db

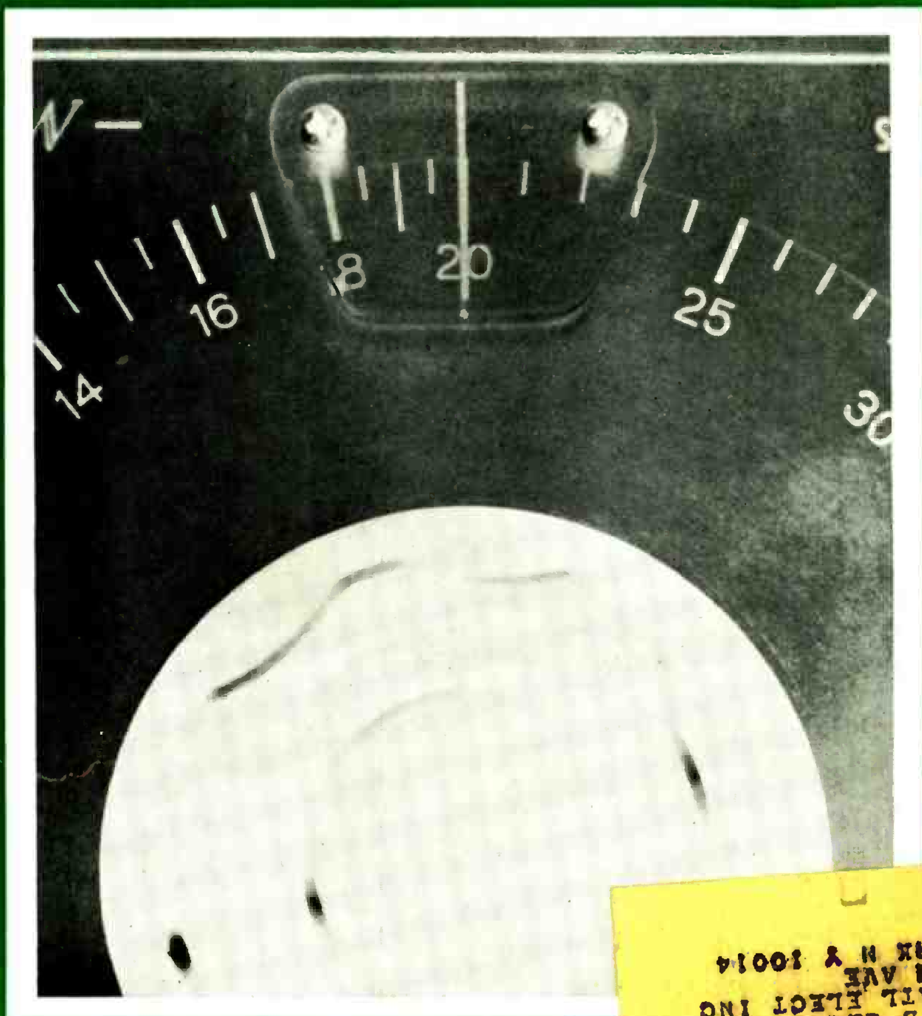
THE SOUND ENGINEERING MAGAZINE

SEPTEMBER 1968 75c

Frequency Response Measurement

Electronic Video Recording

A New Ribbon Microphone



ALBERT B GRUNDY JR
INTERNATL ELECT INC
333 6TH AVE
NEW YORK N Y 10014

www.americanradiohistory.com

A new Angel Record is the sum of the creative efforts of many individuals. Orchestra, soloists and engineers must be scheduled many months in advance, and are frequently brought together over great distances to make the recording. Engineering at the recording session and during the transfer from tape to disc requires great care and precision. Each stage of the process, and the way in which it is carried out, influences the musical values in the recording finally released.

AR INC. *components are used by executives at Angel Records to hear first pressings of new releases.*

As responsible executives of one of the world's largest recording organizations, the men who conduct Angel's operations can afford any equipment except that which distorts or falsifies the quality and content of a recording. The executive conference room at Angel Records is equipped with AR high-fidelity components. Write for a catalog of AR products.

Suggested retail prices of AR components shown: AR amplifier, $225; AR turntable, $78; AR-3a speaker systems, $225-$250, depending on cabinet finish.

ACOUSTIC RESEARCH, INC., 24 Thorndike St., Cambridge, Mass. 02141

CIRCLE NO. 1 ON READER SERVICE CARD

Circle 11 on Reader Service Card

www.americanradiohistory.com

Coming Next Month

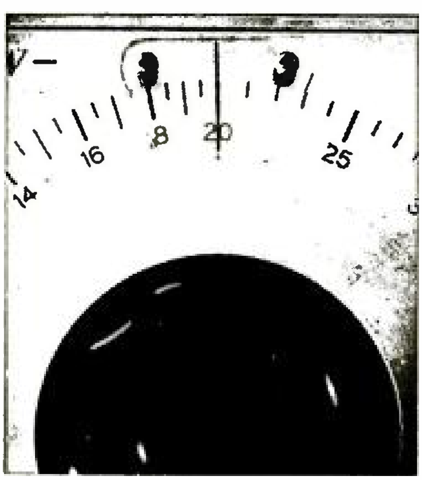
● In October Sidney L. Silver will cover the determinations that go into selecting the correct tape-recording bias. His article BIASING CONSIDERATIONS. discusses the relationships of bias to frequency response and distortion — and offers methods of reaching an optimum condition for all situations.

October is the month of the Fall AES Convention in New York. Accordingly, we will have a complete guide to the papers, convention exhibition times — and maps of manufacturers' locations.

And there will be our regular monthly columnists: George Alexandrovich, John A. McCulloch, Norman H. Crowhurst, and Martin Dickstein.

Next month in **db, the Sound Engineering Magazine.**

About the Cover



● An audio signal generator — vital to the measurement of frequency response. See Mel Sprinkle's article beginning on page 17.

db

THE SOUND ENGINEERING MAGAZINE

September 1968 ● Volume 2, Number 8

Table of Contents

FEATURE ARTICLES

MONTHLY DEPARTMENTS

EDITORIAL BOARD OF REVIEW

George Alexandrovich
Sherman Fairchild
Norman Anderson
Prof. Latif Jiji
Daniel R. von Recklinghausen
William L. Robinson
Paul Weathers
John H. McConnell

db, the Sound Engineering Magazine is published monthly by Sagamore Publishing Company, Inc. Entire contents copyright © 1968 by Sagamore Publishing Co., Inc., 980 Old Country Road, Plainview, L.I., N.Y. 11803. Telephone (516) 433-6530. **db** is distributed to qualified individuals and firms in professional audio—recording, broadcast, audio-visual, sound reinforcement, consultants, video recording, film sound, etc. Application must be made on an official subscription form or on a company letterhead. Subscriptions are $6.00 per year ($7.00 per year outside U. S. Possessions, Canada, and Mexico) in U. S. funds. Single copies are 75c each. Application to mail at Controlled Circulation Rate is pending at Easton, Pa. 18042. Editorial, Publishing, and Sales Offices: 980 Old Country Road, Plainview, New York 11803. Postmaster: Form 3579 should be sent to above address.

www.americanradiohistory.com

Robert Bach
PUBLISHER

Larry Zide
EDITOR

Bob Laurie
ART DIRECTOR

Marilyn Gold
COPY EDITOR

Charles N. Wilson
ASSISTANT EDITOR

Richard L. Lerner
ASSISTANT EDITOR

A. F. Gordon
CIRCULATION MANAGER

David Pollens
ASST. CIRCULATION MGR.

SALES OFFICES

New York
980 Old Country Road
Plainview, N.Y. 11803
516-433-6530

Denver
Roy McDonald Associates, Inc.
846 Lincoln Street
Denver, Colorado 80203
303-825-3325

Houston
Roy McDonald Associates, Inc.
3130 Southwest Freeway
Houston, Texas 77006
713-529-6711

Tulsa
Roy McDonald Associates, Inc.
2570 S. Harvard Ave.
Tulsa, Oklahoma 74114
918-742-9961

Dallas
Roy McDonald Associates, Inc.
Semmons Tower West
Suite 411
Dallas, Texas 75207
214-637-2444

San Francisco
Roy McDonald Associates, Inc.
625 Market Street
San Francisco, California 94105
415-397-5377

Los Angeles
Roy McDonald Associates, Inc.
1313 West 8th Street
Los Angeles, California 90017
213-483-1304

Portland
Roy McDonald Associates, Inc.
2035 S.W. 58th Avenue
Portland, Oregon 97221
503-292-8521

Letters

The Editor:

I have just completed reading and agree fully with John E. Hall's letter (in the May issue) concerning the miserable excuse for sound that accompanies most television video signals. It is my belief that it is bad because the public accepts it and in most cases wouldn't be able to find anything wrong with it. I have heard persons listening to our station with radios that looked and sounded like they were shipped over here on the Ark. In many cases tuners drift and the station is only about half tuned on the dial. When I ask them how they stand it, they say: "How can I stand *what*?"

The reason they can stand it is the fact that they don't pay any attention to it. The situation calls for repair or adjustment only when the words are too mushy to be understood—or when the racket stops altogether.

Unless he buys a home-entertainment-center type of system, the buyer is getting a receiver with fine video and audio and a three-inch dime-store variety speaker whose mounting is usually dictated by where the grill cloth looks best, rather than the way it sounds.

Add to this type of setup poorly maintained sets, antennas that have seen far too many hard windstorms, and many listeners and viewers that seem perfectly content with things as they are, and you have a reason why television station engineers and owners (who often have trouble explaining expenditures that produce no *visible* result) are not going to knock themselves out over the audio quality they produce.

William P. Botts
Chief Engineer
KDEX Radio
Dexter, Missouri

We feel that Mr. Botts is correct in his estimation of the problem. Nevertheless, it does not seem appropriate to us for audio engineers to hide behind the statement that the public doesn't appreciate quality anyway. It is true that the set manufacturers are equal culprits in the poor video-sound problem, but there are those video listener/watchers whose equipment is good, and whose ears can distinguish satisfactory sound from indifferent sound. We believe that they represent more than a mere handful and we believe that it is the responsibility of video sound to be as good as it can be—even if this actually only serves a minority of the public. We cannot accept a premise that states that engineering need only be as qualitative as the end user demands. Such a concept only demeans the entire profession. Ed.

The Editor:

Thank you for the copy of your excellent magazine. I must say that your references to meter-pinning on page 8 of the December issue are pretty shocking to a European mind, brought up to the security of Peak-Programme Meters (less cumbersome than your 'scope, and easier to read). Why has this approach never appealed to U. S. engineers? Why, indeed, is it never discussed—not in any U. S. Journal I have ever read, anyway?

G. C. Balmain
GCB Audio
Slough, Buckinghamshire
England.

There are all too many examples of differences in technology between Europe and here—often without clear reasons for the validity of these different approaches. We certainly would be interested in articles discussing non-"standard" approaches to the audio art. Ed.

The Editor:

It has become commonplace in the audio industry, of late, to refer to r.m.s. power when talking about the continuous or average power capabilities of an amplifier as contrasted to I.H.F. or E.I.A. power. Since only current and voltage have an r.m.s. equivalent it would appear that the term r.m.s. power is a misnomer. The term continuous power is more accurate as well as more descriptive. Perhaps the manufacturers and advertisers could be encouraged to adopt this terminology.

A. H. Clegg
Project Engineer
r & d Division
KDI Precision Products, Inc.
Cincinnati, Ohio

We fully concur with Mr. Clegg's comments. Toward that end we will watch editorial contributions. Advertising, however, is controlled by the manufacturers and agencies involved. We can only ask their cooperation in creating this as a standard. Ed.

AUDIO NOMENCLATURE CONTINUED

The Editor:

Thank you for the chance to sound-off on the Hertz/cycle fiasco.

Let it be understood from the first statement that I am opposed to the introduction of any change of terms simply for the erudition it is attempting to express. A cycle is a cycle. . .a hertz (upper or lower case) is an asininity. So Mr. Hertz discovered the electromag-

www.americanradiohistory.com

netic wave propogation bit. I am properly impressed, but don't clutter up my literature with such impossibilities as kHz—that's hard on the eyeballs and means nothing.

If it is imperative that old Hertz be honored with a letter of his own in the already cluttered diatribe of abbreviations, then use the abbreviation where it has some meaning! It is acceptable when Gates sends out data on a new f.m. transmitter operating in the range of 88-108 mHz but mc was easier to read and actually meant more. It is *not* acceptable when Electro-Voice sends out data on a new microphone with a frequency response of plus-or-minus something from 5 Hz to 16 kHz. Hertz did work with an electromagnetic phenomenon and not with cycles *per se.* I could care less how microphones respond to electromagnetic fields; I'd rather they didn't, for that matter. I want to know about cycles, nice acoustic cycles that are just that, and what the mic does when confronted (or conbacked) with them.

If the change to the Hertzian designation was intended to impress other engineering fields with some esoteric new concept, I'm afraid it fell flat on its face! It's done nothing more than clue all others in on the fact that none of us would even have a job today if it weren't for the inquiring mind of *one* man who stumbled across an explanation of a known phenomenon.

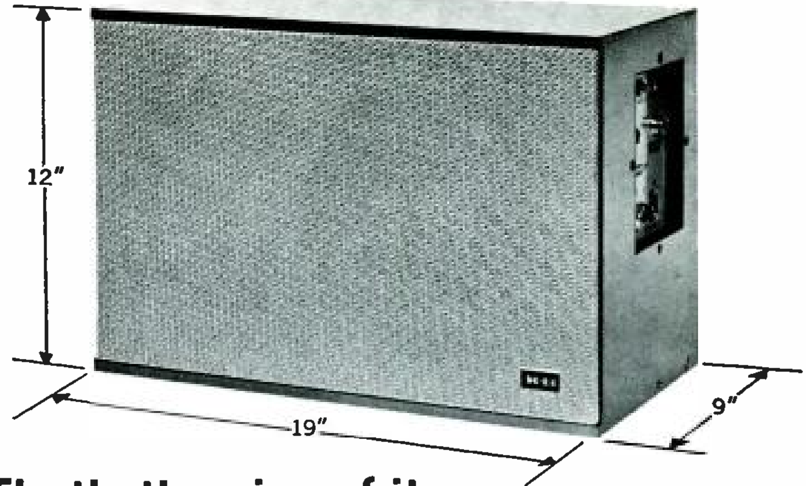
Don't try to act so big-shot—after all, not a one of us can answer the basic question: "What is electricity?"

I apologize for the length of this letter, but this has been grating on my nerves since the first capital H hit the printing fan. The justification that the designation is common in Europe doesn't seem to hold water; so is the prefix *mono.* Except, use the latter term carefully around Spanish speaking people (it translates as: monkey or silly fool).

How many engineers are working with silly fool broadcast stations. Not too many who will admit it (in front of the boss, anyway). So let's be equally careful not to make ourselves mono(manic) on cute terminology and let us get back to truisms.

John Tucker
Chief Engineer
KVOZ Radio
Laredo, Texas

Mr. Tucker certainly makes an impassioned plea for the retention of existing English symbols. Our goal has always been to reach acceptable standards that are meaningful to the audio pro. John McKnight of Ampex has submitted an extended letter that spells out finally the practical logic behind the changes in symbolism that have taken place. It arrived too late for inclusion in this issue, but it will be in next month. *Ed.*



That's the size of it.
A complete monitor speaker system.

Make room for Gotham's new Model OY Integrated Monitor Speaker.

But not too much room. It doesn't need it. The new Gotham Model OY gives you highest quality monitoring in a minimum of space.

This amazingly compact system includes all the features that usually require much more space. It has two built-in 30 Watt silicon transistor, output transformer-less amplifiers so you don't need external ones; a balanced bridging input; and multiple speakers with electronic crossover.

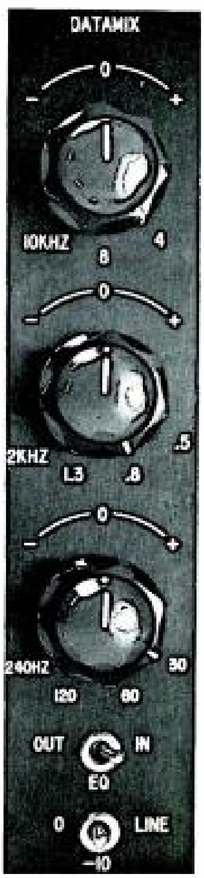
You can order this system in high impact grey Formica.® Or in oiled prime walnut, for the boss' office! (Made in W. Germany by Klein+Hummel)

Write today for our complete 6-page brochure.

GOTHAM
AUDIO CORPORATION
2 WEST 46 STREET, NEW YORK, N.Y., 10036 • 212-CO-5-4111

Circle 19 on Reader Service Card

DATAMIX
250 West 78th St., New York, 10024



It's unequaled

Custom recording consoles

Circle 17 on Reader Service Card

www.americanradiohistory.com

The Feedback Loop

JOHN A. McCULLOCH

The Feedback Loop invites your questions on any subject pertinent to professional audio. Address your queries to The Feedback Loop, **db Magazine,** *980 Old Country Road, Plainview, N. Y. 11803. Please enclose a stamped, self-addressed envelope. Mr. McCulloch will answer all letters in this column or by mail.*

● In the April issue I issued a call for information of thorough technical education especially pertaining to the broadcast and recording field. Some response has come in and is included in this column, but I am sure that there are others who do offer this caliber of training. I will have a list of such schools, as soon as they are all brought to my attention, and I have received their official outline of the courses offered.

