC curves, first published in November 1971, are similar to the NC (noise criterion) curves, first published in September 1957, but use the new octave bands specified by ANSI (American National Standards Institute), and are so drawn that the criterion number of each curve corresponds with the sound-pressure level of the octave-band whose mid-frequency is 1000 Hz.

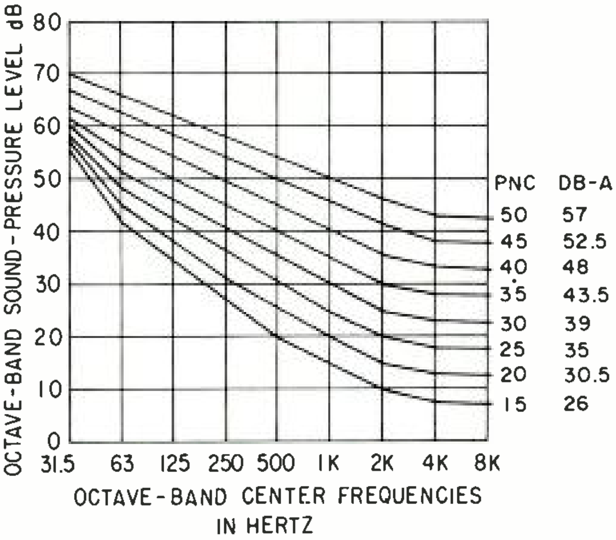


Figure 1. The PNC curves. Each PNC (preferred noise criterion) curve is a code for specifying permissible sound-pressure levels in the nine octaves whose mid-frequencies range from 31.5 to 8000 Hz.

pose, and others. Also, nothing will be said about which might be the best loudspeaker system for such enclosures. Here, too, the motion picture theater industry is fortunate that in this country there are only two such systems in common use—the RCA and the Altec-Lansing horn-loaded two-way theater loudspeaker systems.

SHAPE OF THE ROOM

The horizontal cross-section of the room should be either wholly trapezoidal, or so shaped along the reflective front portions of the sidewalls, while the less reflective rear portions may be parallel. The slope of the slanting frontal portions should be 1:10. This will avoid flutter echoes and will prevent coincidental reinforcement of the normal modes in the room, thus avoiding sharp "peaks" and "valleys" in the so-called transmission characteristic. There is no way to eliminate such modes because they are a natural phenomenon. The amplitude of these modes varies from place to place in every control room during a prolonged note for any one mode or frequency.

Should there be a very unsatisfactory condition at the console due to such a mode, amelioration of the effect can well be achieved by a band-pass or band-elimination filter (graphic equalizer). Placing a reflective panel at some specific location in the room generally suppresses one acoustic effect at one point but establishes another at the same time somewhere else. Effective analysis of the sound field near the console can only be obtained by the use of two or three real-time analyzers, to provide instant information regarding the effects of making an acoustical or electric modification in the room or the system.

Countless hours have been spent in control rooms to establish a uniform listening condition in the vicinity of the console, particularly in enclosures which lack physical symmetry in the horizontal direction. However, unless the mixer is alone in the room, there will always be some lack of symmetry. This lack may be due to other persons in the room, the haphazard placement of bulky equipment, and possibly even doors. An adjustable reflective splay above the console is considered another recommended element of the room shape.

THREE FIRST-ORDER REFLECTIONS TOWARDS THE CONSOLE

Such a reflection from each of the two sidewalls and one from the ceiling splay will do much, not only to add a little life to the reproduced music, but also to generate a more uniform listening condition in the room. Unless there exists a degree of uniformity in the sound level in the room, a producer, client, or sponsor, may well hear a different quality of music than the mixer does at his console. Quite a few arguments have arisen in such rooms between the mixer and other persons in the room who claimed they heard insufficient bass or too much treble in a recording, while at the console the balance was judged correct and satisfactory—a condition often resolved by allowing the complaining person to take the mixer's position.

It should be realized that the sidewall and ceiling reflecting surfaces near the console can act adequately as reflectors only for tones whose wavelength is in the order of the panel dimensions. Hence they might appear inadequate for tones with a frequency below 110 hertz because such a tone has a wavelength greater than 10 ft. and the console is rarely further than that away from the loudspeakers. However, the directivity index of the loudspeakers at the bass notes is generally so small that reinforcing reflections are not so necessary to produce uniform sound energy density conditions in the enclosure during transient signals.

It is indeed well, in the design of a new control room, or even in the redesign of such an enclosure, to perform a geometric analysis of the sound rays emanating from the loudspeakers, keeping in mind the polar response of the reproducers intended to be used.

LOW NOISE LEVEL

The recommended noise level spectra for various enclosures have long been known (since Sept. 1957). FIGURE 1 shows the so-called PNC (Preferred Noise Criterion)

(continued)

first published in Nov. 1971 in the *Journal of the Acoustical Society of America* by Leo L. Beranek, and redrawn by myself to show their relationship with the common A-weighted sound pressure levels. How many control rooms can boast of a recommended level of 25 dB-A?

Since it has come about that magnetic tape recorders and various other electronic equipment are located in the room for the ready manipulation by the mixer or associated personnel, the average noise level in the room has frequently actually increased rather than decreased with time. Many of these pieces of equipment require cooling fans,

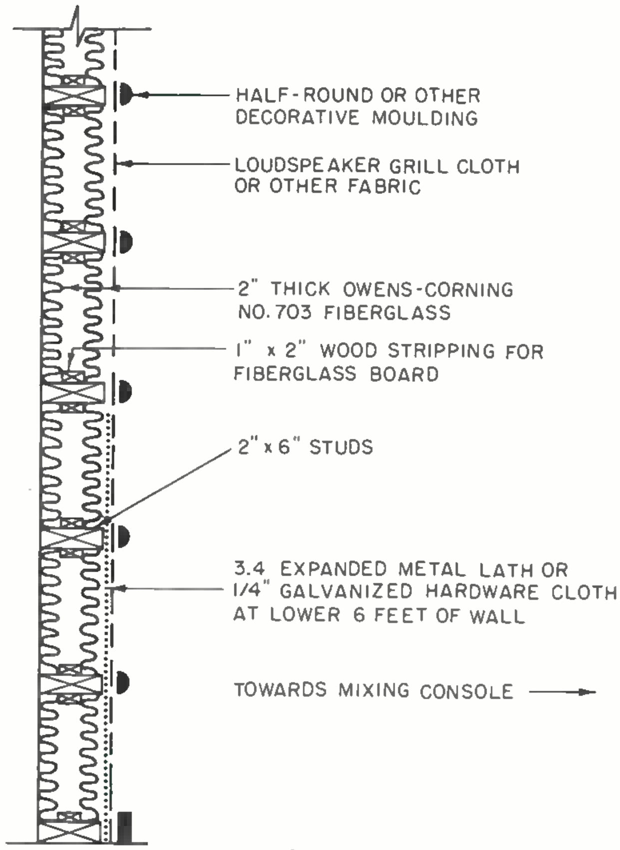


Figure 2. Recommended acoustic treatment of control room real wall.

which are rarely quiet. There are also reel noises, contact pulses, gear disturbances, and a host of other attention-distracting sounds which few have tried to correct because of the modifications of the equipment that are often involved in such a procedure.

