December, 1970/75 cents

Broadcast Engineering

the technical journal of the broadcast-communications industry

A HOWARD W. SAMS PUBLICATION

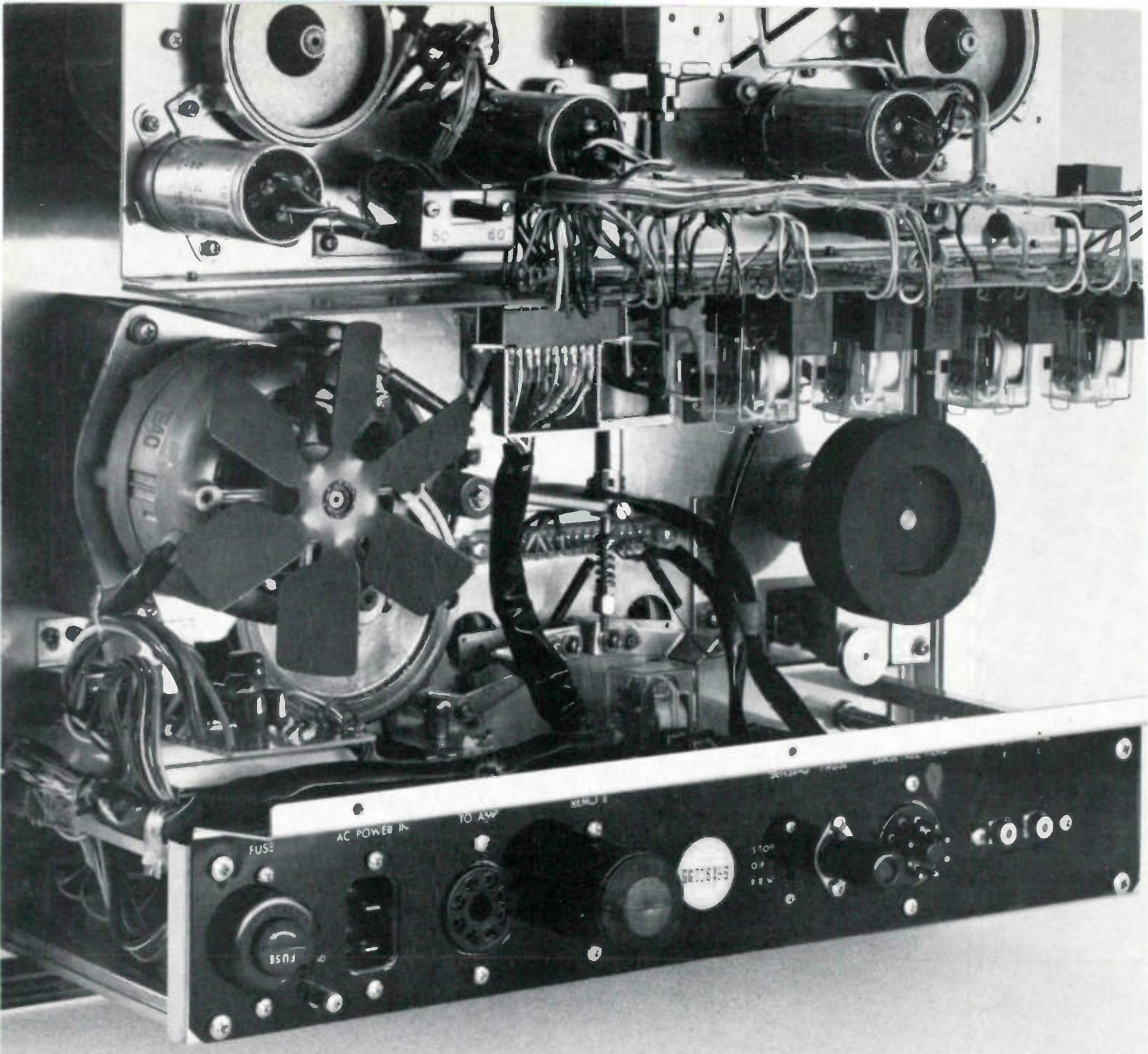
Optimum Performance of Tone Arms

Page 20

Snowmobile Remotes

SCA For Cable TV

Antenna Icing



BACK TALK

When it comes to building sound equipment from the inside out, you could call us the component company. You see, we're one of the few tape deck manufacturers who make all our own critical components – from heads to motors and most of the electronics. After all, who knows better than we do what it takes to make a TEAC?