First received was a letter from Mr. Darrel J. Monson, Director of the Communication Services at Brigham Young University, Provo, Utah 84601. He states, "Associated with this university is a two-year technical institute that offers training in a number of specific areas. Two of the areas that are included are the following:

Electronics Engineering Technician. (training in electronics theory and circuits, electron tubes, solid-state devices, servo-mechanisms, and radio and tv fundamentals.)

Radio-Television Technician. (similar to the above, but with substitution of three courses aimed at providing the 1st FCC license.)"

Other modifications of the program include areas of speech and music for those individuals wishing a background in recording. Also available at BYU is a standard EE degree, with specialization in audio, recording, or broadcasting.

Next to answer was Mr. Tyrone Hemry, WBYO, Boyertown, Pa. He is a graduate of Bob Jones University, Greenville, South Carolina. He states, "They offer a four-year course in Broadcast Engineering leading to the B.S. degree. Also a four-year course for those interested in the speech and production phase of broadcasting, leading to a B.A. degree in Radio Broadcasting." He further indicates that the school operates both carrier current radio, and broadcast services in am and fm.

From Mr. W. J. Gedlaman, instructor in the Electronics Department of The Southern Alberta Institute Of Technology comes a third listing.

"Our course begins with students taking two years (1800 hrs.) instruction in general electronics. The third year is devoted to broadcasting. Please note that at the end of the course our graduate is well versed in general electronics, specifically competent in broadcasting, and has gained on-site training in our three studios on campus."

The school includes the use of extensive television facilities, including color. It is located at 1301—16th Avenue N.W. Calgary, Alberta, Canada.

Any additional replies will be duly noted and added to the list, but with only these three at the moment I shall not make a formal listing until there are ten or more, or until I am convinced that no others do offer a sufficiently sophisticated level of study to warrant including in the list.

BEEPERS

Mr. Mark Durenberger, in Minnesota has been kind enough to submit some comments on the beeper system covered in this column, (also in the April Issue). I quote from his letter:

"You can connect the *incoming* feed, from the LS-141 to the console, electrically out-of-phase with the existing mic feed. This will create a phase condition in which some of the mic audio can be cancelled out, resulting in a better telephone-to-mic ratio. Of course the mic audio will suffer from phase shifting at both ends of the frequency spectrum, and a slight *hollow* sound will result. In some cases this can be tolerated as the lesser of two evils when low-level telephone calls are a problem.

"If the beeper has unity gain the send level should be on the order of −20 dBm, and the receive equipment should be able to handle about −25 dBm. Matching between the send amplifier and the beeper is important for best power transfer down the telephone line."

He suggests that all incoming equipment is bridged onto the system. Mr. Durenberger also offers a suggestion should a hybrid coil not be readily available. He states that a standard pair of repeating coils can be used by tying their respective primaries in parallel to the beeper equipment, and the secondaries to the send amplifier and the normal receive equipment.

This alternate solution should work, but it will not give the isolation of a proper hybrid between the send and receive circuits. I have heard of an additional network which may be coupled into such a made-up hybrid to give back (and possibly increase) the separation, but I do not have such a circuit at present. Perhaps one of you can supply me with such a schematic. It certainly should be useful for many other applications as well as this one.

I have received a request for articles dealing with specific construction projects. I am in no way a design engineer, but it is the function of this column to pass on information of use to the professional audio field. Certainly, ideas you have on small circuits are appropriate to this column. Of course, full credit will be given. (Articles on projects of more massive content will be considered by **db**'s editor for use as feature material.)

MOVING?

Have you sent us a change-of-address notice? It takes time for us to change your plate so let us know well in advance of your move. Be sure to send us the complete new address *as well as your old address*. Include both zip numbers. Keep **db** coming without interruption!

BACK ISSUES AVAILABLE

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.

CIRCULATION DEPT.
db — The Sound Engineering Magazine
980 Old Country Rd.
Plainview, N. Y. 11803

www.americanradiohistory.com

koss model esp-6 electrostatic stereophones deliver a sound never before possible in headphones!

3 Octaves of Sound beyond the limits of ordinary voice-coil and cone-type driver elements—this wide range is reachable only through electrostatics.

World's first Self-Energized Electrostatics—Easy to use—You just plug-in like other headphones. No special amplifiers or power supplies needed.

World's first wide-range electrostatic driver elements for headphones. Give smooth, peak-free, relaxing performance.

Dynamic Level Indicator in each cup light lights up, protects against very high sound pressure levels to give long, trouble-free listening pleasure.

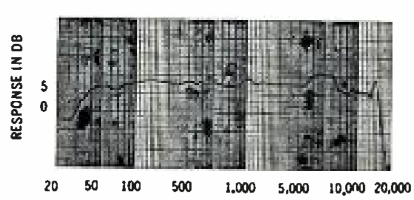
The sound of Koss ESP-6 headphones is as new and unique an experience as the very first time you heard the sound of Koss Stereophones. Remember the dramatic and expansive sound? Like nothing you ever heard before. And now Koss has done it again.

Through the development of the world's first electrostatic driver element for headphones, Koss engineers have created a sound lively in its own reality; smooth and relaxing in character. It is a sound beyond the limits of ordinary voice coil-and-cone-type driver elements. It is a sound reachable only through electrostatics.

Through the development of practically weightless, self-energized diaphragms never before possible for headphone uses, Koss engineers have eliminated the moving cone driver element to achieve a frequency response obtainable in the past only through the use of complex electrostatic speakers like the Koss-Acoustech X system. And only now have Koss engineers been able to employ these techniques for headphone listening. And to prove it, an individual machine-run response curve comes packed with each headset. Dramatic Koss ESP-6 Electrostatic Stereophones feature a dynamic level indicator in each earcup to protect against overload when signal reaches very high sound pressure levels. Constructed with earpieces of sturdy, high impact plastic, coiled cord extending to 10 feet, comfortable foam rubber headband, and fluid-filled ear cushions for effective seal, the ESP-6 will withstand rugged use required by professional recording. Yet uniformly reliable and superb sound reproduction need not be sacrificed.

COMPLETE WITH FITTED, PORTABLE CARRYING CASE AND INDIVIDUALLY MEASURED RESPONSE CURVE $95.00

Write the factory today for free technical article "Adventure in Headphone Design."



TYPICAL RESPONSE CURVE WHEN MEASURED ON 6 cc COUPLER

KOSS

Koss Electronics Inc.
2227 N. 31st Street, Milwaukee, Wis. 53208

Export: Koss Electronics S.r.l.
Via Bellini 7, 20054/Nova Milanese, Italia

Export Cable: Stereofone

Circle 23 on Reader Service Card

www.americanradiohistory.com

Sound with Images

MARTIN DICKSTEIN

LIGHT TERMINOLOGY

● In both the audio-visual and closed circuit television fields, the terminology for illumination is the same. For an acceptable image on the c.c.t.v. monitor, the subject must be illuminated sufficiently; at or above the prescribed minimum indicated in the specifications of the c.c.t.v. camera used. In projection, front or rear, the image on the screen must also be of a sufficient brightness for the entire audience to see the necessary details of the picture.

It might prove helpful, therefore, to indicate a few of the terms referring to illumination which are used either in projection, closed circuit t.v. or both. They are not intended to include *all* the terms used by engineers or consultants.

The *footcandle* was chosen as an arbitrary standard of light intensity. This, according to the literal interpretation, would indicate the intensity of light at one foot from a candle as measured at the center of the light pattern or on the axis of the light. The *footcandle* is a linear term. Thus, 10 candles placed one foot from a surface would produce *10 footcandles*.

As many of the c.c.t.v. cameras in use today are made in foreign countries, the metric equivalent of the *footcandle* has become part of the normal terminology. *One footcandle* is equal to *10.8 lux*; or, approximately *9.3 footcandles* is equal to *100 lux*.

The light output of a source is measured in *lumens*. One *lumen* would result in one *footcandle* of light on an area of one square foot. Total *lumen* output, therefore, could be taken as the average *footcandles* within an area multiplied by that area. Thus, if an area of 10 x 10 feet required an illumination of *100 footcandles*, the required *lumen* output would be determined by the area (100 square feet) times the 100 *footcandles* for a total of *10,000* lumens.

One note should be kept in mind. When a slide or movie projector is rated at a certain *lumen* output, the power rating of the lamp used and the efficiency of the lens system have been taken into account. Changing the lamp of the projector, and/or the lens, will change the *lumen* output unless the same power lamp and same type of lens are substituted.

As the term *lumen* is actually a measure of the light emitted by a theoretically uniform point source at the apex of a unit solid angle, the term *beam lumens* describes the amount of light available within the area bounded by 50 per cent lines, or, those lines beyond which the light falls below one-half maximum intensity.

A similar term, *field lumens*, is used to define the amount of light available within the area up to 10 per cent of maximum intensity.

Another familiar term used in illumination is *candle-power*, a rating applied to light sources. This term follows the "square law" well known to sound men. If the number of *footcandles* required are known, it is a simple matter to divide the *footcandles* by the square of the distance at which the source will be placed to find the *candlepower* rating of the required source. *Candle-power*, therefore, is equal to *footcandles over* $(feet)^2$. It can also be said that *footcandles* are equal to *candlepower* times the distance (in feet) squared.

Just as there are in sound distribution, there are graphs for light distribution. These are plotted for *footcandles versus coverage* at different distances from the axis of projection. Since the *footcandle* was shown as a linear term, the graph is made on linear graph paper. Sources such as spot lights will have a graph which peaks sharply at the axis line and falls off very quickly on either side of the axis. A broad beam, does not rise as high on axis and falls off much more gradually on either side of the axis.

It must be remembered that the term *footcandle* describes the amount of light at a definite distance from the source. Therefore, the graph would have to indicate the distance used to determine the values for the *footcandles* on the vertical axis of the graph.

The term *coverage*, used as the horizontal axis on these graphs, is described in two ways. The area illuminated, taken on a surface perpendicular to the light projection at a specified distance from the source, can be used with the per centage of maximum intensity usually indicated. The *angle of light emission* is the other means of describing the coverage of a source. The latter method provides a simple means to determine the coverage area at any distance from the source with the percentage of maximum intensity indicated.

Beam coverage describes the area within which the intensity of the light is equal to or greater than 50 per cent of the maximum intensity. This one-half point is equivalent to one stop on a camera lens and is useful in determining beam overlaps needed to provide equal or uniform coverage with more than one source.

Field coverage is used to describe the area illuminated up to 10 per cent of the maximum intensity and is useful in determining limits of set or display lighting.

Some of the above terms are applicable in c.c.t.v. work, others in front- or rear-screen projection. In image projection, it is also necessary to be aware of the term *gain*, used to describe the reflection (or transmission) characteristic of a front (or rear) screen. The *gain* of a screen material is usually indicated in the specifications available from the manufacturer.

When the *gain* of the screen material is known, the resulting *luminance* can be determined by multiplying the *illumination* from the projector by the *gain*. *Luminance* defines the amount of light reflected from (or passed through) by a front- or rear- projection screen.

Another factor that should be taken into account when a projection system is designed for a particular project is the *contrast ratio*. This term indicates the proportion of image brightness to non-image brightness or extraneous reflections caused by ambient light, such as the stray light of the projector or light from the window or general room lighting.

Another term commonly used in projection is the *foot-Lambert*. If a random-reflecting surface with a reflection factor R and an area of A square feet were illuminated with E footcandles (E being used as the symbol for illumination), the brightness of the surface would be RE/π *candles/square foot* or RE *foot-Lamberts*. Pi (π) enters into the calculation as the reflection is actually a re-radiation of REA *lumens* into a hemisphere. It is seen, then, that 1 *foot-lambert* is equal to $1/\pi$ *candle*/ft^2.

These are by no means all the terms necessary to assist in the design of a projection system. Nor are they intended to be the only ones that an audio man working in audio visual projects is expected to know. Designing large audio-visual presentation rooms and the complicated systems that go into them is a very complex one indeed and can only be handled by a specialist in this field—someone well versed in the technology, techniques, and philosophy of image projection. Simpler situations can be handled by audio men moving into the audio-visual field and the terms mentioned are only a very minute portion of the specialist's lexicography.

www.americanradiohistory.com

It's time you stopped squinting and got a new electronic stopwatch by Electrodyne.

That old clock, timer, or stopwatch of yours is certainly some sort of an anachronism in the midst of all your modern electronic gear. Besides that, it's getting just a little bit harder to read every year, now isn't it?

That's why we're bringing out our new electronic stopwatch. It times continuously up to an hour and forty minutes, reads out in minutes and seconds—in big, bright digits. And has just two controls—one for start/stop/reset, the other for power on/off. Completely self-contained in its own handsome Teak cabinet, this new electronic stopwatch by Electrodyne is readily rigged for remote control.

Our optional tape motion sensor lets you use it for direct timing of magnetic tapes—even at high speed.

We call this piece DC-900. You'll call it the best thing that's happened to timing since the sundial. Get one no later than Tuesday.

ELECTRODYNE CORPORATION
7315 Greenbush Avenue ▪ North Hollywood ▪ Calif. 91605
Phone: (213) 875-1900 ▪ Cable Address: "ELECTRODYNE"

Circle 26 on Reader Service Card

www.americanradiohistory.com

When you're ready to buy your next professional recorder...

Look for:

LOW NOISE Pure sound reproduction is the minimum requirement for a professional recorder. Listen carefully for hum and other machine-produced noises—marks of an "amateur" machine. Incidently, the noise level of all Crown recorders is lower than that of most other professional recorders. (Guaranteed minimum S/N of 60db at 7½ ips.)

WIDE BAND-WIDTH Any professional recorder will cover all the audible sound spectrum. Now try to find one with the band-width safety margin of a Crown. (Guaranteed minimum of ±2db, 30-25 kHz at 7½ ips and 30-15 kHz at 3¾ ips.) In side-by-side comparison, you'll discover that reproduction on a Crown at 3¾ ips is comparable to that of other professional recorders at 7½ ips, giving you savings of 50% on tape in many recording applications!

MINIMUM DISTORTION Wow, flutter and other signal distortions should be imperceptible at 7½ ips for professional quality tapes. Crown guarantees a minimum of 0.09% wow and flutter at 7½ ips.

FLEXIBILITY Look for a recorder with a full range of professional refinements. More than with any other professional recorder, you can "do anything" with a Crown—record sound-on-sound, create special equalization and echo effects, A-B monitor while recording, mix four microphones and much more.

INVESTMENT Professional electronic equipment is a good secure investment, with a slow rate of depreciation. A Crown is insured against obsolescence with a design acclaimed by professionals "years ahead of the industry." With only ten moving parts, normal care and routine service will assure like-new performance for ten years. In 1978, you'll be glad you purchased the very best—a Crown.

Write to Crown International
Box 1000, Dept. DB-9
Elkhart, Indiana 46514

MADE ONLY IN AMERICA

Circle 15 on Reader Service Card

The Audio Engineer's Handbook

GEORGE ALEXANDROVICH

● Last month we looked at the construction, electrical characteristics, and commonly-used circuits in which switches are normally used. We also covered noise suppression in power switching.

In *audio* switching the variety of levels and circuits may create special problems when the goal is noiseless audio transfer. It may be helpful, therefore, to classify switches for audio according to the function they must perform. In sound-mixing consoles we would distinguish the following types of switches:

microphone level switches
channel selector switches
monitor selector switches
talkback switching systems
patchbays.

There are other types of special switches, of course, but the above categories cover most of the normally encountered types.

The noise and click suppression methods described last month do not apply to audio circuits. In *audio* the sequence of switching is the most important condition. while in *power* circuits short-circuiting of the power pulse transient is the objective.

However, the origin of transients is basically the same in both types of circuit. Current flow has been suddenly interrupted or resumed. All the reactive components in the circuit (the capacitors and inductors) are storing or dissipating energy—creating the transient.

From this statement you might assume that the elimination of reactive elements from the circuit would remove the danger of switching noise. But there is always the possibility that the circuit to be opened or closed has d.c. bias (possibly due to faulty design or component failure; but also possibly purposeful as when d.c. bias is carried for condenser mics). Interruption of this established current flow produces a step function causing a click even though there might be no reactive components present.

Basic good-engineering practice calls for several rules to be followed when switches are called for.