Interestingly, I have on occasion measured an electric signal-to-noise ratio in the order of 65 dB from the recorded tape, when the acoustic signal-to-noise ratio in the control room was barely 40 dB (a signal level of 100 dB-C and a noise level of 60 dB-C, where the subscript "C" refers to the C network in the common sound level meter). Undoubtedly, the record head could "hear" notes and even passages which the mixer could not hear, or at best only assumed to exist.

In most noisy studios, it is the doors which contribute a great deal to the condition. Best, of course, are double doors with adequate seals and a sound-absorbent treatment on the walls between the solid-core panels.

SOUND-ABSORBENT REAR WALL

This is designed for the purpose of lengthening the critical listening distance, that is, the point from the loudspeaker where the direct signal predominates. Much is sometimes made of D_c, the critical distance at the point where the direct sound energy density equals the generally reflected one for steady-state conditions—an almost artifical quantity, since steady-state conditions occur only during very prolonged music passages. Indeed, it is desirable to look at this term a little closer. To establish steady-state conditions for any signal, it must continuously be radiated until a steady-state condition has been reached. This occurs rarely in speech, which consists essentially of sound pulses, or in music, which is generally a series of short notes.

A more informative quantity of this type may be called the *transient critical distance*, d_c. It can readily be calculated in terms of the steady-state condition critical distance D_c. Below are the equations for the two terms:

$$D_c = 0.14\sqrt{\frac{QSa}{1-a}}$$

$$d_c = \frac{D_c}{\sqrt{1-e^{-14t/T}}}$$

where Q = directivity factor of loudspeaker at frequency f
S = total interior surface of room, square feet
a = average absorptivity of room boundary material at f
t = time after signal starts in room
T = reverberation time of room at f

Thus, after 10 milli-seconds, at about the time when the three first-order reflections arrive at the console of a control room whose reverberation time at the frequency f is 0.5 seconds and whose long-term critical distance has been calculated to be 5 feet at the same frequency, the transient critical distance will be

$$d_c = \frac{5}{\sqrt{1-e^{-14x.01/.5}}}$$

$$d_c = 10 \text{ feet}$$

This condition can well be obtained when the rear wall of the control room carries adequate acoustic treatment of the type shown in FIGURE 2. It may be noted that some control rooms carry anechoic wedges on the rear wall. With the cost of space as high as it is in the urban recording studio, anechoic wedges 2 or 3 feet long constitute a great expense compared to the 6 in. acoustic treatment shown in FIGURE 2. Nor is it believed that such a highly absorbent treatment is necessary, or its effect audible to the mixer, compared to the 6 in. treatment. The use of an absorbent rear wall is not intended to approximate outdoor conditions, but merely to soften the impact of the reflections returned from this surface towards the mixer.

As shown in FIGURE 2, the rear wall may be finished with an attractive loudspeaker grill cloth or other highly sound-transparent fabric. When I asked the mixer of a studio why he preferred to show the anechoic wedges on the rear wall of his control room he answered with "They look more professional that way. . . ."

ADEQUATE BOUNDARY STIFFNESS

It is surprising how few control rooms exhibit a longer reverberation period at the low frequencies than at the standard frequency of 1,000 hertz. This can be accounted for only by the diaphragmatic action of the walls and ceiling, which act as bass absorbers.

Since, presently, the vogue is to generate noticeable bass in a control room (whether or not it can be recorded on a disc, and if recorded, whether the average hi-fi enthusiast has the type of loudspeaker which radiates these low notes), it becomes necessary to provide stiff sidewalls and a stiff ceiling in such an enclosure. In a room in which the bass reverberation time is now less than at the mid-range, doubling this period means doubling the bass sound-pressure level in it for the same acoustic power output on the part of the speaker.

To estimate the loudspeaker output requirements for control rooms in which the frequency response is to extend to 30 hertz, the following calculations are in order.

Assume that we are interested in a distance of 10 feet from the loudspeaker where the direct sound energy predominates over the generally reflected one, and that the directivity factor of the loudspeaker on the wall comes to 2. For this condition the required acoustic power level comes to

$$WL = SPL + 20\log R - 10\log Q + 0.3$$
$$= SPL + 17.3$$

where SPL = sound pressure level at 10 feet from the radiator. The corresponding acoustic power somes to

$$W = 10^{(SPL - 102.7)/10}$$

The loudspeaker cone peak displacement in inches from its mid or rest position, when the unit is mounted in a baffle and acts as a piston, is

$$d = \frac{117000\left[10^{(SPL - 102.7)/10}\right]^{\frac{1}{2}}}{f^2D^2}$$

where f = frequency

D = cone diameter in inches

If we let f = 30 hertz, D = 16 inches, we get

$$d = 0.368 \times 10^{-5} \times 10^{SPL/20}$$

For a sound pressure level of 100 dB, the cone excursion comes to 0.368 inches—not readily possible with most loudspeakers. For a desired sound pressure level of 110 dB at 30 hertz, the cone displacement becomes 3.16 times as large, or 1.15 inches. Hence several woofers are necessary to generate such a bass note at the console, assumed to be 10 feet from the loudspeakers.

It may also be noted that for a 30-hertz note to sound as loud as a 1,000-hertz tone with a sound pressure level of 90 dB, the sound pressure level for the low frequency has to be 20 dB higher, or 110 dB, as may be seen from FIGURE 3 which shows the equal loudness characteristics for the human ear.