For instance, our heads are hyperbolic, not conventionally rounded. This means more intimate tape contact, less tape tension, better sound reproduction. Hyperbolic heads are the shape of things to come – and the only kind we'd think of using.

Meanwhile, we still buy outside parts for certain purposes. The ones we buy, we buy because they're the best. The ones we make, we make because they're the best.

And most of the time, we've got it made.

TEAC

TEAC Corporation of America • 2000 Colorado Avenue • Santa Monica, California 90404

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. . . that's why Cohu's new 2600 Series Broadcast Sync Generator uses an ultra-stable digitally generated time base to insure jitter-free performance.

Everything depends on your timing pulses. So, stable pulses are the key factor in designing a sync generator that does what the specs say it does. Jitter-free sync comes from digital dividers and logic circuitry that sequentially divide the base frequency of the temperature-compensated oscillator.

A precision color standard is built in and generates pulses required for local color or monochrome broadcasting at 525 lines/frames, 60 Hz with 2:1 interlace. All pulse widths except vertical drive, vertical sync and equalizer are adjustable with no interaction of controls.

Three plug-in boards make up the system, which occupies just 1¾ inches of vertical space in a standard 19-inch rack. All active circuitry is solid state with integrated circuit construction for maximum reliability. In addition to the sync gen, output and power supply modules, the system can include an optional phase lock module. The phase lock circuitry genlocks the sync gen to an external NTSC composite video signal or a monochrome composite video signal.

To prevent jitter between separately locked burst and sync, the master oscillator is locked to the incoming burst and the sync is phased into coincidence. Absence of an incoming signal causes the sync generator to revert to the internal color standard to produce a set of color synchronizing signals.

Timing is money, and Cohu's got the clock that keeps it that way. For more details contact your nearest Cohu representative or the TV Product Line Manager direct at 714-277-6700, Box 623, San Diego, California 92112, TWX 910-335-1244.

COHU
ELECTRONICS, INC
SAN DIEGO DIVISION

Circle Number 4 on Reader Reply Card

December, 1970 • Volume 12, No. 12

Broadcast Engineering

The technical journal of the broadcast-communications industry

in this issue...

ABOUT THE COVER

This month's cover picture was taken in the studios of station WXYZ, Detroit. The focus is on the turntable and pickup arm as is our leading feature on page 20. (Photo courtesy of Gates Radio.)

DEPARTMENTS

BROADCAST ENGINEERING is published monthly by Intertec Publishing Corp., 1014 Wyandotte Street, Kansas City, Missouri 64105. Telephone: 913/888-4664.

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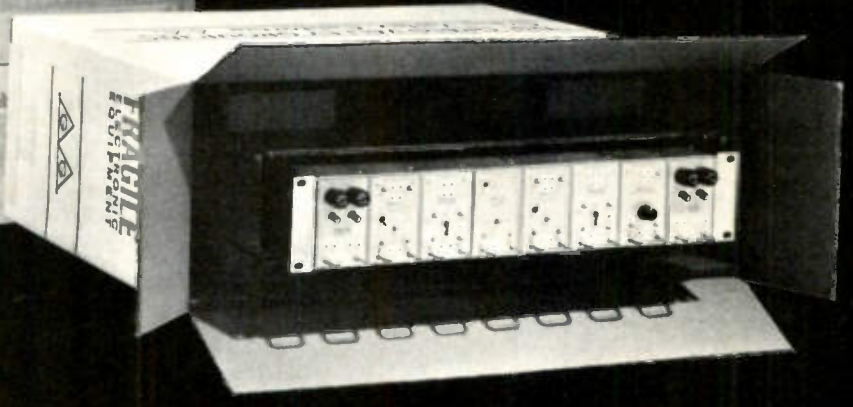
Robert E. Hertel, Publisher

Intertec Publishing Corp.
Subsidiary of Howard W. Sams & Co., Inc.

EIGHTEEN HUNDRED AND TWENTY FOUR

ANOTHER GVG MODEL 951 DUAL SYNC GENERATOR AND CHANGEOVER SYSTEM READY FOR SHIPMENT. THE TWO MODEL 950 SYNC GENERATORS ARE THE 1,823RD AND 1,824TH UNITS TO BE PLACED IN SERVICE.