1. Analyze the circuit before deciding what kind of switching can and should be used.

2. *Determine if the impedance of the circuits in question must be kept constant and what effects impedance change may have on associated circuitry.*

3. *If the signal to be switched is at mic level and the circuit is a balanced one, be sure to select a switch with adequate shielding and enough contacts to provide switching in of a dummy load when the source is disconnected.*

In the last rule above it is important that the dummy load be switched in *before* the source is disconnected. Conversely, the source must be re-connected before the dummy load is removed. Switches designed to do this job have make-before-break contacts. If the input of an amplifier is switched to different sources it is feasible to use a

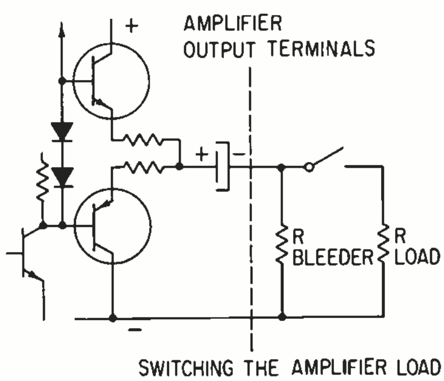
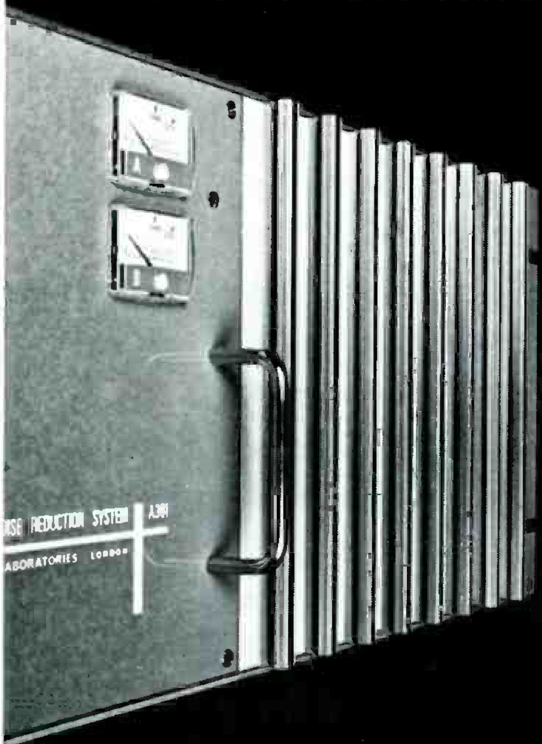


Figure 1. Switching the amplifier load.

www.americanradiohistory.com

THE DOLBY A301 AUDIO NOISE REDUCTION SYSTEM



Making the Master Recordings of the Future

Already in use in eighteen countries, the Dolby system is making master recordings which will withstand the test of time.

The system provides a full 10 dB reduction of print-through and a 10 – 15 dB reduction of hiss. These improvements, of breakthrough magnitude, are valid at any time—even after years of tape storage. This is why record companies with an eye to the future are now adopting this new revolutionary recording technique.

A301 features: Easy, plug-in installation · solid state circuitry · modular, printed circuit construction · high reliability, hands-off operation. Performance parameters such as distortion, frequency response, transient response, and noise level meet highest quality professional standards.

Price $1950 f.o.b. New York.

NEW Remote Changeover option cuts costs, enables one A301 unit to do the work of two.

NEW NAB and DIN level setting meters simplify recorder gain calibration.

DOLBY LABORATORIES INC.

333 Avenue of the Americas · NewYork · N.Y. 10014
(212) 243-2525 · Cables: Dolbylabs New York

Circle 24 on Reader Service Card

The precision instrument for SPEED CONTROL of tape...

The growing trend to multitrack recording has necessitated that tapes be "on cue" and "on speed," now more than ever.

The Tape Strobe — a small, precision ground, high quality, stroboscopic wheel with professional specifications — shows you, instantly, whether a tape is truly on speed. Detects slippage and uneven tape speed, eliminates errors of timing, cueing, measurement and calibration. Indicates mechanical damage and worn transports.

EASY TO USE — Press strobe wheel gently against tape, check direction of pattern for off-speed condition. Any 60-cycle light source furnishes the basic timing.

HIGH QUALITY FEATURES — All anodized finish, precision machined out of solid aluminum, strobe wheel mounted with instrument pivot bearing, metal etched stroboscopic pattern.

Calibrated for three tape speeds: 7½ ips, 15 ips, and 30 ips. Other speeds available. Calibrated chart included with each Tape Strobe. Packaged in beautiful deluxe jewelry case.

TAPE STROBE

$22.50
plus local taxes.

dubbings ELECTRONICS INC.

A subsidiary of Consolidated Electronics Industries Corp. • 1305 S. STRONG AVE., COPIAGUE, N.Y. 11726 / 516 893-1000

Circle 25 on Reader Service Card

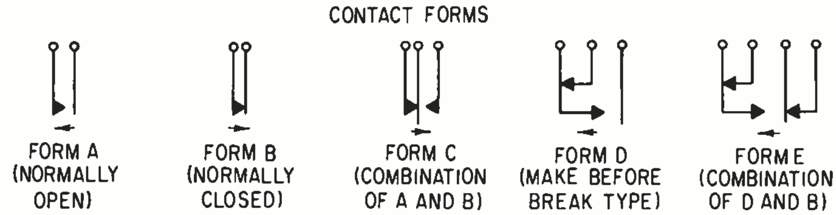


Figure 2. The various contact forms found in switches and relays.

permanent dummy load across the input to the amplifier—providing the sources require load resistors anyway. In this way, the input to the amplifier is never left hanging—picking up noises and hum.

In a modern directly-coupled amplifier, the output is available through an electrolytic capacitor. The amplifier side of the capacitor faces a certain d.c. potential. If the amplifier's output is left unterminated the charge on the capacitor will slowly fade away. Reconnecting the load produces a renewed charging of the capacitor, drawing excessive current and producing an audible click.

In order to eliminate this click a bleeder resistor should be put across the output as a permanent load. In this way, even when there is no regular load connected, the bleeder resistor keeps the capacitor charged. This is shown in Figure 1. (Take this as a hint in servicing. Leaky electrolytics can cause switching clicks. If you have a stepped or carbon attenuator as a load, d.c. will cause crackling noises when the fader wiper is moved.)

In many systems, where it is important to keep input circuits free of extraneous noises, each microphone is connected to its own preamplifier without any intervening switches. This brings the level of the input up to easier-to-manage line level.

MIXING BUSSES

There is much to be said about mixing busses when the technology of audio mixing deals with problems of multichannel mixing consoles and tape machines. It's only been fairly recent that we have become so interested in maintaining channel separation. The tools for achievement have followed classic forms with lengthy formulae and matching impedance loads and sources.

The advent of operational amplifiers and transistorized circuits have given audio engineers the opportunity to generate new approaches to old problems. There is no need for having every component in the system available on the patch bay. The packaging of consoles and the attendant reliability of present-day circuits are such that balanced lines needed to patch around failed components are all but forgotten. Only with long mic cables and output lines will they still be found.

The compactness of packaging affects the choice of the circuits being used. Because of the extensive use of transistors and the consequent elimination of balanced lines, transformers have been used mostly as a means of isolation from mic and output lines. Normally, transformers contribute to noise-free switching by keeping d.c. away from switches. Without transformers, switching, wiring, and grounding circuits become more involved; they will be discussed in detail in future installments. And since mixing normally is a subject in itself, it too will be treated separately in the future.

TALKBACK SYSTEMS

One of the most difficult switching problems to be found in a recording console is the complete talkback system. Switching must be noise-free and it must be sequentially correct.

Basically, a talkback facility allows the engineer or producer located in the control room to communicate with the performers in the studio. Since studio microphones are feeding signal to the console and control room (CR) monitor speakers, one-sided communication already exists. Reversing the direction of signal flow requires that the mics be turned off in the studio (to prevent acoustic feedback) while a mic in the CR that is tied to speakers in the studio is turned on. This complicated switching sequence is begun by depressing the talkback button (TB) on the console. (This sequence is shown in Figure 3.)

A most important condition for TB switching is the sequence with which the circuits close and open in order to get smooth switching. Since many of the circuits to be affected are physically scattered in different parts of the system, relays are the most common solution to this problem. (Since a relay is nothing more than an electrified switch, we will treat it as a switch.)

Relays, just as manual switches, can be purchased with a variety of contact configurations. The most common type, however, is form C as shown in Figure 2.

The TB sequence of switching is as follows: first, the monitor speakers in the CR have to be disconnected; Then the studio microphones are cut; next the TB mic is connected; and finally the studio monitors are switched in. This completes the switching sequence in one direction.

When returning to normal console operation, the switching sequence is reversed. First the studio monitors are shut off; then the TB mic; followed by connection of studio mics; and last by the control-room speakers. In order to appreciate the potential complexity, realize that an eight-channel console would have at least sixteen relays. There may be short cuts that allow you to achieve the same results with less relays. but you may well end up buying extra wiring and crosstalk problems instead.

There are a number of ways in which the correct switching sequence can be achieved. In smaller installations, manual switches with form E contacts or several switch-operated relays having sets of adjustable contacts—each set closing or opening just a little later or sooner than the other contacts—can be used. In this way a selection of the proper sequence of contact closing will properly activate the remote relays.

Another way to achieve the same results, but at higher expense. is by connecting the relays through series resistors and placing a capacitor across the relay coil. Thus, the time required to charge the capacitor to the voltage at which the relay kicks in becomes controllable. Larger capacitors take longer to charge and also longer to discharge. Therefore, in order to make this type of circuit work for us both ways, a diode should be inserted between the capacitor and the coil. This will prevent discharge of the capacitors through the coil; also preventing a prolongation of the turn-off time. A fairly large resistor should be placed across the capacitor to help it loose its charge for the next switching cycle. This is a complicated circuit, to be sure, but it does offer one particular advantage. Switching delays are fixed regardless of the speed with which the talkback switch is operated.

It is recommended that the selection of relays for switching using capacitive-delay circuits be in favor of higher-voltage, more-sensitive d.c. relays. These require less power to operate and smaller capacitors to do the job. A circuit configuration is detailed in Figure 4.

Adjustment of the capacitors is dependent on the relays used. and on voltages and series resistors. The higher the voltage, the larger the series resistor, must be, and the smaller the capacitor required. However, it is recommended that the total time delay be kept to less that 0.5 seconds in one direction. Any-

www.americanradiohistory.com

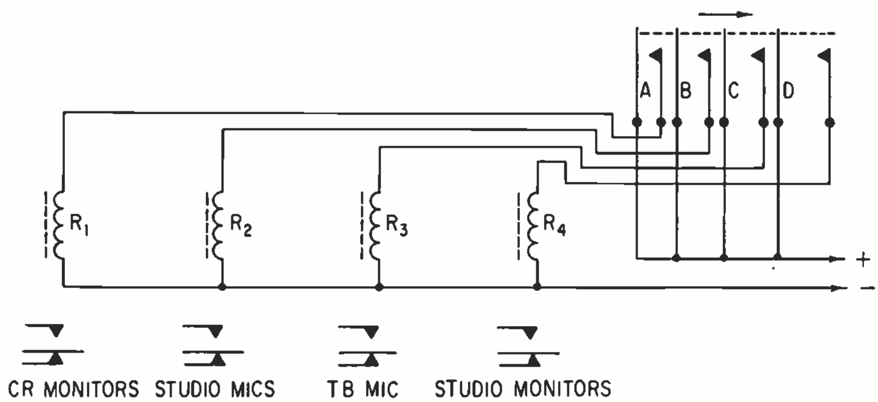


Figure 3. The sequencing of relays in a studio talkback system. In the illustration, note that the contact distances in sections A,B,C, and D are different, producing a switching sequence. Most lever keys can be so adjusted.

thing longer is likely to be objectionable because of sluggish response.

AMPLIFIER LOAD SWITCHING

Since talkback switching involves the selection of different monitor speakers in the control room or studio, special power switching will be required if economy dictates the use of one set of power amplifiers. Under this condition the amplifier outputs are being switched into different loads. It is important to remember that tube-type amplifiers must have a load across the output at all times when signal is present. Failure to do so may cause burnout of the output tubes and transformer.

The story is quite different with transistor amplifiers. Transistors are basically current amplifiers, not voltage drivers as tubes. Thus when we talk about loading properly as it relates to a transistor amplifier, we are not considering impedance matching. We *are* considering the power transfer to different impedances. The source impedance of a transistor may be on the order of hundredths of an ohm; however, best power transfer is achieved into impedances much higher than the source impedance. We may look upon the loading of a transistor amplifier as a bridging of the load across the output. Output voltage across the amplifier doesn't change. If there is no load, current just doesn't flow through the output transistors.

Obviously, this means that it is simpler and safer to switch transistor amplifier output loads than it is with tube amplifiers. With a tube amplifier we must use dummy loads, or switch with make-before-break contacts. The opposite is true for transistor amplifiers. Caution should be exercised to ensure that a transistor amplifier is not shorted or overloaded (even though most amplifiers are protected against damage from such conditions).

In the end the most desirable type of power circuit switching involves switching the *inputs* to the power amplifiers—something possible only in systems with separate monitor amplifier systems for control room and studio.

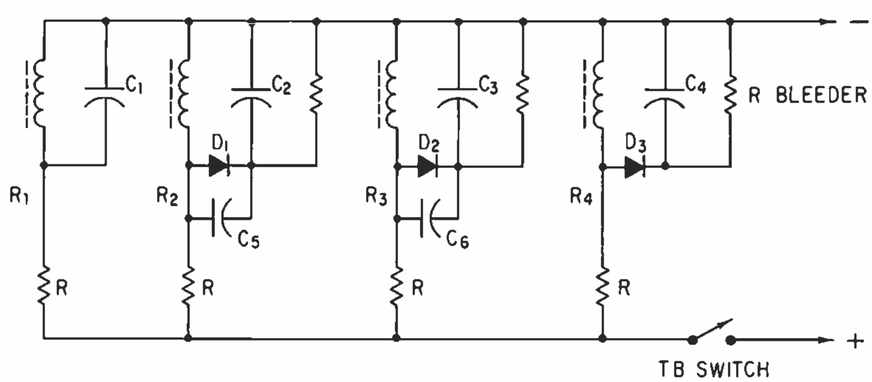
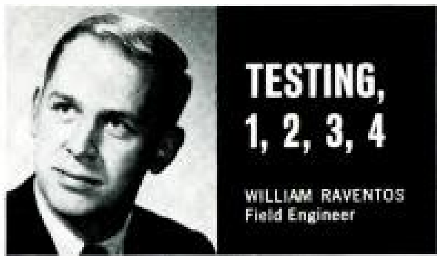


Figure 4. A relay-operating capacitive-delay circuit. In the circuit, R is the same in all cases, C_1 is the smallest and C_4 is the largest. The turn-on sequence is R_1, R_2, R_3, R_4. D_1, D_2, and D_3 prevent discharge through the coils of R_2, R_3, and R_4, but C_5 and C_6 delay turn-off enough to reverse the sequence with the same time constants: $C_1 < C_2 < C_3 < C_4$ $C_5 < C_6$.

One of a series of brief discussions by Electro-Voice engineers



Testing of microphones ordinarily takes two distinct forms: laboratory tests and field tests. The former is basically objective in nature and results in performance specifications, while the latter provides a subjective evaluation of the microphone under actual use conditions. Both forms of testing are valuable, but on occasion the field results do not seem to fully support the laboratory tests.

The difference, of course, lies in the "idealized" conditions that consistently form the basis for laboratory tests. No such uniformity exists in the field, yet the need for correlation between specifications and actual performance is increasingly felt.

In order to more thoroughly explore the causes for deviation from laboratory response, Electro-Voice has undergone a series of tests of varying types of microphones using its large anechoic chamber as a research tool. To date the investigation has concentrated on effective polar response, effects of distance on frequency response, and the results of multiple in-phase and out-of-phase microphone pickups. While the studies have just begun, causes of several common problems have been pinpointed.

Polar response was investigated by rotating the microphone in the anechoic chamber, while speaking at constant volume. This test pointed up the necessity for uniform response off-axis as well as on-axis. With microphones such as the Model RE15, level changed with rotation of the microphone, but voice quality (hence frequency response) remained constant. However with directional microphones that did not offer uniform off-axis response, sound quality quickly became unacceptable. Using a microphone to reduce unwanted pickup to reasonable levels can alter the tonal character of the unwanted suund, as well as distort the apparent acoustical characteristics of the studio or hall.

It was also noted that many omni-directional microphones exhibited directional characteristics that were quite audible at an angle as small as 80° off axis. This proved to result from interference of the microphone case, and was directly related to increasing case diameter.

In another series of tests, the effect of distance on frequency response and articulation was investigated. A male voice was recorded at distances from 2′ to 25′ in the anechoic chamber. Levels were then equalized, and tonal quality and articulation was compared. No significant difference could be noted as distance increased. It is evident that the "loss" of highs with distance is not due to reduction in actual intensity. Rather the changing phase relationships determined by environment acoustics has an increasing effect with rising frequency. This is interpreted subjectively as a loss of intensity.

Further tests of this type will be discussed in future columns, and suggestions for other areas of investigation are welcome.

For reprints of other discussions in this series, or technical data on any E-V product, write: ELECTRO-VOICE, INC., Dept. 983BD. 686 Cecil St., Buchanan, Michigan 49107

Electro-Voice®
A SUBSIDIARY OF GULTON INDUSTRIES, INC.