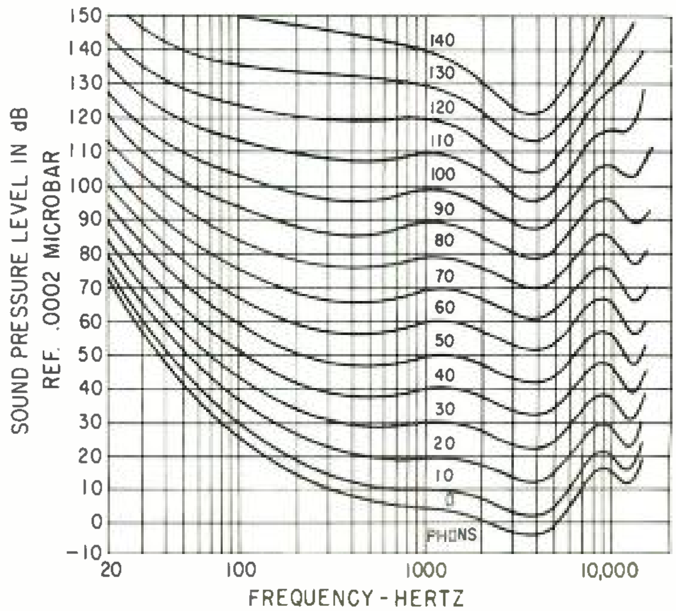


Figure 3. Equal loudness contours.

It should be almost needless to mention that a solid wall. floor, and ceiling, besides providing high stiffness, and therefore low absorptivity for the bass, will also act as efficient sound insulators against extraneous noises, particularly in urban studios exposed to a great deal of ground vehicular traffic disturbances and aircraft flyover rumble.

CONCLUSION

In my dreams I sometimes see the perfect control room with exponentially curved hardwood plywood sidewalls along the frontal half of the enclosure like the throat of a horn at whose mouth the all-important mixing console is located; with parallel cork-treated sidewalls along the back half of the room; a light-transparent, sound-reflective splay above the console through which the spot lights might direct their cones on the "keys" of the console; lush, non-electrostatic carpet with foam or sponge rubber underlay (so that it might not compress like felt) over the computer type floor which hides the nest of cable snakes; highly sound-retardent doors and windows; a convex sound-absorbent rear wall against which a minimum of noisy equipment is placed; horizontal symmetry of the room boundaries to obtain uniform listening conditions for all interested parties; loudspeaker systems which extend unobtrusively into the studio so that only the diaphragms line up along the front wall (the horn throat) of the control room, which wall also represents a large baffle for the multiple reproducers overhead and ahead of the mixing console, preventing radiations from the rear of the reproducers as well as cabinet diffraction effects to interfere undesirably with the frontal radiations of the emitters; a stylized and automated console some 28 in. to 32 in. above the control room floor, shining like a throne; noiseless air-conditioning diffusers—not a dinky enclosure whose interior decor was installed by a non-professional, but a fine tastefully appointed enclosure in which form follows function according to the old architectural dictum. ■

GARRY MARGOLIS

Transducer Power Handling

Blowing of your loudspeakers at a crucial moment is avoided if you realistically appraise power requirements.

POWER HANDLING is one of the most troublesome factors in audio transducer applications. Excessive power is the cause of nearly all non-warranty defects repaired by the JBL Customer Service Department. The following discussion of transducer power ratings is presented in the hope that much grief can be avoided by all parties—the sound man, the musician, the retail dealer, and the manufacturer.

First, some basics. All audio transducers have an impedance to the flow of alternating current. This impedance will vary with the frequency of the applied signal, and is not a linear function, as shown in FIGURE 1. A typical cone transducer in free air will have a peak impedance at its resonant frequency. Above the resonant peak, the impedance will drop sharply to a minimum and then climb gradually. This minimum impedance will be greater than the d.c. resistance of the voice coil, due to the reactance and back EMF induced when the coil moves through the intense magnetic field in the gap. In most JBL low frequency and extended range transducers, the minimum impedance occurs between 200 and 300 Hz.

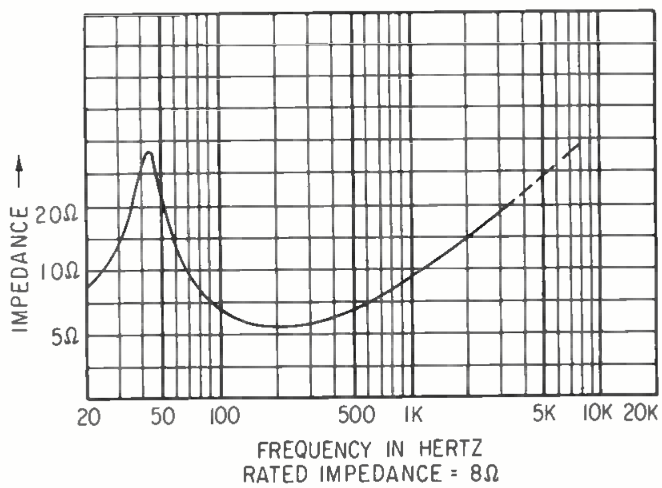


Figure 1. Impedance vs. frequency of a typical 15-in. low frequency transducer.

IMPEDANCE

Since impedance varies with frequency, it is obvious that no single number will completely describe the impedance characteristics of a transducer. There are several methods used by various manufacturers in an attempt to arrive at a single number to represent impedance. The impedance rating of JBL Professional Series transducers is the measured value in the recommended crossover region. For most JBL low frequency transducers, this region is around 800 Hz. The rated impedance of the loudspeaker graphed in FIGURE 1 would be 8 ohms. However, the same transducer sold by the JBL Home Entertainment Division, under a different model number, may have a different impedance rating. For example, the 2215B Professional Series loudspeaker is rated as 16 ohms, while the LE15A home loudspeaker, which is the same unit, carries an 8-ohm rating.

Since the home listener is concerned with how many speakers can be connected across a receiver before it will explode, JBL home speakers and systems carry ratings which are closer to their minimum impedances. Minimum impedance is also of concern to the professional, but commercial-grade power amplifiers are generally capable of handling low-Z loads more reliably than is home equipment. Also, the transition area frequency response of a custom array of transducers used with passive dividing networks will be, in large part, dependent on proper load impedances presented to the dividing networks.