Circle 16 on Reader Service Card

www.americanradiohistory.com

NORTRONICS HAS THE REPLACEMENT TAPE HEAD YOU NEED FOR ANY TRACK STYLE OR FUNCTION!

To keep getting optimum performance from your tape recording equipment you must regularly replace worn tape heads. With Nortronics heads, adapters, and brackets, it can be done quickly and easily . . . and you can also *convert* track styles in minutes.


Replacements for
AMPEX • MAGNECORD
CONCERTONE • RCA •
CROWN
as well as 1500 popular priced recorders

REEL-TO-REEL OR
CARTRIDGE TYPES


MONO/STEREO
FULL TRACK
HALF TRACK
QUARTER TRACK
EIGHTH TRACK

RECORD • PLAYBACK • ERASE

RECORD
RECORD • PLAYBACK
ERASE

NORTRONICS Bulletin 7230A describes the complete line of Nortronics replacement heads, conversion and mounting kits, and accessories. Write for free copy.

Nortronics® COMPANY, INC.

8101 Tenth Avenue North
Minneapolis, Minnesota 55427

Circle 21 on Reader Service Card

Theory and Practice

NORMAN H. CROWHURST

●Just before the high schools were having their baccalaureate exercises this year, I received a frantic call from an old buddy in the p.a. business. His story went something like this.

He installs p.a. and associated equipment for the local high school and they'd complained about a bad hum in the system that they wanted out for the baccalaureate. The superintendent couldn't get sanction for a new system to do it, so what could my friend do?

Well, to give credit, he's resourceful. He knew that the school's amplifier (an ancient tube job) had got some bug in it that had eluded him many times before, but that the hum went when the gain controls were turned 'way down. So he figured a quick solution that wouldn't cost much would be a remote transistor preamp, working from a couple of small flashlight batteries.

This would boost the level from the mic, so the main amplifier could be kept down, avoiding the hum. Then, because he'd have a remote preamp, he thought he would put tone controls on it, so as to have better control for boys' voices *versus* girls' voices, etc., without having to go backstage and fiddle with the main amp.

So he sat down and figured out a circuit, built it up and ran down to the high school to try it out. Shortly after that was when he called me. He'd gotten around the hum problem nicely, and had a workable margin of gain to spare, but his tone control didn't work worth beans—couldn't hear any effect as he rotated both knobs—and he felt he'd like it to, having gone that far.

So he brought his gismo round, along with the sketch of the circuit from which he built it. FIGURE 1 is his schematic, dressed up to be readable.

The first stage was designed to accept input from a line-impedance mic. It fed a 25k gain control. From the slider of the gain control he ran a voltage divider (for audio) basically consisting of 33k and 10k, to give a little over 12dB attenuation.

He'd inserted a 0.01 mfd and a 0.025 mfd capacitor between them, with a 100k potentiometer to serve as the bass control. Then he'd put another 100k potentiometer between another 0.01 mfd and 0.025 mfd capacitor to serve for treble control. Paralleling their sliders, he took them through a 0.1 mfd capacitor to an emitter follower.

The responses he planned are shown in FIGURE 2. Starting at 600 Hz, as the 3 dB point, either way, he should get about 12dB bass or treble boost, or a cut that went on down from the 600 Hz starting point.

The emitter follower was intended to replace a line-impedance mic input to the main amplifier, and prevent the main amplifier's input from loading down the tone-control output circuit.

He was using pnp transistors of which he had a boxful, giving a current gain

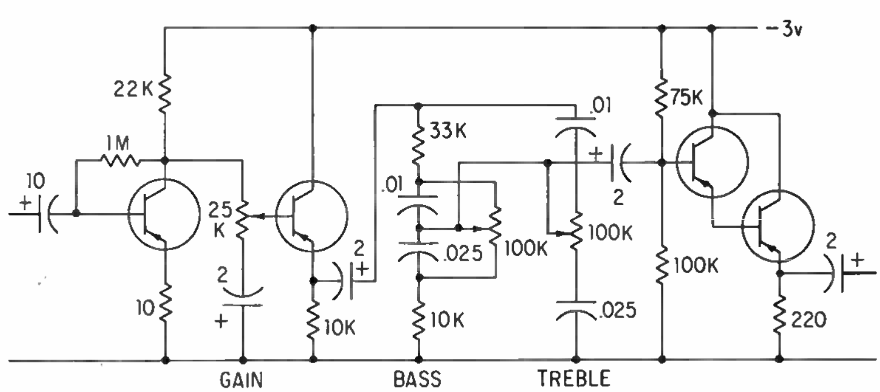
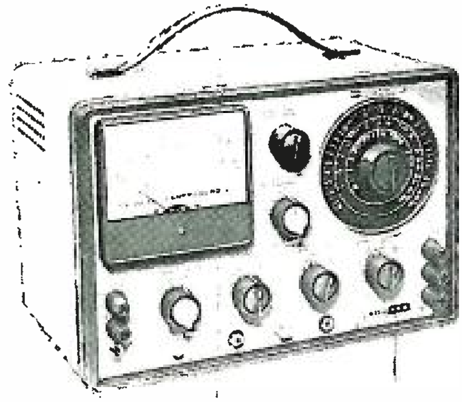


Figure 1. The circuit my friend put together.

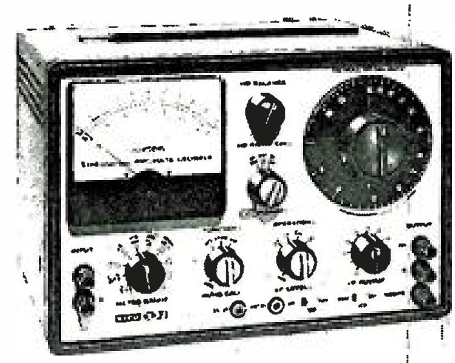
Circle 20 on Reader Service Card →

www.americanradiohistory.com

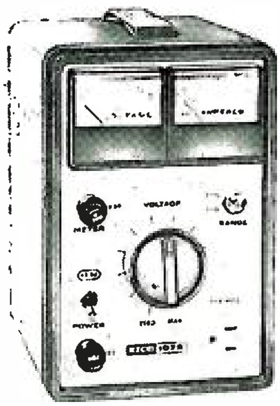
Professional Quality Instruments
AT LOWEST COST



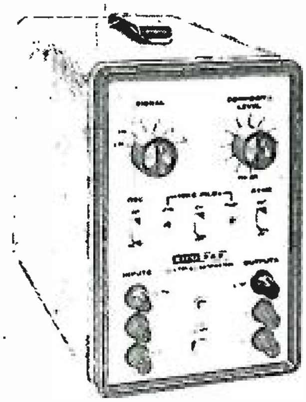
EICO 965 Faradohm Bridge/Analyser
Low bridge supply voltage permits testing of all types of capacitors. Measures diode reverse and transistor quiescent current. Measures insulation resistance and leakage currents. **$175.00**



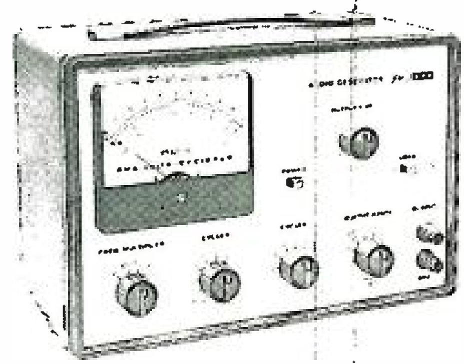
EICO 902 IM/Harmonic Distortion Meter and A.C. VTVM
High quality tuning capacitor provides easy frequency setting. Less than 0.7 volt input required for measurements. **$250.00**



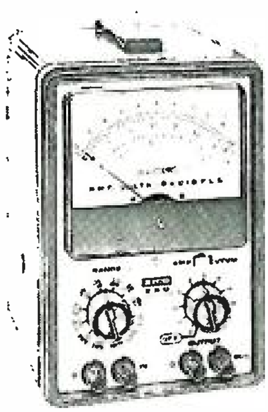
EICO 1078 Metered A.C. Supply
0 to 140 V a.c. adjustable output at 7.5 A max. Separate output ammeter and voltmeter. **$95.00**



EICO 342 FM Multiplex Signal Generator
Crystal-controlled 19 kHz (±2 Hz) pilot. Both composite audio and f.m. r.f. outputs. F.m. stereo broadcasting from tape/phono/oscillator source. Low distortion signals to permit alignment for lowest distortion. **$175.00**



EICO 378 Audio Generator
Switch selectable frequency output of 1 Hz to 110 kHz. Attenuated output in eight steps. Metered output voltage. Excellent frequency resettability. 0.1% distortion 20-20,000 Hz. **$79.95**



EICO 250 A.C. VTVM and Amplifier
Measures a.c. voltages from 100μ V to 300 V. Cathode follower input circuit for greatest stability. **$89.95**

NOW THESE INSTRUMENTS MAY BE ORDERED ON A DIRECT MAIL-TO-YOU BASIS. SATISFACTION IS FULLY GUARANTEED.

BSC Sales Co., 78 Wellington Road, Garden City, N.Y. 11530

PLEASE SHIP ME THE FOLLOWING ITEMS:

MODEL________QUANTITY__________ | MODEL________QUANTITY__________

MODEL________QUANTITY__________ | MODEL________QUANTITY__________

I HAVE ENCLOSED $________AS PAYMENT FOR THESE UNITS. I UNDERSTAND THAT THEY WILL BE SHIPPED F.O.B. NEW YORK.

NAME______________________________COMPANY____________________

ADDRESS____

CITY______________________________STATE______________ZIP________

I understand that I must be fully satisfied or I can return the unit within ten days for refund.

www.americanradiohistory.com

AMPEX

MORE PROFESSIONAL AUDIO SALESMEN WANTED

Because we are expanding our operations, we need to expand our staff. We need professional salesmen to take over territories from Ampex salesmen who are moving up in the organization. They must be men who:

- know how to sell through distributors
- know the needs of end users in broadcast and master recording applications
- want to work with the industry's first team, Ampex's professional Audio Division

Opportunities exist throughout the United States.

Please submit your resume, with salary requirements, to Mr. R. E. Rutman, Ampex Personnel Department, 2655 Bay Road, Redwood City, California 94063.

AMPEX *An equal opportunity employer*

CLASSIFIED

Classified advertising is an excellent and low-cost way to place your products and services before the audio professional. If you are a prospective employer seeking skilled help or an employee seeking a change you will find that the classified pages of **db** reach the people you want. Special low rates apply for this service.

Rates are 50c a word for commercial advertisements. Non-commercial and employment offered or wanted placements are accepted at 25c per word.

Frequency discounts apply only to commercial ads and are as follows.

3 times — 10%

6 times — 20%

12 times — 33⅓%

Agency discounts will not be allowed in any case.

Closing date for any issue is the **fifteenth** of the **second** month preceding the date of issue.

nominally 50, but actually ranging from 35 to 70. I think they were 2N323s, but that's not important. The important thing is that when he tried it, the use of the tone controls didn't seem to make a hoot of difference.

As he'd calculated it, he should get a variation from a 12 dB maximum boost on down to a quite drastic roll-off, working either way from 600 Hz, which should be a quite audible change. But it wasn't!

As he was in a hurry, I didn't stop to check his figuring, but put the thing on the bench, to see where the gains changed or didn't change, as the case may be, using an oscillator to provide the input.

The first trouble I found was in that emitter follower. Oh, his operating voltages were all ok, and he was getting adequate gain, as his tryout had verified. But the attenuation at 600 Hz, and most everywhere else, between the slider of the gain control and the base of the emitter follower, wasn't just over 12 dB. It was more than 20 dB.

This set me looking at the circuit again. The bias resistor to control the emitter follower's current was 10k. This also loaded the output of the tone-control circuit. Then the 220 ohm emitter resistor, assuming the circuit was otherwise unloaded (which it was when I was checking it) reflects back about 50 times this, or 10k, reducing the load at the base of this transistor to about 5k. The main amplifier input impedance, shunting the 220 ohms, a.c.-wise, might make this about 3k.

The high frequency roll-off capacitor was based on an assumed circuit impedance for it to shunt, of 10k. In fact, this was being swamped with another 3k shunt, so the capacitor was shunting only about 2k in fact. The high-frequency roll-off was thus shifted up from 600 Hz to 3,000 Hz, which was far less noticeable, to say the least.

At the other end of the control range, the boost wasn't working. Why? Bench checking it, I found that turning the control to maximum boost didn't make the level appreciably higher at the base of the emitter follower, but instead it

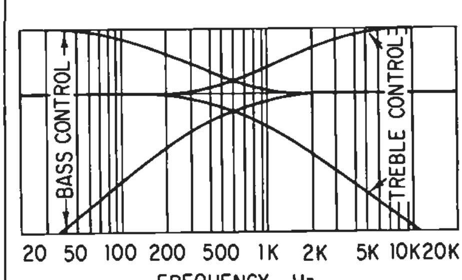


Figure 2. The tone-control performance he expected to get, but didn't.

www.americanradiohistory.com

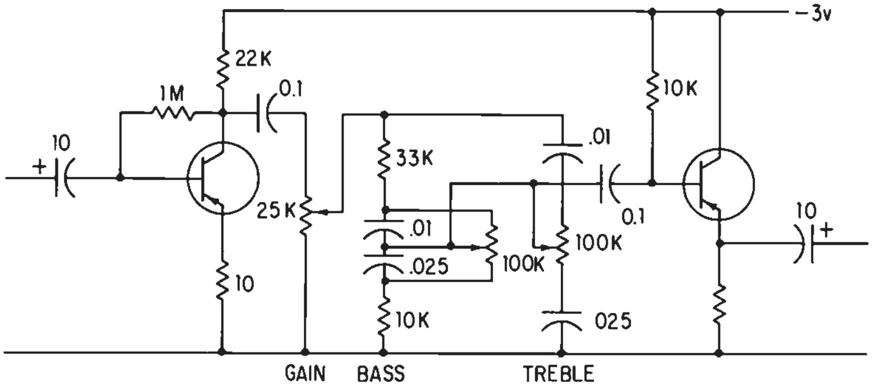


Figure 3. The final circuit that overcame the difficulties.

reduced the level at the slider of the gain control. The boost was being limited by that high 22k source resistance.

The same lack of effect was noted on the bass control. Further, he'd used 0.1 mfd capacitors for both couplings, from the first stage collector to the gain-control circuit, and from the tone-control circuit to the emitter follower, in the belief that this was high impedance.

Checking low-frequency response showed that the first coupling produced a little phase shift, but very little low-frequency loss. However, the coupling to the emitter-follower base was responsible for a rather severe bass loss, so that achieving any boost at all was quite impossible.

In effect, the tone-control circuit was working merely as an attenuator with almost fixed attenuation value, because the impedances among which it was connected were swamping those designed into it: the 33k and the 10k.

All in all, this was a case of *more haste, less speed*. But he'd used some good theory, without being thorough enough to be sure that some silly mistake like this didn't destroy his calculations.

So I figured out a slightly more complicated circuit to take all these bugs out. I put in an emitter follower to separate the source impedance from the tone control. By using an electrolytic (2 mfd) at the bottom end of the gain-control potentiometer, I could use the collector voltage as bias for the emitter follower (FIGURE 3).

I could have used the tone control as an emitter load directly coupled, but for one thing: the emitter current would pass through the bass-control potentiometer, which would probably make it noisy when it was working at relatively low level. So I used a 10 k emitter resistor, and an electrolytic coupling here, as well as into the final follower, to avoid neutralizing the bass boost.

Now we only had to avoid the output emitter-follower loading down the tone-control circuit. A gain of 50 just wasn't enough to accept line-impedance loading and refer back a load high enough for the tone-control circuit. But transistors are not expensive, so we doubled up, squaring the gain.

With a gain of 50 per transistor, this could give a compound current gain of 2,500, which was ample. The 220-ohm output resistor would reflect back as 500k. The only thing was, if we used a 500k bias resistor, the variation in gain could have us off the map, one way or the other, in bias.

If individual transistor gain could vary from 35 to 70, for a nominal 50, the circuit would still have a workable voltage, in a single transistor stage. But squaring this possible maximum error means the gain of the double transistor could vary from 1,200 to 5,000, which is a little too much variation to hold!

But now we had plenty of something to throw away. We threw away some of our impedance advantage. We used voltage-divider biasing for the double emitter follower, with 100k in the bottom and 75k in the top. This holds the emitter follower d.c. voltage fairly well centered and provides a loading of about 40k for the tone-control circuit, which allows it to work as he'd originally calculated.

All in all, this was an exercise in not applying your theory in too much of a hurry.

ADD CONTROLLED DIMENSION with the new FAIRCHILD REVERBERTRONS!

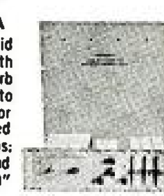
The use of controlled reverberation has gained wide acceptance in the professional recording field because the use of reverberation in several microphone channels produces records that have wide audience appeal. Simply stated: reverberated sound produces hit records. Secondly, reverberated sound is apparently louder than the same non-reverberated signal.