There is a finite amount of current which may be drawn by a voice coil before it will overheat. When it is driven by a constant voltage, which is the most common amplifier output condition, the voice coil may be overheated most easily when operating in the region of its minimum impedance because maximum current flows through the coil under these conditions. Also, it should be noted that as the coil heats up, its resistance increases, lowering the efficiency of the transducer.

In an overheated condition, a number of things may happen. The wire in the coil can melt, shorting to an adjacent turn or opening up. The voice coil support can deform. In extreme cases, the solder at the voice coil connections may even melt.

Some manufacturers use metal voice coil supports, which supposedly will increase power handling capacity.

(continued)

Garry Margolis is an applications engineer with James B. Lansing Sound.

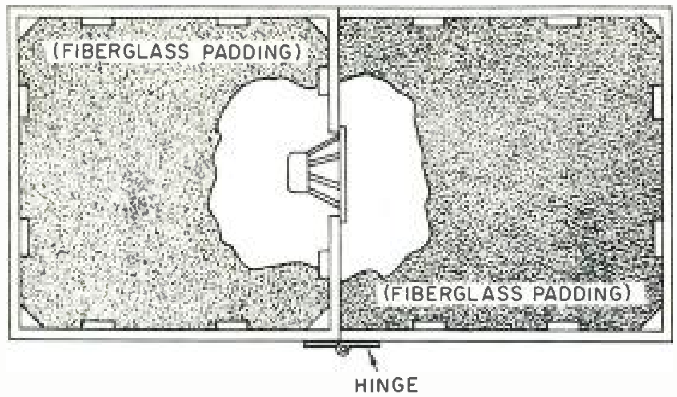


Figure 2. Enclosure for power testing cone transducers.

Unfortunately, all-metal supports have inherent problems. They can act as a shorted turn or produce other losses in the circuit, generating extra heat and losing efficiency. Additionally, the expansion coefficients of metal supports are generally greater than those of the high-temperature Nomex paper supports used for most JBL coils, resulting in more deformation of the coil for a given amount of heat and consequent increased likelihood of interference with the free movement of the cone.

The other major aspect is mechanical travel of the piston, which has finite limits. At any given frequency, the greater the magnitude of the signal, the further the piston will travel. If excursion goes beyond the design limit, distortion products created will dramatically rise, and the piston suspension may be damaged. Also, piston excursion will generally increase as frequency is lowered, assuming constant drive voltage and proper coupling of the piston to the air. It is therefore possible to push a piston too far by driving it at frequencies below the design limits of the transducer and its associated horn or enclosure.

TESTING POWER RATING

With all of the above as preamble, we can now discuss how JBL determines the power ratings of its transducers. Other manufacturers may use different methods.

JBL cone transducers are mounted in a 10 cubic foot (280 liter) sealed, heavily padded enclosure. The front of the transducer radiates into another similar enclosure, as shown in FIGURE 2. The transducer is driven by a constant voltage source using a swept sinusoidal waveform. The sweep has a sawtooth logarithmic frequency pattern normally set for a repetition rate between 2 and 8 Hz, as shown in FIGURE 3, rather than a warble tone.

The frequency range of the sweep signal is selected to cover the minimum impedance region of the transducer under test, where it overheats most easily. For most low frequency and extended range transducers, the sweep runs from 100 to 500 Hz. The sharp discontinuity between the highest and lowest frequencies puts severe demands on the ability of the transducer to withstand mechanical shock.

JBL compression drivers are given the same type of test, except that the sweep operates from 500 or 800 Hz to 2.5 kHz. In the past, the driver under test has been mounted on a terminated tube, which is similar to the plane wave tube used by other manufacturers. Both tubes present a pure acoustic resistance to the driver; therefore, the results from his test are analogous to those obtained by testing power amplifiers with load resistors instead of loudspeakers. Since a horn does not present constant acoustical impedance to the driver (just as a resistor does not behave like a loudspeaker), JBL is now also power testing compression drivers mounted on a 2350 horn, which is an average radial, or sectoral, horn.

The power applied to the transducer is calculated by squaring the true rms voltage across the voice coil and dividing by the *rated* impedance, not the *minimum* impedance. If the minimum impedance were used for this calculation, the resulting power rating would be artificially inflated. The transducer under test must be able to operate at its rated power with the given test signal for a minimum of one hour. JBL K Series musical instrument loudspeakers are required to operate at rated power for a minimum of eight hours, simulating the heavier duty cycle encountered by such transducers in actual use.

CONTINUOUS PROGRAM POWER

The published power rating of JBL K Series transducers and Professional Series studio monitors is given in steady state or rms watts. However, the other transducers and passive dividing networks in the JBL line are rated in *continuous program power*, which is a specification that cannot be found in any publication of ANSI, IEC, DIN or any other standard-setting organization.

The reason for the continuous program power standard is that many years ago, a number of major manufacturers established a rating convention which takes into account some of the peak power handling capabilities of audio transducers. This convention is defined as twice the rms power, or 3 dB greater than rms power. When working with speech and music with normal spectral distribution and peak to average power levels, this rating serves as a reasonable approximation of the size of the power amplifier which can be used without damaging the transducer, assuming that clipping is avoided.

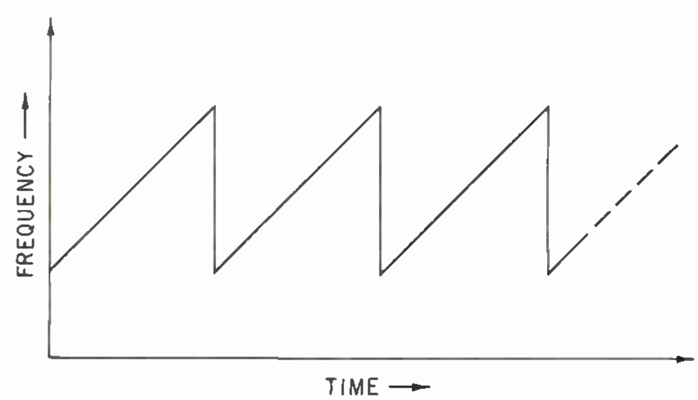
ALLOW HEAD ROOM

In the past few years, however, peak to average power levels and spectral distribution have changed in many frequently encountered situations, such as room equalization with random noise or impulse sources, reproduction of electronically synthesized music and heavily equalized recordings, as well as in the obvious case of reproducing a tape moving in a rapid spooling mode. These electrical signals have great amounts of high frequency energy and extremely high peak to average power levels, far beyond those found in normal acoustical signals.