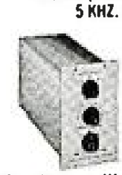
The use of reverb in broadcasting and sound re-enforcement is becoming equally more popular for the same reasons: A more pleasing commercial sound and production of a signal that is apparently louder for the same signal level.

TWO COMPACT REVERB SYSTEMS...

Now FAIRCHILD has created two electro-mechanical reverberation systems that produce a sound, termed by recording studio mixers —the experts who know what they hear, as "extremely natural sound possessing the quality of good acoustical reverb chambers." The two models differ more in their flexibility and cost rather than in reverberation effect.

MODEL 658A
The 658A is a complete solid state reverberation system with electronically controlled reverb time adjustments up to 5 seconds; mixing control for adjustment of reverberated to non-reverberated signal ratios; reverb equalization at 2, 3 and 5 KHZ. Size: 24½ x 19"





MODEL 658B
Compact, reverberation system for the 'big' sound in a small space. Contains reverb equalization in mid and low frequency range; level control; solid state design. Size: Only 5¼ x 3 x 10" deep.

The "sound" of the Model 658A and 658B REVERBERTRONS will satisfy the most demanding audio engineer. Their pricing and size makes them even more appealing.

Write to FAIRCHILD—the pacemaker in professional audio products—for complete details.

FAIRCHILD
RECORDING EQUIPMENT CORPORATION
10-40 45th Ave., Long Island City 1, N. Y.

Circle 22 on Reader Service Card

www.americanradiohistory.com

Editorial

OUR MAIL CONTINUES TO POUR in heavily in favor of the editorial direction we are traveling. We try to serve all the people of professional audio:

. . .the audio man operating in broadcasting—both radio and t.v.

. . .the engineer working in a recording studio, dubbing or disc-mastering operation, or processing plant.

. . .the broad group employed in sound reinforcement-audio/visual with their highly individualistic requirements.

While, of course, we seek articles of the broadest possible interest, we have, and will continue to publish articles that are directed to only one specific group. Virtually everyone can use more information about microphones, for example, and many readers need to better understand basic audio electronic techniques.

Our editorial policy also recognizes that there are areas of professional audio with particular problems outside of the basic divisions. We take care that these people (e.g. film sound) are not ignored.

This brings us to the need for your continuing opinions. If you have an idea for an article you wish to contribute, write to us. Discussion with us before it is actually written will produce more meaningful work.

db was founded to provide a forum for professional audio engineers. So let us hear from you!

L.Z.

www.americanradiohistory.com

The Measurement of Frequency Response

MELVIN C. SPRINKLE

Incorrect measurement of frequency response can invalidate important results. The author covers the correct procedures and techniques to ensure that the final result you achieve is the right one.

THERE IS A WELL HACKNEYED REMARK attributed to Mark Twain that everybody talks about the weather but nobody does anything about it. In the same vein we might paraphrase Mr. Twain by saying that everybody in audio talks about frequency response but not as many know much about it and particularly how to measure it properly. This latter observation is of some importance, since it has been the writer's experience that there are pitfalls into which the unwary often fall and as the result of which erroneous conclusions are drawn.

The term *frequency response* is so widely used that there might appear to be little point in discussing its meaning; yet for the sake of completeness, it is well to do so.

Actually and precisely, there is no such term as *frequency response* since there is no definition for it in the IRE (now IEEE) *Standards on Audio Techniques: Definitions of Terms, 1958* and as published in the Proceedings of IRE, Volume 46, No. 12, December 1958. The IRE Standard does define *Amplitude-Frequency Response* as "The variation of Gain, Loss, Amplification or Attenuation as a function of frequency." There is also a Note to the definition which states: "This response is usually measured in the region of operation in which the transfer characteristic or component is essentially linear." It will thus be seen that the frequency response of an active device such as an amplifier is the variation in Gain or Amplification at various frequencies; and the frequency response of a passive device such as a transformer or

Mr. Sprinkle is a project engineer with Page Communications Engineers, Inc. of Washington, D.C.

www.americanradiohistory.com

coupling network is the variation in Loss or Attenuation as a function of frequency.

It will be recalled that the IRE definition had a note appended which stated that the frequency response should be measured in the region of operation in which the transfer characteristic or component is essentially linear. The transfer characteristic referred to is a plot on rectangular coordinates of the input-output characteristic of the device at a stated frequency. In general the transfer characteristic applies mostly to amplifiers, since passive devices (with some exceptions which will be mentioned later) are usually linear. In the case of amplifiers, it is well known that if the input signal is increased in uniform steps such as 1 dB each, then the output signal will also increase in the same amount up to the overload point at which a 1 dB increase in input signal will produce less than 1 dB increase in output. The overload point is a function of frequency since it is less well known but true that at frequency extremes (say 20 and 20,000 Hz.) the power output of amplifiers is less (sometimes embarassingly so) than at the mid-range of 1000 Hz. In order to ensure a valid measurement of frequency response and to ensure that the frequency response *is* measured in the linear portion of the amplifier's characteristic, it is well to precede frequency-response measurement with a measurement of the amplifier's power output at 1000 Hz and also at 20 and 20,000 Hz. (or the frequency extremes of the band of frequencies of concern) for a given and specified distortion. The input signal level used for frequency-response measurement should then be chosen to be below the overload point at the frequency extremes. Langford-Smith quotes EIA Standard SE-101 as recommending that the test level be 3 to 10 dB below rated power output.

In the preceding paragraph it was mentioned that some passive devices are nonlinear. Perhaps this is an unfortunate description, but it is the case. In tests of an audio transformer, or on an audio amplifier in which an audio transformer is used, it is very informative to make frequency-response measurements at levels 30 and 60 dB below nominal level. The frequency response of transformers especially input or microphone transformers, is often markedly different at low a.c. excitation than at the normal or rated level.

Some amplifiers will have self-contained gain controls and, if such is the case, the frequency response should be measured at full gain and also at 25 per cent and 50 per cent of full rotation of the gain control. This is done to smoke out any changes in response due to gain-control action. Amplifiers containing "tone" controls, or adjustments which are intended to alter or warp the frequency response (e.g. a bass boost-cut control) should be measured with each control adjusted for nominal flat response and also with each control at maximum and minimum effect (if different from flat).

The signal used for frequency-response measurement should be reasonably free from harmonic distortion. The EIA Standard value is 5 per cent or less total harmonics. The signals from most commercial oscillators sold for audio testing will meet or exceed this requirement.

While not essential, it is highly desirable that a cathode-ray oscilloscope be connected across the output of the equipment under test. The trace of the output signal will immediately show if the signal is being distorted by the amplifier.

When making frequency-response measurements, the device under test is always terminated. Usually this is a resistive load equal in value to the manufacturer's rated load or better yet, to the actual load into which the device will work if different from the manufacturer's rated load. In the case of amplifiers intended to drive a loudspeaker, and especially if inverse feedback voltage is taken from across the load, a test should be made with the same kind of loudspeaker and baffle as will be used in the actual system. The reason for this is that the impedance of a loudspeaker, although commonly given as a number, is not constant across the audio range, and while voltage feedback attempts to maintain the load voltage constant, the degree to which it is successful depends upon the changes in load impedance as well as upon the amplifier circuitry.

The voltage across the load or termination is measured and changes in the load voltage are interpreted as changes in frequency response for a constant level input signal. The usual instrument for measuring the input and output voltages is the high resistence, wide-range a.c. voltmeter equipped with an electron-tube or solid-state amplifier. Instruments of this type are typically those made by Hewlett-Packard or Waveforms. Meters without amplifiers, such as the common *dB Meter* or even the vu meter should be checked for frequency errors. It is very important that the resistance of the voltmeter be much higher than the resistance across which the voltage is being measured and that the frequency response of the meter be better than that of the device being tested.

Perhaps the most common pitfall in measuring frequency response is the lack of a source impedance. This is elegantly demonstrated in a circuit suggested by McProud[2]. Referring to FIGURE 1, we have a two port network or a black box with four terminals whose frequency response is to be measured. The usual setup for measuring frequency response is also shown in FIGURE 1. The signal source output is maintained constant as measured by V_1 over the range of frequency for which the measurement is made, and the variations in load or termination voltage as measured by V_2 are interpreted as the frequency response of the black box. Then, suppose we become curious as to why the frequency response of the box is as flat as a floor over the entire frequency range and we open the box to peek inside. We find that in the box is a big fat capacitor and two pieces of wire connected as shown. Based upon the measured data alone, one might conclude that the frequency response of a big fat capacitor is flat, but as one well knows from sad experience, such is not the case. On the other hand, if we measure the frequency response of the black box using the set-up of FIGURE 2 which differs from FIGURE 1 in that a source resistance has been inserted, and again holding the voltage at V_1 constant, we now find that the response is flat up to the frequency at which the capacitive reactance of the capacitor becomes comparable with the source resistance and then begins to fall. It is -3 dB at the frequency at which the capacative reactance equals the source resistance and ultimately attains a roll-off of 6 dB per octave or 20 dB per decade of frequency. This example points up the general rule that meaningful frequency-

www.americanradiohistory.com

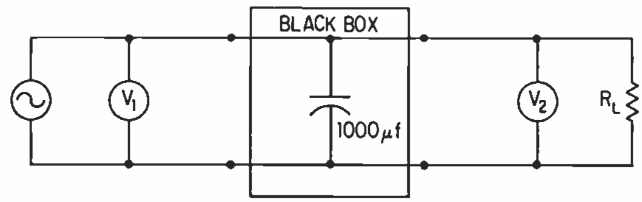


Figure 1. A black box with four terminals whose frequency response is to be measured. The illustration indicates the usual setup to be used.

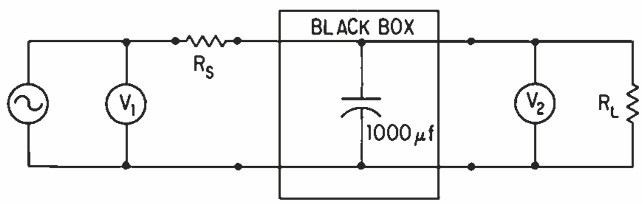


Figure 2. The same setup as in Figure 1. This time a source resistance has been added at R_s.

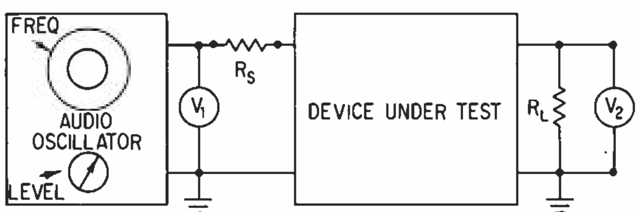


Figure 3. The proper connections for the measurement of the frequency response of a device. This is an unbalance case; a different setup using a 1:1 transformer with two windings would be used to isolate the unbalanced part of the test setup from the balanced equipment.

response measurements *must* be made with some source impedance unless the test is *deliberately* and *knowingly* made with a constant voltage source which is a zero effective source impedance. FIGURE 1 actually represents a test with a zero effective-source impedance (constant-voltage source) and *any* shunt capacitor does have a flat frequency response if and only if the source impedance is zero. In a practical case, the source resistance used for frequency-response measurement should be the value given by the amplifier manufacturer in his specifications, or better yet, a value which is the same as the source impedance from which the amplifier will be fed in an actual system. If the source impedance is not known, then several values may be assumed which are representative of possible use, and the resulting response curves *must* be labeled with the value of the source resistance used for the test. It is important that audio engineers recognize that the source resistance can and does affect frequency response, and in a manner similar to that in which the insertion gain of an amplifier is also affected by the value of the source resistance.

FIGURE 3 shows the proper connections for the measurement of the frequency response of a device. The signal source is an audio oscillator such as those made by Hewlett-Packard, General Radio, or Waveforms. The frequency control should have a calibrated dial and for most applications this calibration will be of adequate accuracy. Where the frequency must be accurately known, as for example in filter measurements, it should be monitored and measured by an electronic counter. The signal source should have an output control for adjusting the level of the signal output. This control need not be calibrated.

The necessity of having a proper source resistance has been considered in a previous paragraph. In *some* cases it may be possible to use the oscillator output directly without an external source resistance. The requirements under which this is possible are:

1. *The oscillator's output level control is behind (when looking into the output terminals) a source resistance, and*
2. *The oscillator's output over the frequency band of interest is sufficiently flat so that the output control need not be touched during the measurement, and*
3. *The oscillator's source resistance is the value desired for the measurement, and*
4. *No external voltmeter is used to measure the source voltage with the purpose of holding it constant.*

In general it is far safer and better engineering practice to completely ignore any signal-source internal resistance and use the output-level control to maintain a constant voltage across the output terminals which are behind an external source resistance.

For most audio work, the source impedance from which a device will be fed (and which governs the value of the source impedance in an actual system contains reactances, either inductive or capacative, these must be included in the test setup so as to simulate actual system conditions.

The diagram presented in FIGURE 3 is for the unbalanced case. Many amplifiers have balanced inputs or outputs or both. When balanced equipments are tested, it as necessary to insert a two-winding 1:1 transformer or repeat coil to isolate the unbalanced part of the test setup from the balanced equipment. Needless to say, in such cases the transformer's own response may be included in the measurement (depending upon where the transformer is used) and therefore the transformer's own response must be known or measured so that the true response of the device under test may be isolated from the over-all measurement. In measuring balanced equipments, it is customary and necessary that the source resistance be divided by two and half inserted in each of the balanced lines.

REFERENCES

1. Langford-Smith, *Radiotron Designer's Handbook, Fourth Edition*, RCA Victor Division, Radio Corp. of America, page 1323.
2. McProud, C. G., *A Practical Gain Set, Audio Engineering Magazine, Vol. 32, No. 5*, May 1948, page 20.

www.americanradiohistory.com

A New Ribbon Microphone

DAVID B. HANCOCK

Ribbon designs can perform to modern standards, even though they seem to be out of fashion. The author describes a new design that has been re-gaining acceptance for ribbons.

Figure 1. (Left) the Cambridge C-3 microphone and (right) the new C-4 model. These are ribbon designs with built-in solid-state amplification and emitter-follower outputs. The battery power supply for the C-3 is seen atop the microphone.

David B. Hancock is a well-known recording engineer who operates his own studio in New York City.

www.americanradiohistory.com

IN MY EARLY ASSOCIATION with sound recording, it was the usual practice to assign microphones to various categories. One microphone would be referred to as a good piano mic, another as a good voice mic, etc. This was a sort of involuntary specialization being more descriptive of the shortcomings of the microphones than it was of their virtues.

If one were to imagine the ideal microphone, it would be one that registered all impinging sounds with equal fidelity, not favoring any particular instrument. Almost all of the condenser designs now available have been designed with intentional specialization; they have *cardioid* patterns to surmount acoustical limitations, limited low-frequency response for close pickup, etc. Very little attention has been devoted in recent years to the design of transducers for operation in ideal acoustical circumstances. Most condenser designs have extended high-frequency response, but to some critical ears the *quality* of the high frequencies is not what it should be; a certain shrillness or buzziness is often in evidence.

Although early ribbon types were definitely lacking at the high end, that portion of the sound spectrum that was reproduced tended to be very pleasant. For this reason, many older designs, such as the RCA 44BX, are in limited use even to this day.

Some years ago, out of dissatisfaction with what was available, I began some investigations into the possibility of updating ribbon microphones. Using the limited facilities available to me, I determined that it was possible to modify existing types of ribbon microphones and achieve considerable improvement in their performance. The improvised modification consisted of replacing the ribbon with thinner material; replacing the transformer with one of superior design; removing various internal screens; and replacing ancient cobalt steel magnets with up-to-date Alnico V. The result was a measurable improvement in frequency response of at least an octave at both ends of the audio spectrum, plus a lowering of the frequency and amplitude of the ribbon resonance, which could thus be brought down below 20 Hz. Investigation also revealed that although the 44BX was a more efficient microphone than its predecessor the 44A, the latter had a wider and smoother frequency response. For about a decade every commercial recording I made employed modified RCA 44A ribbon microphones that had measurable response up to 25 kHz, and down to 20Hz. Techniques for fabricating and handling the super-thin ribbon material had to be developed, since there was no other way to learn them. Fabrication and installation used to take about an hour, on the average (so long as no member of the author's family created any air currents by walking through the room!). In the original designs, a rubber stand-mounted shock-mount was employed; this was effective in conjunction with the limited low-frequency of the transformer. With the subsequent improved models, more compliance was required; so a mount was improvised employing springs. This worked well enough, although the springs tended to go *boinnng* if shock excited the stand.

Eventually recordings made with these microphones caught the ear of Mr. Charles P. Fisher, president and chief engineer of Cambridge Records. Ideally equipped by reason of technical background and personal tenacity, Mr. Fisher em-

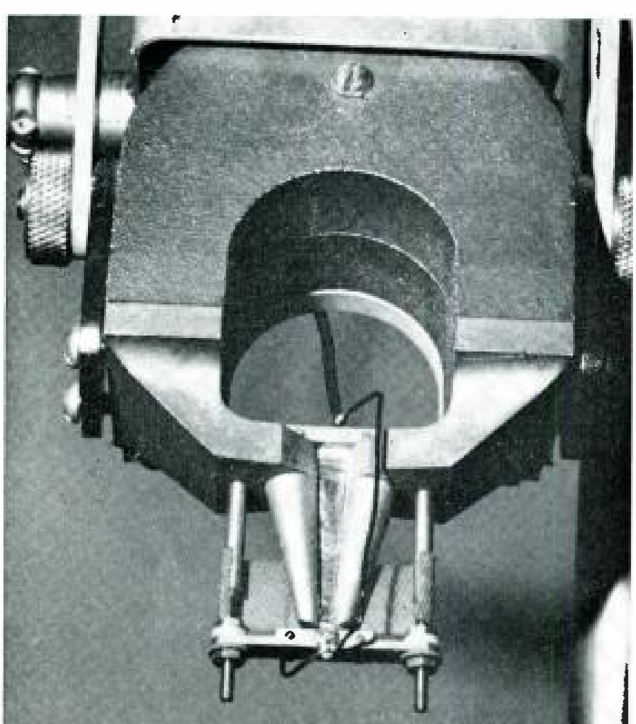


Figure 2. The pole-piece and ribbon assembly of the C-3 microphone.

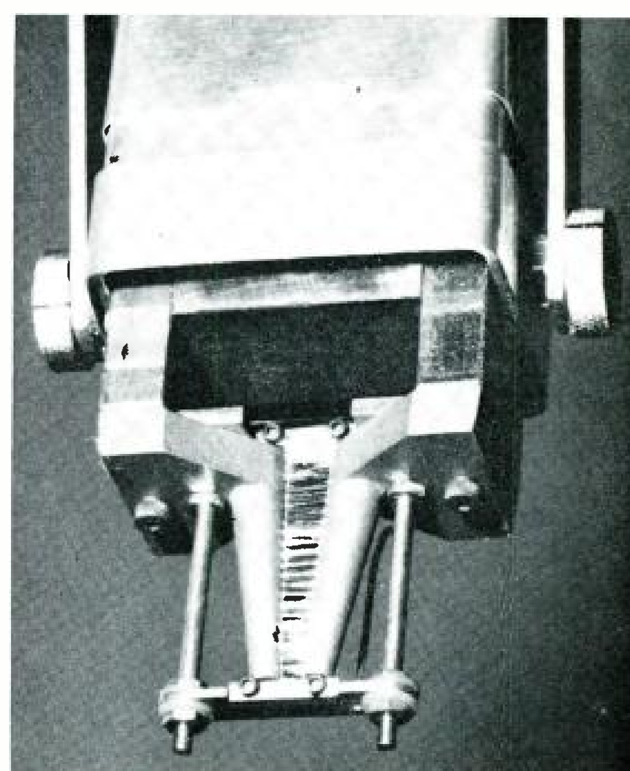


Figure 3. The pole-piece and ribbon assembly of the C-4 microphone.

www.americanradiohistory.com

barked upon the task of improving upon these microphones. After two false starts, he came up with a design that represents a substantial advance in the art, as confirmed by the U.S. Patent Office. This is the Cambridge C-3 microphone, which is being produced in limited quantities by Mr. Fisher. This microphone has the following qualities: extended high-frequency response without artificial coloration or resonance phenomena; excellent transient response, owing to the absence of internal acoustical screens; extended low-frequency response, to below 20 Hz; comparatively high output level (around −20dB) with the capability of feeding any termination down to 30 ohms single-ended.

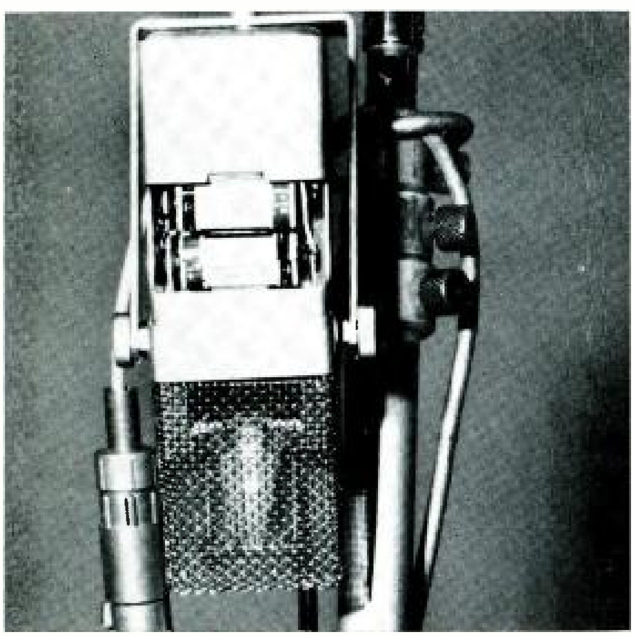


Figure 4. Lifting the cover plate of the C-4 gives access to the battery supply of the built-in gain stage.

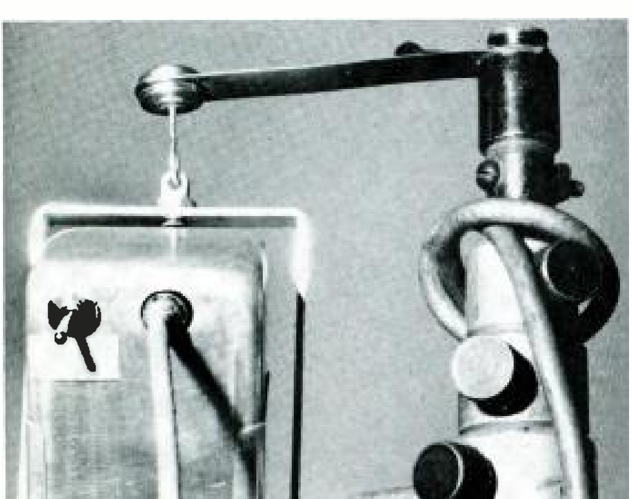


Figure 5. The leaf-spring suspension employed on the C-4 microphone. Ribbon mics are insensitive to shock in a plane parallel to the ribbon, a fact taken into account in this simple design.

One of the resultant design improvements is the elimination of a transformer from the chain. Other specific design improvements in these microphones are the following: special tapering and converging pole-pieces of high-permeability material which in conjunction with modern magnetic materials produce a nearly uniform flux density in the air gap of about 3,000 gauss, higher than in any previous design; a special tapering aluminum ribbon which in conjunction with the pole-pieces distributes any baffling cut-off effects over a wide band of frequencies, the lowest of which is above 15 kHz; and a specially designed transformer matching the extremely low ribbon impedance to the input of a high-quality solid-state amplifier and emitter follower contained in the base of the microphone. This last feature allows the microphone to work into a grid or a transistor stage, eliminating the questionable usual system of two transformers in a row.

In use, I have found these instruments to be without vices; recordings made with them have a clarity and a *transparency* that must be heard to be appreciated. Functionally, they are an improvement over older designs in the following respects: Wider, smoother frequency response; improved signal/noise ratio; off-axis pickup more uniform with changes in frequency, with less directionality at high frequencies; less sensitivity to hum pickup at the microphone or in the cables; and better transient response owing to absence of internal resonant screens.

It should be remembered that velocity microphones are not suitable for close pickup without modification; Mr. Fisher has devised a feedback network for reducing low frequencies when necessary. In less-than-ideal circumstances, the figure-eight pickup pattern can be a drawback, especially when there is a wall behind the microphone.

Owing to the extended low frequency response, these devices are subject to seismographic effects. To avoid this, Mr. Fisher has designed a simple single-leaf spring arrangement (see Figure 5) which is both neat and successful. Ribbon microphones are not sensitive to shock transmitted along a plane parallel to the ribbon, and it will be observed that this fact is taken into account in the design.

Aside from those recordings I have made for various independent record companies*, it may be of interest to note that Cambridge C-3 microphones are now being used by RCA Victor in forthcoming records of the last six string quartets of Beethoven, performed by the Guarneri String Quartet. That this came about is due to the combined astuteness of Mr. John Eargle, who is RCA quality control, and Mr. Max Wilcox, who produces the recordings of the Guarneri Quartet.

For applications where the "door-stop" qualities of the C-3 microphone are undesirable, Mr. Fisher has evolved the C-4 which achieves very nearly the performance of the C-3 in a much lighter package.

*Including **Turnabout, Bach Guild, Classic Editions, Monitor, Lyrichord, Musical Heritage Society,** and **ESP disc.** Mr. Fisher has also employed the C-3 microphones on recordings issued by his record company, **Cambridge Records,** 473 Washington Street, Wellesley, Mass. 02181.

www.americanradiohistory.com

35TH AUDIO ENGINEERING SOCIETY

CONVENTION and EXHIBITION

PROFFESSIONAL AUDIO EQUIPMENT
FOR STUDIO AND LABORATORY

OCTOBER 21 through 24

PARK SHERATON HOTEL, NEW YORK CITY

TECHNICAL SESSIONS INCLUDE: Solid State Transducers • Sound Reinforcement • Symposium, Audio Engineering and the Environment • Disc Recording • Magnetic Recording • Audio in Medical Practice and Research • Audio Apparatus and Communications Systems • C. J. LeBel Memorial Symposium (next 20 years in Audio) • Audio Abroad (2) • Developments in Electronic Music Systems.

SPECIAL APPLICATION SEMINAR: "From Studio to Microphone to Listener," Tuesday Evening at 7:30. No admission charge for this session.

HOURS OF SESSIONS: Monday-Thursday, 9:30 a.m., 1:30 p.m. and 7:30 p.m. except Tuesday, 7:15 p.m. and Wednesday, 9:30 a.m. and 1:30 p.m. only.

HOURS OF EXHIBIT: Monday and Tuesday, 12 noon-9:00 p.m.; Wednesday and Thursday, 12 noon-5:00 p.m.

AWARDS BANQUET: Wednesday evening, 7:00 p.m., preceded by Social Hour, 6:00 p.m., Boston Symphony conductor Eric Leinsdorf, speaker.

Write, telephone for program and banquet information.

AUDIO ENGINEERING SOCIETY, INC., Dept. 35
Room 428, The Lincoln Building, 60 East 42nd Street
New York, New York 10017 (212-661-8528)

AUDIO
AES

20TH ANNIVERSARY

www.americanradiohistory.com

EVR

EDWARD TATNALL CANBY

Rumors run wild on this remarkable recording system. Frustratingly little information has been made available by the developers. Our author has collated facts and conjectures.

As we all know, the Medium is now the Message And yet sometimes the biggest Messages take the longest to get around. How many of us, at this moment, are aware that *the* upcoming Message in several major communications areas is a radical t.v. recording and playback system known as *e.v.r.*, electronic video recording?

E.v.r. a product of long gestation behind the scenes, comes from that fruitful source of new ideas, CBS Laboratories, teamed up with Imperial Chemical Industries, Ltd. in England and CIBA, Ltd., in Switzerland (e.v.r. is part electronic, part photographic, and these firms evidently are the photographic arm of the combine; CBS providing the electronic element.) The same master mind that block-busted the ancient 78 r.p.m. disc with the lp is responsible for the integrated e.v.r. concept, Dr. Peter Goldmark. To be sure, e.v.r. is not all his. It takes a large team and many brains to launch an over-all communications system today. But Goldmark's was the creative and directive force that sparked the new medium, which is now in the laborious process of being launched out of the safe drydock of development into the stormy ocean of commerce. What an ocean!

You can measure any new development's impact by the uproars it causes. E.v.r. was announced almost a year ago. By now it is already dismally behind schedule thanks to these same uproars, and is not likely to have made its public bow before this article appears, though it should have burst

---

Mr. Canby is a well-known writer on audio and musical subjects.

www.americanradiohistory.com

into full array in "late spring". An excellent indication of its importance, I say.

There is, of course, the inevitable "sensitive-patent situation" (where have we heard *that* before?). And there are delicate business negotiations for rights to the system. Also, we may guess, some not-so-delicate dagger thrustings, from those who feel that their interests are threatened by the newcomer. All of which is routine and to be expected. If you haven't heard about these things—that, too, is normal. For many months, details of the e.v.r. process have been kept in rigid secrecy. Fortunately, the circumspect CBS announcements, mostly in Dr. Goldmark's own words, have given us a good idea of what is at stake. *Plenty.*

E.v.r. is being promoted in two forms, both from a common type of master recording. One is designed for education, home use, libraries, archives—an enormous field, worth billions of dollars. The other type, broadcast e.v.r., will find its most immediate place at opposite poles of t.v. program spectrum—in educational television and in commercial ads. Eventually it could take over a sizeable portion of t.v. recording, notably that which is in color, where e.v.r. saves fabulous sums.

In the home, e.v.r. in cassette form, playing full t.v. color, will have the field pretty much to itself (if and when because of its dramatically low cost and extraordinary compactness. An hour of black-and-white t.v., or a half hour of full compatible color, come in a seven-inch cassette loaded with a slim 8.75 mm. film, no larger than the standard home movie film, and to sell for between $7 and $15!

In education, an enormous field is open for e.v.r.'s incredible savings in cost and space and for its unique convenience and permanence. It will be a major factor in the various t.v. monitor retrieval systems now spreading through schools and colleges to the tune of millions of dollars. In addition, it is marked for a big place in direct classroom teaching. Its cassetted t.v. pictures, may be stopped and held on the screen at any point, for ad-lib discussion. Both color and black-and-white pictures can be accommodated, both moving and still pictures of every sort. The whole bewilderingly complex array of present pictorial media—filmstrips, movies, slides, and the rest all may be transferred to the single e.v.r. medium, for projection on t.v. screens of the near future.

In the broadcast field, the special broadcast e.v.r. format makes full color t.v. possible at a small fraction of present costs, and is thus aimed especially at the hundred-odd educational t.v. stations which cannot now afford the enormous expense of standard high-band color installation. Commercial t.v. will, so to speak, go along for the ride—but business being what it is, probably the the earliest application of e.v.r. broadcasting will be in the form of color commercials. That's where the ready money is, after all.

COLOR

Perhaps the greatest long-range value of e.v.r. is directly due to its revolutionary method of recording color. The color image is *coded in black and white*, then photographically printed on an inexpensive type of film, either the 8.75 mm sprocketless e.v.r. for home and education or a standard fine-grain 16 mm. black-and-white film for television broadcast.

Direct color is not only expensive but also highly perishable. In e.v.r. form, color is to all intents permanent and unchanging—so much so that reference e.v.r. "safeties" may become standard even in the moving picture industry to safeguard color values for the future. The coding system, moreover, entails virtually no quality loss in color balance or detail; e.v.r. copies therefore may soon have archival significance, somewhat as microfilms now serve in the direct black-and-white area.

E.v.r. is a typical Peter Goldmark innovation. You can spot them a mile off. Always, his new systems are fundamental technological advances, revolutionary in terms of current practice. And yet, as is common today, they are mainly significant as imaginative *recombinations* of existing know-how, for a new efficiency and impact—maximum packing density of information and materials.

Thus in 1948 there was nothing new about the Goldmark lp record. Nothing *except* its shrewdly calculated new parameters, its updating of techniques for maximum effectiveness, its shrewd margin for improvement, which has held the lp on course through twenty years of audio development and change, including the introduction of tape recording and of stereo. Plus, of course, some very hot engineering-in-detail, to make the lp concept practical and commercial from the very beginning.

E.v.r. is more radical, in similar directions, and probably more important then lp for a number of excellent reasons. Its potential scope is much broader, ranging from t.v. broadcast through the whole field of media education and on to library and archive use, plus at the tail end, home entertainment. E.v.r. combines the hitherto disparate elements of t.v. electronics and photography into one intimately integrated system, using each to maximum effect. Still further, e.v.r. puts the most advanced information theory to work in a coding system—still very much a secret as I write this—which crams an astounding amount of information into a tiny film space.

Finally, though the lp was a major breakthrough in this same area of information density and thereby cut the cost of recorded sound in half, e.v.r.'s more sophisticated encoding on film will offer far more dramatic cuts in the cost of t.v. recording, especially in color—where the new process may reduce the cost as much as *fifty* times. If the lp record revolutionized the market for phonograph sound, e.v.r. will surely cause enormous changes in t.v., particularly in its educational aspects, which were Goldmark's first interest in its development. (Broadcast e.v.r. announced later, seems to have been an inspired "last-minute" addition to the e.v.r. basic technology.)

ELECTRONIC RECORDING?

This core of the new CBS system is not wholly new—hence, perhaps, the sensitive patent situation—nor is CBS the only concern working with it. Others are at work on allegedly similar recording techniques. At least one major magnetic recording company has experimented with electronic recording, reportedly with film from Kodak (CBS' film is English). But the principle is new to most of us.

www.americanradiohistory.com

A special sensitized tape—or is it film?—responds not to light but to *an electron beam in a vacuum.* In effect, the recording process is taken inside the television tube. The CBS electron beam is only five microns wide and its trace is evidently microscopic in detail, on a film that must be virtually grain-free.