Also, most amplifiers contain output current-limiting circuits to protect the output transistors. When these circuits are activated, particularly at low frequencies and when working into reactive loads, a strong high frequency spike may be generated and sent to the speakers. In addition, a clipped amplifier will, by definition, be generating large amounts of odd-order harmonics. It can be seen that a clipped low frequency impulse can blow out high frequency drivers, particularly if the system is not biamplified. Therefore, it is of great importance that peaks be considered in the design and use of any system which may encounter such signals.

If noise or impulse sources are to be used for equaliza-

Figure 3. Frequency vs. time period of power test signal.



tion, at least 10 dB of headroom should be allowed. In other words, if a system has a continuous program rating of 100W, any equalization signal fed to that system should be no greater than 10W rms for driver protection. Additional power reduction will afford greater protection.

The use of fuses, scrs and/or zener diodes has often been suggested for protection of transducers from overload conditions. If fuses are to be useful in preventing overheating, however, they may blow on short-term transients which will not damage the transducers. Scrs and zener diodes, on the other hand, create a momentary short circuit across the amplifier output when they conduct, severely distorting the signal, causing serious problems with many amplifiers.

MONITOR APPLICATIONS

In recording control room monitor applications, it should be remembered that, given similar bandwidth, a small monitor cannot put out as much sound pressure level as a large one, when both are driven to maximum power. For example, measured at 8 feet (2.4 meters) in free-field conditions at rated power, a single JBL 4311 or 4315 will produce 99.5 dB sound pressure level, while each of the new single-woofer full-size JBL monitors will produce 104.5 dB and the 4350 will produce 111 dB! It is therefore important to choose a monitor based on the expected sound pressure level in the control room as well as size and cost. Attempting to squeeze more level out of a particular monitor than it is capable of delivering will invariably result in component failure.

If high peak to average program power levels are anticipated in high-level sound reinforcement, such as at rock concerts, a quality limiter may be of value. Note, however, that limiters and compressors should be installed where non-competent fingers can be kept away from the knobs. Unskilled setting of such devices can be more disastrous than if they were not installed. Also, if limiters are in circuit, the temptation to raise overall levels can be great, which, of course raises the average power into the speakers. If the average power exceeds the rated system power, component failure is inevitable.

Many people are using JBL K Series transducers in reinforcement applications because they carry higher power ratings than the standard reinforcement components. Current JBL Professional Series low frequency reinforcement transducers are capable of taking as much power as the similar K Series units without damage, but the increase in distortion at such levels make the net results unsatisfactory for reinforcement purposes. The K Series units also put out similar distortion at their rated power, but since they are intended as musical instrument reproducers, the distortion becomes part of the instrumental character and is acceptable, and even desirable.

HIGH LEVEL POWER FAILURE

Due to the many differing types of program material, electronic lashups, and personal operating styles, there are no hard and fast rules for preventing power handling problems with high-level systems. It is recommended that anyone in this business carefully monitor the power levels at various points in the system, both with meters and oscilloscopes, to know what is going on at those points. When running maximum power systems, it is normal for a number of drivers to be burned out until the operator learns how that system interacts with his or her personal style. If, however, everything fails repeatedly, not enough level is available from the system and there are no gross hookup errors, there are two possible solutions:

1. Increase the amount of equipment, remembering that twice the power represents only 3 dB additional spl; or
2. *TURN IT DOWN!* ■

PETER D. HISCOCKS

A Headset Communications System

Telephone company headsets, with microphones, can be simply converted into an intercom system.

THE TELEPHONE COMPANY headset—boom mounted carbon microphone and single dynamic earphone—is convenient and commonly used in intercom systems. Where only a few headsets are involved, the simplest scheme is to wire the headsets and microphones in series, and power the circuit from a source of d.c., FIGURE 1.

Carbon microphones require a bias current of 20 to 100mA, which, with a microphone resistance of 75Ω and headphone resistance of 45Ω, makes Es about 6 volts per headset, at 50mA.

A choke may be connected in parallel with each headphone to divert d.c. around the headphone. With a headphone inductance of 10mH, the choke should be 100mH, inductance, 4Ω resistance, and capable of carrying at least 50mA d.c. without saturating. The supply voltage reduces to 3.95 volts per headset.

Alternatively, the headsets may be wired in parallel, as shown in FIGURE 2. This scheme results in a lower supply voltage, which is independent of the number of headsets, but requires an additional inductor at the source, to prevent signal current from being short circuited through the low impedance supply.

Peter D. Hiscocks is associated with the Department of Electrical Technology at Ryerson Polytechnical Institute in Toronto, Canada.

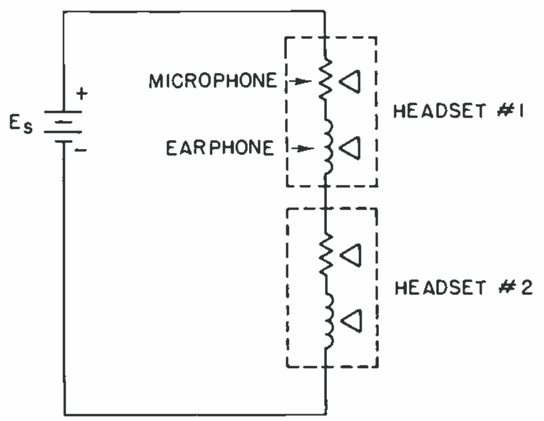
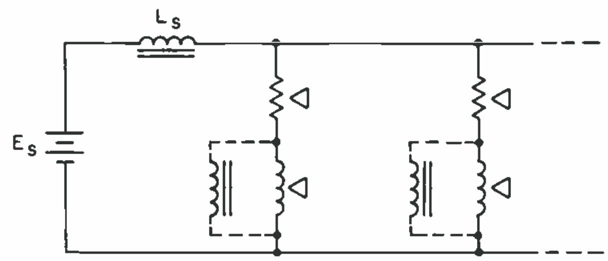


Figure 1. A series intercom connection.

Figure 2. A parallel intercom connection.



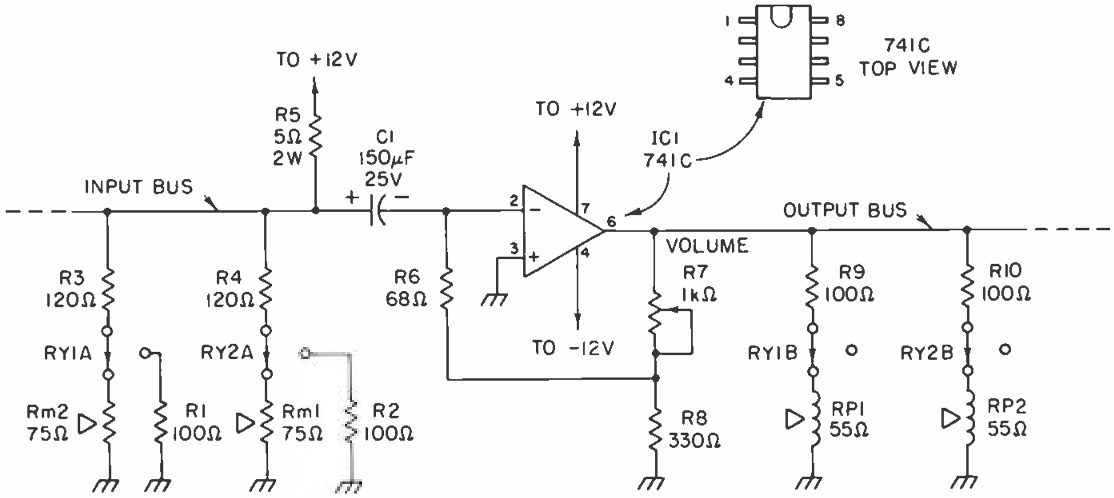


Figure 3. The headset system

Both these schemes work for small numbers of headsets, but suffer a progressive decrease in level as the number of headsets increases. More than five headsets would result in an unacceptably low level, particularly in the presence of high background noise level. (See box).

USING AN AMPLIFIER

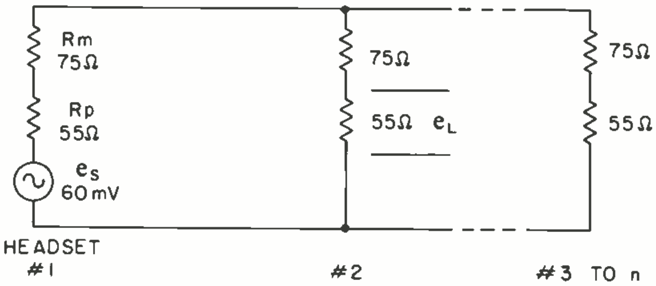
The relatively simple amplifier circuit shown in FIGURE 3 will satisfactorily power up to ten headsets. It also eliminates direct current through the headsets, does away with all inductors, and has some measure of protection

(continued)

ESTIMATING LEVELS

With the microphone biased at 50mA d.c. and spoken into at a normal voice, the signal level was estimated as 60mV a.c. (rms). The minimum acceptable level across the headphone terminals (e_L) was estimated as 5mV a.c. (rms).

The microphone source resistance Rm was about 75Ω at 500 Hz. The resultant circuit diagram is shown below:



The voltage across the phones is

$$e_L = es \left[\frac{1}{n} \times \frac{Rp}{Rp + Rm}\right]$$

where n is the number of headsets. Substituting for e_L, es, Rp and Rm, n = 5. Consequently, any more than five headsets will have unacceptably low volume level.

OUTPUT CAPABILITY OF 741 OP AMP

The short circuit output current of a 741 is 20mA, so its maximum rms output current will be $20/\sqrt{2} = 14.2$ mA. This allows 1.4mA per headset, for ten headsets, which at 55Ω per head is

$$V_L = 1.4\text{mA} \times 55\Omega = 78\text{mV}.$$

This is 23 dB above our minimum of 5mV per headset, so it is satisfactory.

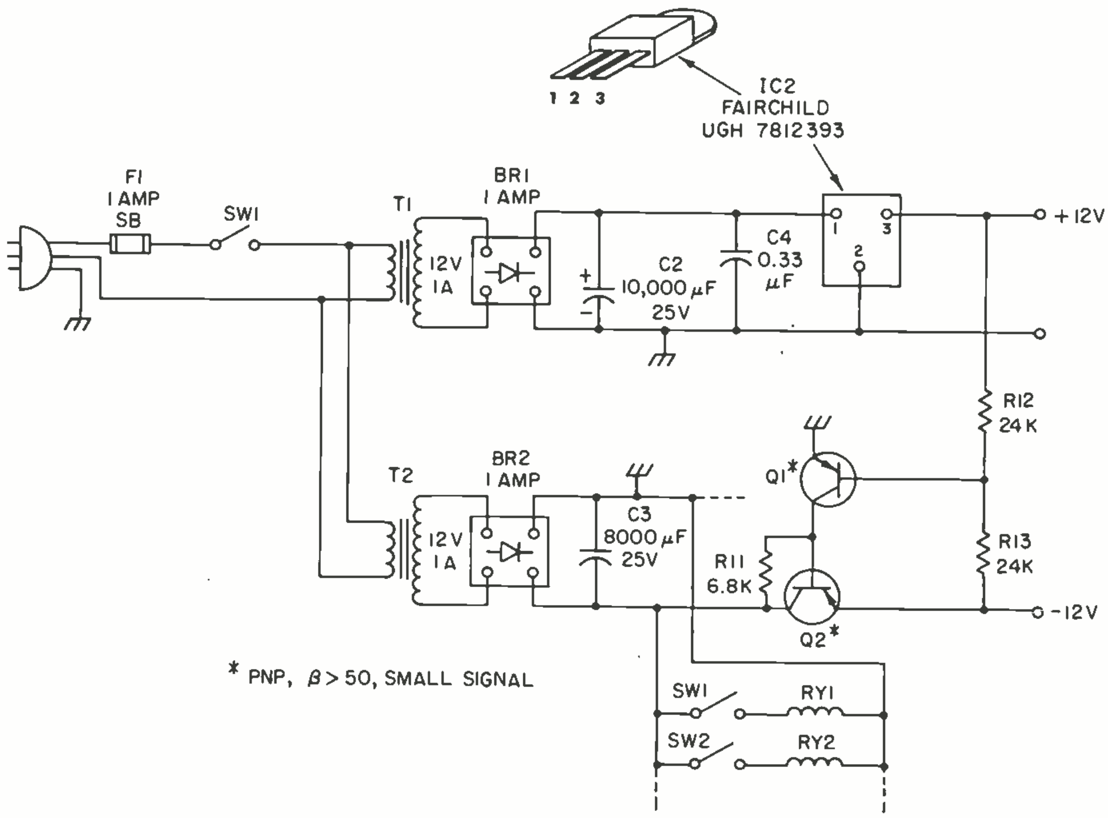


*Figure 4. The headset power supply, * PNP, β > 50, small signal.*

against open and short circuits in the headsets. Because the frequency response requirements (200Hz to 3kHz) and output swing required are relatively modest, the ubiquitous 741 op amp may be used as an amplifier. Resistors R9 and R10 isolate a shorted headphone, ensuring that the rest of the system will continue to operate.