In theory, CBS says it can record the entire *Encyclopedia Britannica*, page by page, on the successive "frames" in a single 7-inch cartridge of 8.75 mm. e.v.r. film—though whether the projected images could be read via our normally fuzzy tv resolution is another matter. (The point is that the images *could be recorded*, and made available, given a playback system with sharp enough resolution for reading.)

Added to this basic vacuum process is the equally ingenious coding system, converting the complex color signal into microscopic black-and-white information. Just how the coding operates is not, at this writing, a matter of published fact, but apparently the e.v.r. pictures are actual miniature frames, somewhat like those on 8 mm. film but minus sprocket holes. For months, this last year, those of us who are puzzle prone have been trying to figure this one out—and many were the varied hypotheses! Pulse coding has been on everyone's lips. But how? And a vexing question for the speculative kibitzer has been that of film *motion*, for we were not told whether e.v.r. film moves continuously (it boasts a *5 in./sec.* speed), or in the usual jerks of conventional moving pictures. The definitely sprocketed broadcast e.v.r. film only added to the confusion on this score. Does *it* jump, frame-by-frame, projecting its special black-and-white images into the e.v.r. broadcast camera?

From the e.v.r. film master, which is wide enough to take up to eight parallel programs side-by-side, a photographic duplicator makes the essential high-speed mass-production copies that gear the system to large-scale operation. For the home-educational e.v.r. film a very rapid printer, developed at the English end of the CBS corporate team, turns out a twenty-minute t.v. color program in 30 seconds, which, as CBS points out, equals the speed of lp record duplication. Higher printing speeds are likely as the system gets its commercial bearings. For broadcast e.v.r. a similar printer transfers the e.v.r. master to conventional 16 mm. raw stock, fine-grain black-and-white. This film is projected into the special e.v.r. broadcast camera, which in turn produces a standard NTSC *color* signal for the transmitter.

The e.v.r. playback unit for home and education is a major link in the system. It is described as a large briefcase in size, portable and very simple to use. The e.v.r. cartridges plug in and feed automatically to an enclosed take-up reel and also rewind automatically, a mechanism clearly patterned on the CBS-developed 3M automatic tape cartridge of several years ago. In due time, the whole thing can be built directly into t.v. sets, for a saving in space. The portable unit feeds the t.v. antenna by a simple connection so that the e.v.r. player can be carried from class to class if desired. Or plugged in and out of the family t.v. sets.

Needless to say these various e.v.r. elements are designed to remain under CBS control and exploitation, either directly or via normal licencing. If CBS wins out against all challengers, the latter form of profit taking will surely take over—for no major system of this sort can be confined to one company and achieve industry-wide acceptance as a monopoly, as we have found in the case of f.m. radio, Kodachrome and, of course, the lp record and its 45 running mate.

It is also clear today that even if an initiating company eventually loses control of its brainchild its profits may even continue unchecked. In any case, patent hassles now rarely hold up exploitation of a new product or medium by the originator—*unless* there are matters of government regulation or standards involved. That was the problem with f.m. that led to Major Armstrong's undoing (and the subsequent universalization of f.m.—too late for him). That was the trouble with early color t.v., and with f.m. stereo broadcasting, which had to wait upon F.C.C. decisions.

But e.v.r. presents a standard U. S. television signal to the broadcast transmitter (or any other standard signal—just adapt a camera to match). And home-educational e.v.r. similarly feeds a standard signal to the school monitor system, or classroom t.v., or home t.v. Since these are wholly orthodox electronic messages, strictly according to the rules, who can object?

THE CAMERA

We were told significantly nothing at all about the most important link in the e.v.r. chain, the master electron-beam recorder or "camera" (it is hard to know which term to use) which makes the original recording. But we could guess that it would *not* be very portable, nor very simple—what with the conversion and coding necessary. It seems likely that any e.v.r. recorders made available would be strictly professional, operated by pro engineers—stationary or portable—comparable to our audio/video recording engineers. In broadcasting, where everything is pro, the difference between e.v.r. and videotape will be, so to speak, internal, and not unlike those between present film and tape. But how many schools (and how many homes?) will have their own e.v.r. recorder and duplicating equipment? No more, I would guess, than now have built-in color-film processing plants.

Definitely, e.v.r. is a "pre-recorded" mass-production medium, the equivalent of moving-picture film, the long-play record, and recorded audio tapes. That is where the big business will be. In broadcasting too—via multiple-distribution of t.v. commercials, packaged programs, etc. Magnetic recording, on the other hand, will remain the useful instantaneous medium that it already is.

But the enormous price differential will have to change. Videotape is going to have to streamline itself, or die of overweight. And so we can now expect a violent flurry of videotape innovation, pressing that medium towards much greater efficiency and compactness. Indeed, the beginnings are already public or known to the trade, and there'll be plenty more to come. Good thing! Nothing like competition to spur improvement.

One thing, at least, is certain. Until somebody can match e.v.r.'s sensational, runaway cost reductions in t.v. color recording, and match its equally fabulous space economy, this new system is likely to foment revolution wherever it appears. No wonder there has been a slight delay. . .

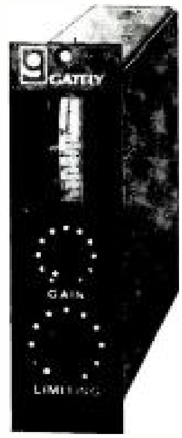
www.americanradiohistory.com

New Products and Services

CONTROLLED DISPERSION SPEAKERS

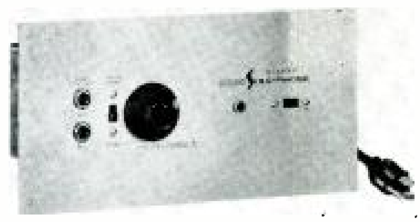
● A newly developed family of speakers and drivers will be designated as the UH series. One feature common to them will be a sound deflector which gives the installer the ability to control the dispersion pattern of a paging/talk-back speaker. The sound deflector also has value when a microphone must be located in close proximity to a speaker. With the sound aimed away from the mic, the possibility of feedback can be materially reduced. The deflectors are adjustable 360° around the face of the speaker bell, and between 0° and 20° off the center axis of the horn in 10° increments. The UH speaker is a true exponential horn with a phasing plug, resulting in smooth response. The several models currently available allow for different impedance requirements. All are of weatherproof design and use injection molded cycolac construction.
Mfgr: University Sound
Circle 85 on Reader Service Card

AUDIO LIMITER



● A new compact limiter is just 1½ inches wide and can be installed either above or below the new-type console modules. Eight such limiters would fit into a space only 17-inches wide, 5¼-inches high, and 9-inches deep — including the associated power supply. With all this saving in space, the claim is that the Model 1800 audio limiter still exceeds the performance of present rack-mounted limiters. The latest in transistor and f.e.t. technology, long-life components, and excellent attack time, along with a lack of waveform and transient distortion, are virtues of the present design.
Mfgr: Gately Electronics
Circle 89 on Reader Service Card

HEADSET AMPLIFIER



● The Solo-Phone Model SA-1F is designed for flush panel mounting in listening-station desks or cabinetry. As is the original Solo-Phone model, this version is a compact transistorized stereo headphone amplifier, now more ideally suited for music-library, language-laboratory, and classroom use. Two input jacks on the back of the unit permit connection to any low- or high-level signal source. Outlet for a.c. is a three-wire, three-prong type designed to meet stringent building code requirements. The complete unit is UL approved for commercial installations. Output is by front-panel jacks for standard stereo-wired low-impedance phones. Two pair may be connected.
Mfgr: Shure Bros., Inc.
Price: $57.
Circle 87 on Reader Service Card

HEADSETS

● Designed for the educational market, this headset utilizes dynamic earphones with wide frequency response and low distortion incorporated to accomplish maximum intelligibility. They are available in blue or beige, with or without dynamic noise-cancelling ball-swivel boom microphone, and with a variety of cords, connectors, and other accessories. Designed to meet government requirements and approved by DLI for language labs. Complete engineering data is available.

Mfgr: ISC/Telephonics
Circle 88 on Reader Service Card

CASSETTE DUPLICATOR

● Four one-hour cassettes are produced every four minutes from a reel-to-reel master on this high-speed, low-cost duplicator. Operation is at eight-times normal tape speed and all tracks are suplicated simultaneously. The unit uses standard blank-tape cassettes available anywhere. The manufacturer states that the unit is simple to operate and that unskilled personnel can be properly trained in fifteen minutes. Additional slave units, each containing an added eight cassette positions are also available.
Mfrg: Infonics, Inc.
Circle 83 on Reader Service Card

www.americanradiohistory.com

For professionals only...

Your best acoustic theories can now become realities. DuKane Medallion equipment is designed for the man who understands and works with sound. You'll find satisfaction in matching Medallion components to provide the perfect electro-acoustic balance.

You can achieve professional results—hi-fidelity with minimal feedback or distortion. All of our Medallion products, from microphones to speaker systems, present audio specialists with a more exact and rewarding science. Many quality products make up the Medallion line, and flexibility is unlimited. Write for further information. But, for the ultimate in sound, you should hear Medallion.

DUKANE

DUKANE CORPORATION
COMMUNICATIONS SYSTEMS DIVISION
ST. CHARLES, ILL. 60174
DEPT.

Circle 14 on Reader Service Card

SOUND LEVEL METER

● Specifications defined by the International Electrotechnical Commission in IEC 179, 1965 are met by the new type 1561 precision sound-level meter. A new ceramic microphone is used, the instrument is all solid-state, provides flat response from 20 Hz to 20 kHz for measurement of sound-pressure level, and has a jack that permits connection of an external filter to shape the frequency response as desired. The 1561 is available as a portable instrument using either dry cells or rechargeable nickel cadmium batteries, or as a relay-rack instrument operating on a.c.
Mfgr: General Radio Company
Price: $675 (portable); $725 (rack mount).
Circle 82 on Reader Service Card

LITERATURE OFFERINGS

● The following represent recently received brochure and catalog offerings. Secure your free copy by circling the appropriate numbers on the reader service card at the rear of this issue.

Alpha Wire offers an easy reference guide to their wire cable and tubing line. *Circle 61.*

Altec Lansing has several publications:
A 16-page brochure describes complete sound systems for the travelling entertainer and professional musician.
Circle 62
A composite Altec catalog covers sound and communications equipment for all types of installations; 16 pages. *Circle 63*

The Altec **Acousta-Voicing** system is described in an 8-pager. *Circle 64*

Ampex Corporation offers a number of data sheets on new products:
The **AA-620** portable audio amplifier/speaker. *Circle 65*
The **AA-80** sound-reinforcement power amplifier. *Circle 66*
Specifications and uses of the Ampex **VR-7800** solid-state portable c.c.t.v. color recorder. *Circle 67*
Features and specifications of the Am-

pex **AG-500** portable professional audio recorder. *Circle 68*
Ampex also offers a 16-page brochure answering many commonly asked questions about non-commercial videotape recorder. A v.t.r. terms glossary is included. *Circle 69*

A new catalog from **Ampli-Vox** details their complete sound systems and lecterns. *Circle 70*

B & K has issued two new product bulletins: The B & K **model 130** servo chart drive—an accessory for driving their graphic level recorder—is described in a two-page bulletin. *Circle 71*
A new frequency-response test unit, **model 4409,** for tape recorders and phonographs is detailed in a specifications bulletin. *Circle 72*

Craig has a 4-page illustrated brochure listing a score of practical and economic business and industrial applications made possible with their videotape recording systems. *Circle 73*

Electronic Devices, Inc. has a short form rectifier catalog referencing the company's line of silicon and selenium rectifiers. *Circle 74*

Gotham Audio Corp. is offering a pocket-sized catalog and price list of products from the firm of **EMT Wilhelm Franz.** This includes the **EMT-140st** steel plate reverb unit, **EMT-939st** turntable, and the **Studer A-62** and **C-37** master tape units. *Circle 75*

Lafayette Radio has announced the availability of their 1969 general catalog. 512 pages detail their extensive offerings. *Circle 76*

J. B. Lansing has some advice, instruction, and hints on building loudspeaker enclosures. There are two manuals: **The Enclosure Construction Manual** details basics of enclosure design, construction, and finishing. *Circle 77*

Enclosure Construction for JBL "F" Series Musical Instrument Speakers is a boon to the guitar and organ player who prefers to do-it-himself (or have an expert do-it-for-him). *Circle 78*

Hewlett-Packard has two large-size offerings: A 6-page brochure lists all 22 of H-P's electronic frequency counters in a chart that simplifies comparison. *Circle 79*

Frequency domain measurement is the purpose of a 16-page booklet from H-P. It describes and offers applications of their 1 kHz-110 mHz spectrum analyzer. *Circle 80*

AUDIO SEMINAR

• Anyone interested in professional sound reproduction, sound recording, or broadcasting is invited to attend a practical, how-to discussion entitled "From Studio to Microphone to Listener." The seminar, which will feature three noted electronics experts, will be given by the Audio Engineering Society during its 35th convention in October. No registration fee is required and interested non-members are invited.

The three panelists will discuss various aspects of audio reproduction. **Victor Brociner** of H. H. Scott, Inc. will talk about practical acoustics—the speakers, the listening room, and the human ear. **L. R. Burroughs** of Electro-Voice will discuss selection and placement of microphones, paying particular attention to directional characteristics and acoustic phasing. **John M. Eargle** of RCA's Record Division will describe electronic signal processing—equalization and filtering, compression of dynamic range, and artificial reverberation. The moderator will be **Irving L. Joel** of Capitol Records. Recorded tapes will be played to demonstrate the techniques described by the panelists. There will also be a practical demonstration illustrating a technique for adjusting the sound reproduction system to compensate for room acoustics. Finally, the audience will be invited to ask questions.

The seminar will be held at 7:30 P.M. on October 22, 1968, in the Oriental Room of the Park-Sheraton Hotel in New York City.

JUST ARRIVED!
AMPEX NEW 8 TRACK MASTER RECORDER
New Mastering capability for modern recording studios.

ARROW ELECTRONICS assures you of prompt service and immediate delivery! Where the Recording Industry is concerned our people are clock watchers. You can depend on us to deliver the finest equipment made for professional use.
Contact Mr. Howard Winch for additional information on the complete line of Professional Audio Recorders-

ARROW ELECTRONICS, INC.
PROFESSIONAL COMMUNICATIONS DIVISION
900 Route 110 . Farmingdale, N.Y. 11735
212-526-0300 516-694-6800

Circle 18 on Reader Service Card

The db Bookcase

As a service to our readers we are pleased to offer these books from prominent technical publishers. All prices listed are the publishers' net. Shipping charges are included.

Use the coupon at the bottom of the page or give the complete title, author and coupon number. Be sure to indicate quantity on the special instructions line if more than one copy of a title is wanted. Full payment must accompany your order. We cannot ship c.o.d. Checks or money orders should be made payable to Sagamore Publishing Company, Inc. Because of the time required to process orders, allow several weeks for the receipt of books.

Broadcasting

RADIO BROADCASTING

edited by Robert L. Hilliard. Each of the five chapters has been written by a prominent educator with an extensive background of practical experience in commercial and educational broadcasting. The areas covered include: management and programming, operating and studio facilities, producing and directing, writing, performing. For those of you who want to, or must, operate on both sides of the control room, this is virtually required reading. 190 pages; 6¼ x 9½; indexed; clothbound.

$6.95 ($8.35 in Canada)
Circle 2 on Coupon Below

PLANNING THE LOCAL UHF-TV STATION

by Patrick Finnegan. 1965. An informative guide for the planning, building, and operation of a small-market, UHF-TV station. Based on the author's lengthy experience in the technical operation of such a station, it explains equipment, layout, and building costs that apply to the small studio (one-man control room operation) with a heavy film schedule. A valuable aid for the station owner, manager, engineer and layman interested in this medium. 328 pages; 6 x 9; illus; clothbound

$10.00 ($11.95 in Canada)
Circle 17 on Coupon Below

How To

HOW TO BUILD SPEAKER ENCLOSURES

by Alexis Badmaieff and Don Davis. A thorough and comprehensive "do-it-yourself" book providing a wealth of practical and theoretical information on the "whys" as well as the "hows" of constructing high-quality, top-performance speaker enclosures. Contains detailed drawings and instructions for building the various basic enclosures. Includes infinite-baffle, bass-reflex, and horn projector types as well as several different combinations of these. The book covers both the advantages and the disadvantages of each enclosure type and includes a discussion of speaker drivers, crossover networks, and hints on the techniques of construction and testing. Written and compiled by two of the nation's leading authorities in the field of acoustical engineering. 144 pages; 5½ x 8½; softbound.

$3.50 ($4.25 in Canada)
Circle 3 on Coupon Below

PRACTICAL PA GUIDEBOOK: HOW TO INSTALL, OPERATE AND SERVICE PUBLIC ADDRESS SYSTEMS

by Norman H. Crowhurst. 1967. This book gives all the basics needed to become a successful PA operator, in any situation where the reinforcement, relay, or distribution of sound can provide a service. It shows how to properly install, operate and service public address systems. All aspects of the subject, from survey to the selection of appropriate equipment, to installation, to routine operation and the maintenance of a finished system, are covered. Attention is given to solving problems encountered in providing successful service. The book's systematic and practical approach makes it highly useful to radio-TV servicemen, hobbyists, and PA equipment manufacturers. 136 pages; 6 x 9; illus; softbound.

$3.95 ($4.60 in Canada)
Circle 15 on Coupon Below

CLOSED CIRCUIT TV SYSTEM PLANNING

by M. A. Mayers and R. D Chipp. 1957 This book discusses in detail the vitally important and rapidly expanding concept of closed circuit TV systems, its utility and functioning. This book is not an engineering or a technician's text — it is written for management. It explains and illustrates the kind of systems that are available and their applications. 264 pages; 8½ x 11; illus; clothbound.

$10.00 ($11.95 in Canada)
Circle 16 on Coupon Below

General Audio

THE TECHNIQUE OF THE SOUND STUDIO

by Alec Nisbett. This is a handbook on radio and recording techniques, but the principles described are equally applicable to film and television sound. It describes how the highest standards may be achieved not only in the elaborately equipped studio but also with simple equipment out on location. 264 pages; 60 diagrams; glossary; indexed; 5½ x 8½; clothbound.

$10.50 ($11.95 in Canada)
Circle 1 on Coupon Below

MICROPHONES

by A. E. Robertson. 1963. This book, primarily written as a training manual for technicians, will also prove valuable to all users of quality microphones whether for broadcasting, public address systems, or recording of all types. There is now an almost bewildering array of microphones of differing characteristics, and new designs are constantly being produced. The author makes no attempt to catalogue these but concentrates mainly on the principles of operation. He only describes actual microphones if they illustrate an important feature or have some historic significance. The book is intended for the user rather than the designer; mathematics have been omitted from the main body of the text. 359 pages; 6 x 9; illus., clothbound.

$12.75 ($15.40 in Canada)
Circle 13 on Coupon Below

Electronics and Mathematics

ELECTRONICS MATH SIMPLIFIED

by Alan Andrews. For the engineer, student, or technician who requires a knowledge of mathematics as it pertains to electronics. Covers the subject in a logical, clear, and concise manner, using dozens of examples related specifically to electronics. Particularly suited for use as a textbook in any school or other training program involving the study of electronics, the book has been especially prepared to coincide with studies leading to 2nd- and 1st-class FCC Radiotelephone licenses. (2 vols. in slipcase)

$7.95 ($9.95 in Canada)
Circle 11 on Coupon Below

MATHEMATICS FOR ELECTRONICS ENGINEERS & TECHNICIANS

by Norman H. Crowhurst. This book is written to help the advanced technician and the engineer bridge the gap between "book learning" and practical experience. It is not about mathematics but about how to use mathematics in electronics. A unique programmed method shows not only how to apply textbook math towards the solution of any electronics problem but also teaches how to think in the best way for solving them. Much emphasis is placed on correcting misconceptions commonly held by technicians. The book begins with Ohm's and Kirchhoff's laws and goes on to selective networks, properties of coils and transformers, feedback circuits, etc. 256 pages; 5½ x 8½ (hardbound).

$6.95 ($8.35 in Canada)
Circle 4 on Coupon Below

Sagamore Publishing Company, Inc.
980 Old Country Road, Plainview, N.Y. 11803
Please send me the books I have circled below. My full remittance in the amount of $......... is enclosed. N.Y. State residents add 2% sales tax.

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22
23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40

Name..

Street Address..

City.........................State.........................Zip.........

Special Instructions..

www.americanradiohistory.com

HANDBOOK OF ELECTRONIC TABLES & FORMULAS, (2nd Edition)
A one-stop source for all charts, tables, formulas, laws, symbols, and standards used in electronics. Devotes complete sections to items of interest to service technicians and to circuit design data. Includes a 6-page, full-color fold-out chart showing latest FCC allocations for the entire frequency spectrum. 192 pages; 5+ x 8+; hardbound.
$3.95 ($4.95 in Canada)
Circle 8 on Coupon Below

Test and Maintenance

INTERMODULATION AND HARMONIC DISTORTION HANDBOOK
by Howard M. Tremaine. A complete reference guidebook on audio signal intermodulation and harmonic distortion. 172 pages; 5½ x 8½; softbound.
$4.25 ($5.25 in Canada)
Circle 9 on Coupon Below

Circuitry and Components

PASSIVE AUDIO NETWORK DESIGN
by Howard M. Tremaine. A complete and comprehensive guide to the design, construction, and testing of all types of attenuators, equalizers, and wave filters for the practicing audio technician or engineer. This authoritative text is one of the few written on the subject, and requires only nominal mathematical background. Written in easy-to-understand language, the content presents the basic design, construction, and testing considerations without the confusion often associated with passive networks. 288 pages; 5½ x 8½: softbound.
$5.50 ($6.45 in Canada)
Circle 5 on Coupon Below

TRANSISTORS FOR AUDIO FREQUENCY (AUDIO-FREQUENCY AMPLIFICATION)
by Guy Fontaine. 1967. This systematic and detailed treatment of the application of transistors in audio-frequency amplifiers shows how the published transistor characteristics are related to the principles of design. To assure clarity, the figures are rendered in several colors and placed opposite the related text. Simple equations reinforce the lucid approach. An ideal textbook or reference on the subject for engineers and advanced technicians. 384 pages; 5½ x 8; illus.; clothbound.
$7.95 ($9.55 in Canada)
Circle 12 on Coupon Below

ACOUSTICAL TESTS AND MEASUREMENTS
by Don Davis. Provides a solid understanding of the entire subject of acoustical measurements; based on actual field test work, using commercial equipment. Contains practical, time-saving solutions to actual problems encountered in the field; minimum math is required for understanding. The author is an expert in this field, and an authority on auditorium acoustics. An invaluable book for phone company special service engineers, plant maintenance engineers, communications engineers, noise control specialists, architectural engineers, broadcast engineers and technicians, hi-fi fans and students. 192 pages; 5½ x 8½; hardbound.
$6.95 ($8.35 in Canada)
Circle 7 on Coupon Below

DESIGN OF LOW-NOISE TRANSISTOR INPUT CIRCUITS
by William A. Rheinfelder. **1964.** Written for students as well as circuit design engineers interested in low-noise circuit design. Throughout, the book gives a multitude of time-saving graphs and design curves for the practical circuit designer. Simple derivations of all important formulas are also presented to help the reader obtain a deeper insight into the fundamentals of practical low-noise design. 128 pages; 6 x 9; illus.; clothbound.
$5.50 ($6.50 in Canada)
Circle 14 on Coupon Below

Reference

New 17th Edition of the famous RADIO HANDBOOK
Tells how to design, build and operate the latest types of amateur transmitters, receivers, transceivers, amplifiers and test equipment. Provides extensive, simplified theory on practically every phase of radio. Broad coverage; all original data, up to date, complete. 847 pages.
$12.95 ($15.50 in Canada)
Circle 10 on Coupon Below

Classified

Looking for a qualified professional to fill a job opening?
Trying to sell some audio equipment privately?
Want to get an audio engineering position in another city?

USE **db** CLASSIFIED . . .
A UNIQUE NEW EMPLOYMENT AND EQUIPMENT EXCHANGE FOR THE WHOLE AUDIO INDUSTRY
db
THE SOUND ENGINEERING MAGAZINE
now offers a classified advertising section to firms and individuals in all areas of audio — recording, commercial sound, broadcasting, manufacturing, film and tv sound, etc.
Closing date is the fifteenth of the second month preceding the date of issue. Send copy to:
Classified Ad Dept.
db
THE SOUND ENGINEERING MAGAZINE
980 Old Country Road
Plainview, New York 11803

FOR SALE

SOLID-STATE 50 WATT RMS plug-in d.c. thru 25 kc operational power amplifier kit, model 440K. Price $30.00. Send for free catalog and 50 operational amplifier applications to: **Opamp Labs. 172 So. Alta Vista Blvd., Los Angeles, California 90036.**

SCULLY TAPE RECORDERS — One to twelve track. Two, four, and eight track models in stock for immediate delivery.
SCULLY LATHES — Previously owned and rebuilt. Variable or automatic pitch. Complete cutting systems with Westrex heads.
MIXING CONSOLES — Custom designed using Electrodyne, Fairchild and Universa Audio modules. From $4000.00.
Wiegand Audio Laboratories, 3402 Windsor Road, Wall, New Jersey 07719. Phone: 201 681-6443.

AUDIO EQUIPMENT for churches, schools, recording studios, radio and t.v. stations. New and used. Trade-ins accepted. AMPEX, BOGEN, ELECTRO-VOICE, SHURE, SCULLY, and many others. Free lists. **Boynton Studio, 118 Brook St., Scarsdale, N. Y. 19583.**

EMPLOYMENT

TECHNICIAN DISC RECORDING. Large Detroit Studio. 1 year experience minimum. Stereo experience preferred, not required. Call **Robert Dennis,** collect, **(313) 965-9250.**

SERVICES

PROFESSIONAL AUDIO REP serving the greater New York area seeks additional compatible lines. **Box S4, db Magazine, 980 Old Country Road, Plainview, N. Y. 11803**

DON'T BE AN AUDIO DROPOUT! See BROADCAST EQUIPMENT REBUILDERS for your tape cartridge rewinding needs. **Route 8, Box 718, Fayetteville, N.C. 28304. (919) 425-7332.**

PROFESSIONAL DIRECTORY

Philip C. Erhorn
Systems Design and Specifications
Custom Consoles Technical Writing
P.O. Box 861
Stony Brook, New York 11790
Tel: 516 941-9159

www.americanradiohistory.com

People, Places, Happenings

● **Rolf Hertenstein** has been appointed director of marketing for **United Recording Electronics Industries**. The North Hollywood-based firm is a manufacturer of professional audio equipment and instruments. Mr. Hertenstein will have total marketing responsibility for all product lines, including **Universal Audio, Waveforms,** and **Teletronix.** The parent firm plans a major expansion of its product promotion program which will include expanded factory support for field representatives, increased promotional assistance for local distributors, and increased new product development. Mr. Hertenstein was previously assistant sales manager at **Langevin** and most recently (the past three years) was district sales manager for the far west for the **DuKane Corp.**

● The fifth expansion move in as many years—that's the latest word from **Sparta Electronics Corp.** According to **William J. Overhauser,** president and general manager of the Sacremento, California-based firm, this latest addition has more than doubled their production and office space size, permitting expanded engineering and production departments as well as an accelerated shipping program. Sparta manufactures professional broadcast equipment.

● A note from **Dave Taylor** executive vice president of **KPRO radio** in Riverside, California, tells us that **Steve Gibson,** up to now chief engineer of the station, has been named director of engineering of the growing chain of **Dick Clark stations**—one of which is KPRO. Mr. Clark acquired the station in June, 1965; later he purchased **KGUD** in Santa Barbara, and currently he is negotiating for an additional station in northern California.

● Things are happening at **Telex.** Ground has been broken for a 26,000 square-foot addition to its new tape recorder plant in Blue Earth, Minnesota. The plant will employ a total of 400 people. It is now in use manufacturing both **Magnecord** and **Viking** tape units.

Meanwhile, a Telex group has been reorganized complete with a new name. According to **James S. Arrington,** director of marketing for the Telex-Magnecord-Viking group, the new group will be called **Telex Communications Division,** and will function as a sales organization for the three brand names. National sales managers will be **James R. Dow,** educational products; **Paul R. Bunker,** broadcasting and industrial products; **Russ Molloy,** consumer products; **Sidney T. Kitrell,** aircraft products. **Gordon Thorburn,** who has been head of Viking tape recorder sales, has been named manager, marketing administration, a new post with overall responsibilities for order processing procedures, service, parts, and technical correspondence.

● The scattered NAB fall conferences, one in each of six regions, will each have as a luncheon speaker a member of the **Federal Communications Commission.** "We are delighted that the Commission will be represented," **NAB** president **William T. Wasilewski** said, "and we know Commissioner participation will greatly enhance our programs at these regional meetings."

The Commissioners and their schedule are as follows:

Oct. 17, Commissioner James J. Wadsworth—New York at the New York Hilton Hotel.

Oct. 21, Commissioner Kenneth A. Cox—Los Angeles at the Ambassador Hotel.

Oct. 24, Commissioner Robert E. Lee—Denver at the Denver Hilton.

November 11, Commissioner Kenneth A. Cox—Cincinnati at the Sheraton Gibson.

November 14, Commissioner Robert T. Bartley—Dallas at the Dallas Hilton.

November 18, Commissioner Nicholas Johnson—Atlanta at the Atlanta Marriott.

FCC Chairman **Rosel H. Hyde** will be unable to participate because of the duties of this office. One of the Commission seats is vacant.

● **Commercial Recording, Inc.,** Hawaii's largest independent producer of records, radio commercials, film and t.v. sound tracks, has announced the appointment of **Ken Hiller** as production director. Mr. Hiller, former production manager of **KHON-TV,** will handle Commercial Recording's film-sound expansion. According to our information, the firm has recently added Hawaii's only professional film-sound equipment, with synchronous interlock and projection, allowing quality recording comparable to any film sound studio in the world.

Ernest B. Schwartzenbach, president of the Sony Corporation of America has died of drowning. He was 70 years old. Mr. Schwartzenbach had retired at the end of 1965 from Smith, Barney & Co., where he was a vice president, director, and partner. Two weeks later he was elected president of Sony, succeeding Akio Morita, who is an executive vice president and co-founder of the parent company, the Sony Corporation, based in Tokyo. A tall, energetic man who looked younger than his years, Mr. Schwartzenbach was a pioneer in financing Japanese issues on the American market after World War II. It was this background that led him to Sony.

Radio station WBRB has announced the death of Harold Oliver, 42 ,of a heart attack. Mr. Oliver had been with the company for seven years. Prior to this association he had been chief engineer of the Port Huron radio station WHLS. He is survived by his wife Leona and six children and others. Station WBRB is in Mt. Clemens, Michigan and is one of the Malrite stations.

B & K (Cover IV) Circle 12 on Reader Service Card →

www.americanradiohistory.com

Suddenly, every studio microphone in America is out of date!

Now you can get a special professional user price on your next Sony microphone purchase. Industry professionals are invited to send for complete specifications on the new solid-state C37-FET and C55-FET Condenser Microphones. Special prices will be quoted to you immediately by return mail.

Both of these sensational, new, Sony microphones deliver the ultimate in professional capabilities. Flat frequency response free from resonant peaks and dips. Warm, natural sound. Plus a wide dynamic range to capture the magnificence and true timbre of strings, woodwinds and piano. Field Effect Transistors replace the conventional vacuum tube and eliminate external power supplies and connecting cables. And both microphones feature a self-contained, replaceable, 9-volt battery plus a built-in battery condition indicator.

In addition, the C55-FET utilizes a 90° rotating capsule for optimum cardioid pick-up characteristics in any application—hand-held solo performance or interview work, stand- or boom-mount. In the studio, the C55-FET's flexibility meets any microphone placement problem.

For complete specifications and special professional user prices, simply write to: Harold Watson, Sony/Superscope Microphone Sales Department, 8150 Vineland Avenue, Sun Valley, California 91352.

THE C37-FET:

Frequency Response: 20-20,000 Hz (± 2.5 db 30-18,000 Hz). Directional Characteristics: Uni- or omni-directional switch selected. Output Impedance: 50, 250 or 600 ohms balanced. Output Level: —50.8 db @ 250 ohms where 0 db = 1 volt/10 microbar. Noise Level: 24 db SL where 0 db = 2 x 10^{-4} microbar. Dynamic Range: 110 db.

THE C55-FET:

Frequency Response: 20-20,000 Hz (± 2.5 db 30-18,000 Hz). Directional Characteristics: Uni-directional cardioid (axis variable from 0° to 90°). Output Impedance: 50, 250 or 600 ohms balanced. Output Level: —50 db @ 250 ohms where 0 db = 1 volt/10 microbar. Noise Level: 24 db SL where 0 db = 2 x 10^{-4} microbar. Dynamic Range: 110 db.

You never heard it so good.

SONY® SUPERSCOPE®

Circle 10 on Reader Service Card

©SUPERSCOPE, INC., 1968

www.americanradiohistory.com

Only their sound man knows for sure.

The Philharmonic they're not. Joyful noisemakers is really more like it. But that's between them, their audio engineer and the lamppost. On tape they sound strictly euphonious.

Between us, the unsung hero is the guy at the controls. Plus the compact, uncomplicated noise-elimination system with a small price tag and a big name. The Model 123 Graphic Frequency Response Equalizer.

It divides the audio spectrum into 36 critical bandwidths for matchless selectivity in separating unwanted sounds from any program. And your program material suffers not in the least.

There's much, much more . . . like selective emphasis. Read all about it. Or better yet, hear the 123 in action. A quick call or note is all it takes.

B & K INSTRUMENTS, INC.
Bruel & Kjaer Precision Instruments
5111 West 164th Street • Cleveland, Ohio 44142
Telephone: (216) 267-4800 • TWX: (810) 421-8266

www.americanradiohistory.com