Because the input bus is a virtual earth point, signal current will be prevented from flowing through the bias supply by the relatively low value resistor R5. Resistors R3 and R4 are the input summing resistors.

Resistors R1 and R2 act as dummy microphones, so that the d.c. potential of the input bus does not change significantly when a microphone is switched off.

The power supply schematic for the system is shown in FIGURE 4. The design is conventional, except that separate supplies are used to isolate relay coil switching transients from the microphone bias supply. The +12V bias supply is regulated by i.c.2 and used as a reference for the −12 volt op amp supply, Q_1, Q_2 and associated resistors. ■

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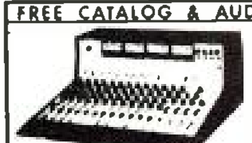

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First major new product line introduced in the U.S. produced by highly innovative and competitive offshore company working with experienced American management. The line encompasses both user and distributor incentives. Significantly, will offer quality, reliability, and style at important price points now neglected. Seeking long term relations with qualified representatives. All inquiries will be treated in absolute confidence.

Please write, **Dept. 42, db Magazine, 1120 Old Country Rd., Planview, N.Y. 11803.**

WANTED: INVESTMENT CAPITAL for sound equipment rental company. Pays 20% interest; minimum investment, $5,000. Return principal and interest monthly within two years. **Serco, 6820 Santa Monica Blvd., Los Angeles, Ca. 90038. (213) 461-2961.**

WANTED

WANTED: TRANSCRIPTION discs, any size, speed. Radio shows, music. **Box 724-db, Redmond, Wa. 98052.**

WANTED: STEVESON INTERFACE CONSOLE and modules, or similar quality product and studio accessories. **Box 2159, Winnipeg, Manitoba, Canada R3C 3R2. (204) 888-6099.**

EMPLOYMENT

YOUNG RECORDING ENGINEER seeks to relocate in 16- or 8-track established studio. 5½ years experience in top 40, jazz, jingles, classical, c&w. Tapes and resume on request. **S. Peppos, 1109 Waterfront Dr. #201, Virginia Beach, Va. 23451. (804) 428-0586.**

EXPERIENCED MUSIC MIXER

For major N.Y.C. studio, expanding staff. Send resume to **Dept. 72, db Magazine, 1120 Old Country Rd., Plainview, NY 11803.**

db people/places/happenings

• Contravening certain abuses caused by unauthorized persons importing their products, **Uher of America** has registered their trademark. In the future only authorized distributors will be entitled to sell products bearing the Uher trademark.

• Organizational restructuring and personnel appointments have marked the assumption of the presidency of the **Tape-Athon Corporation** of Inglewood, Ca. by **Lee Tate.** Mr. Tate has created four new divisions: Sales/Marketing Operations, Engineering, and Audio Products. The new divisions are focalized by **Wally Rubin** for Sales/Marketing, **Joe E. Otis** in Audio Products, **Robert Haller,** director of Operations, and **Bernard Sayers** heading Engineering.

• **Edward A. Schober** has been named manager of technical systems and service at **CCA Electronics Corporation** of Gloucester City, N.J. Mr. Schober comes from **Teledyne, Inc.** He will be responsible for technical liaison with customers.

• The appointment of **Arthur Constantine** as sales manager has been announced by **Fidelipac,** of Mount Laurel, N.J. Mr. Constantine will be responsible for the marketing of tape cartridges and accessories. He comes to Fidelipac from **CCA Electronics.**

• **Masaji Takahashi** has been named as president of the **TEAC Corporation,** of Montebello, Ca. **Mikio Matsubayashi** will continue as executive vice president. Other personnel changes include the appointment of **Allen Novick** as a vice president and **Joseph A. Pershes** as national sales manager of TEAC's audio product line. **Jorge Montero** has been promoted to the post of national sales manager of the special products group.

• Election of **Eugene P. Foley** as vice president and treasurer and **John S. Johnson** as vice president and controller has been announced by **RCA Global Communications, Inc.** of New York City. Mr. Foley had formerly served as treasurer of the firm, and Mr. Johnson as vice president, capital projects and internal controls.

EARGLE

• **John Eargle** has joined **James B. Lansing Sound** of Northridge, California in the capacity of vice president for product development. Mr. Eargle. who formerly headed his own consulting firm, **JME Associates,** has particular expertise in music, combined with engineering. He served as president of the **Audio Engineering Society** and is the author of the technical guide, **Sound Recording.**

• The election of **Ray Dowling** as executive vice president of **Switchcraft, Inc.** Chicago-based subsidiary of the **Raytheon Company,** has been announced. Mr. Dowling comes from Raytheon, where he has served for fifteen years. Another development at Switchcraft is the appointment of **Comtec,** of Seattle, Washington as sales representatives for the company's electro-mechanical component lines in the Pacific Northwest.

• The appointment of **Charles F. Rockhill** to the position of Beaucart sales manager, responsible for all broadcast industry sales, has been announced at **UMC Electronics Co.,** of North Haven, Connecticut. Mr. Rockhill comes to UMC from **McMartin Industries.**

• **Star Enterprises,** of Santa Ana, Ca. has been selected by **Community Light & Sound** as their representatives in California, Arizona and Las Vegas. **Bob Rufkahr** is in charge of the operation. As Canadian representatives, **La Salle Audio Products, Ltd.** of Montreal have been appointed, with **Jacques Bogos** in charge.

• **Wilfred A. Malmlund,** formerly supervisory consultant of **Bolt, Beranek, and Newman Inc.** has opened his own office at 18310 Los Alimos St.. Northridge, Ca. 91326. Mr. Malmlund will be available as a consultant in architectural acoustics, sound system design, and noise control.

• Two new territorial marketing managers have been appointed by **TDK Electronics Corp.,** of Garden City. N.Y. **Robert Mehl,** based in Georgia, will cover the southeastern area and **Michael Fay** will cover the mid-Atlantic states from Maryland.

• The promotion of **Neil R. Vander Dussen** to the post of divisional vice president and general manager of **RCA's** commercial systems division, has been announced. Mr. Vander Dussen's successor is **J. Edgar Hill,** who will assume the position of divisional vice president and general manager of broadcast systems.

• **AKG Acoustics,** of Mahwah, N.J. has appointed **VF Sales** of Canton, Michigan as manufacturers' representatives to handle dealer relations for microphones, headphones, phonocartridges, and reverberation systems. The operation is headed by **Greg Williams.**

• In tribute to his pioneering work in the development of television, **Dr. Vladimir Kosma Zworykin** of **RCA** has been elected to the National Inventors Hall of Fame. Dr. Zworykin has received 27 major awards for his inventions, including the National Medal of Science, conferred on him by **President Lyndon Johnson** in 1966.

• Two recent appointments at **Audio & Design Recording,** of Berkshire, England have placed **Len Lewis** in the post of world wide marketing director, and in his former position, **Chris Walden.** Mr. Walden, formerly of **Alice Ltd.,** will take over Mr. Lewis' responsibilities as United Kingdom sales director. Audio & Design's affairs in Denmark are now in the hands of **Audiophil,** of Copenhagen. **Denis Tyler, Ltd.** has taken over the representation of the firm in eastern Europe.

THE ADC CARTRIDGE CAUSES NO PERCEIVABLE WEAR OVER THE LIFE OF YOUR RECORDS.

Unbelievable? Believe it.

A series of tests conducted by a leading independent audio-testing laboratory prove it.

The tests show that the ADC XLM-MKII cartridge causes no perceivable wear until after 60 plays. Industry sources estimate the "life of a record" (the average number of times a record is played) to be 40 to 50 plays.

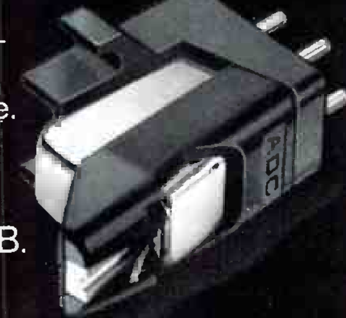
Other cartridge manufacturers may talk about less record wear, but ADC has proven *no wear over the life of your record.*

The reason for this is our unique patented design. It's patent #3294405.

We call it the "induced magnet" cartridge.

Most cartridges are designed so that a heavy magnet is part of the moving system.

The ADC XLM-MKII is different, because our engineers found a way to detach the magnet and position it above the stylus, so the stylus applies less pressure against the groove.



Less pressure means less wear.

The fact is, of all the leading brands, ADC cartridges have the lowest mass moving system you can buy. That means better sound and superior performance.

The XLM frequency response is exceptionally flat, from 15Hz to 24KHz ±1.5dB. And for the ultimate in stereo reproduction, it has a minimum of 28dB of channel separation.

Think about it. In the long run you'll probably spend more on your record collection than you will on your whole stereo system. So it makes sense to buy a cartridge with proof that it makes your records sound better and live longer.

The ADC low mass cartridge. Unbelievable.

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IT HELPS YOUR RECORDS LIVE LONGER.

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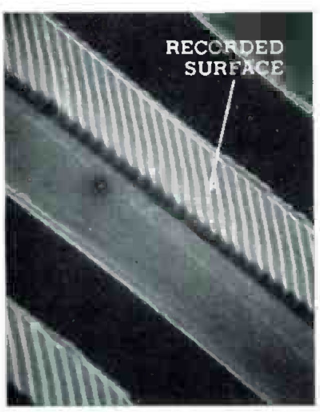
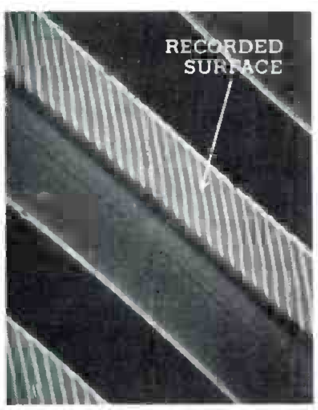
THE PROOF:



267X Magnification

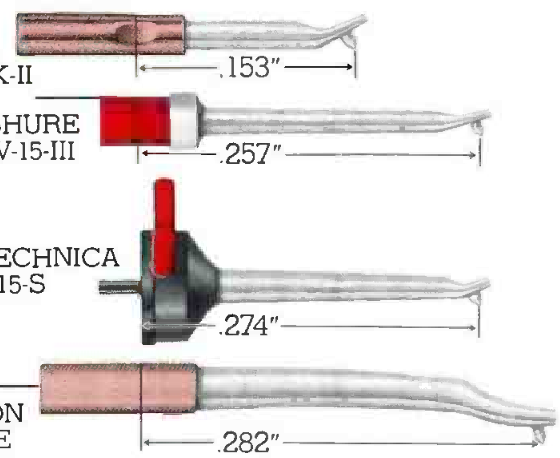
This is a photomicrograph of a 20kHz record groove that has never been played before.



273X Magnification

This is a photomicrograph of a similar 20kHz record groove played 75 times with an ADC XLM-MKII cartridge. As you can see there is no difference.

THE DIFFERENCE:



The way to get the most accurate reproduction of sound is to lower the total effective mass of the moving parts of the stylus. And that's exactly what our engineers did. In fact, of all the leading brands, ADC cartridges have the lowest mass moving system you can buy.

INDUCED MAGNET

MAGNET

If you'd like your own personal copy of the test result, write to ADC at address shown above.

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No glory. No fame. No glitter. But every bit a star.

The pros. They're on stage night after night. Performance after performance. The business is in their blood.

But there are other pros too. Like Altec sound systems. Most of the time they're not even seen—but you know they're there.

The Altec "Voice of the Theatre" heritage offers the dependability, clarity and versatility that performers of all kinds recognize the world over.

The dependability acquired through 40 years of experience. The clarity for which the "Voice of the Theatre" has long been famous. The versatility to meet the varied demands of professional musicians. Altec sound systems—the dependable performers.

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