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Circle Number 5 on Reader Reply Card

DIRECT CURRENT FROM D. C.

December, 1970

By Howard T. Head

Wider Paint Bands Adopted For Towers

New FCC requirements have gone into effect governing the width of the orange and white bands required for aviation obstruction marking on radio and television towers. Previous rules required the bands to be no less than 1½ feet in width, nor more than 40 feet. The 40-foot limit has now been raised to 100 feet. FAA studies have shown the wider bands to be more conspicuous to pilots.

The previous requirement of the painting rule that each of the bands be "approximately one-seventh of the height of the structure" remains in effect. This makes the rule perfectly clear for towers up to 700 feet, but above this height what is the broadcaster to do? There are more than 300 television towers taller than 700 feet above ground.

What the Commission actually wants, but what the rule doesn't say, is that the bands be as wide as possible but no wider than 100 feet. For heights above 700 feet, this requires more than seven bands and the number must be odd so as to provide an orange band at both the top and bottom. This is what the Commission intends, but you'll never find it out from reading the rule.

The new widths are already in effect. Existing structures may be left as they are for the time being, but all paint jobs must be brought into compliance by November, 1977.

TV Coding Scheme Runs into Difficulties

A television commercial coding scheme being promoted by International Digisonics Corporation (IDC) (see Oct., 1970 D.C.) has encountered some heavy going during its start-up period. The IDC code is intended to permit the off-air monitoring of program and commercial material. The system employs patterns in the four corners of the television picture which generate video "tones", which may be decoded off-the-air by suitable computers.

Trouble has arisen because the Commission's Rules requires that these coded signals be confined to lines 21-23 and 260-262, inclusive, of the television raster. Much of the early coded material far exceeded this requirement, leading to a rash of complaints from stations and others. Since the code is optically printed on motion picture film, confining the display to only six lines of the raster as required by the Commission's Rules imposes very stringent requirements. The problem has been complicated by the fact that in many instances stations have received coded film commercials with no advance warning and become aware of the rule violation only after noting the code in the transmitted picture.

(Continued on page 6)

Gainsmanship

...the art of broadcasting the maximum radiated signal without distortion, thumping, pumping or other undesirable effects. Automatic Level Controllers made gainsmanship possible. CBS Laboratories developed the original Audimax Automatic Level Controller more than 10 years ago and has been the leading supplier to the industry ever since.

Now, the new Audimax 4440—fourth generation Audimax—gives the industry new standards—adjustable recovery time, expanded return-to-zero function, long life Tantalum capacitors space-saving slimline design and money saving add-on stereo capability.

You can set new standards of gainsmanship—increase your market coverage—improve quality. Write for full details or call to order (203) 327-2000.

Model 4440—Price $725 Model 4450 (Stereo)—Price $1,295

CBS LABORATORIES

A Division of Columbia Broadcasting System, Inc. 227 High Ridge Road, Stamford, Connecticut 06905

Circle Number 6 on Reader Reply Card

(Continued from page 4)

The Commission has temporarily relaxed the rule so as to permit the code to appear on six lines each at the top and the bottom of the raster rather than three. Even this tolerance, however, is proving difficult to meet, and there is considerable question that the system can be brought into tolerance within the 90-day period provided by the temporary relaxation.

New Source of FM Interference to Television Reception Appears

Even as the Commission moves to form an FM/TV Interference Advisory Committee (Nov. 1970 D.C.), disturbing new reports are being received which indicate that FM interference to television reception may affect channels going beyond the range of Channels 6-13, inclusive, most commonly subject to FM interference.

As an increasing number of high-power FM stations go on the air in the educational portion of the FM broadcast band (88-92 MHz), more and more instances of FM interference to television Ch. 5 are being observed. Although the exact mechanism is not entirely certain, there seems to be good reason to believe that much of the interference is caused by the television station's own visual carrier (f_v) mixing with the interfering FM signal (f_u) in the first detector along with the local oscillator frequency (f_{Lo}). If a sufficient amount of the interfering FM signal passes through the television tuner, a combination of these three signals may appear in the IF pass band. When this occurs the situation is as follows:

$$41 < f_v + f_u - f_{Lo} < 47$$

The combination $f_v - f_{Lo}$ is always −45.75 MHz, leaving the following situation:

$$41 < f_u - 45.75 < 47$$

or applying a little elementary algebra:

$$86.75 < f_u < 92.25$$

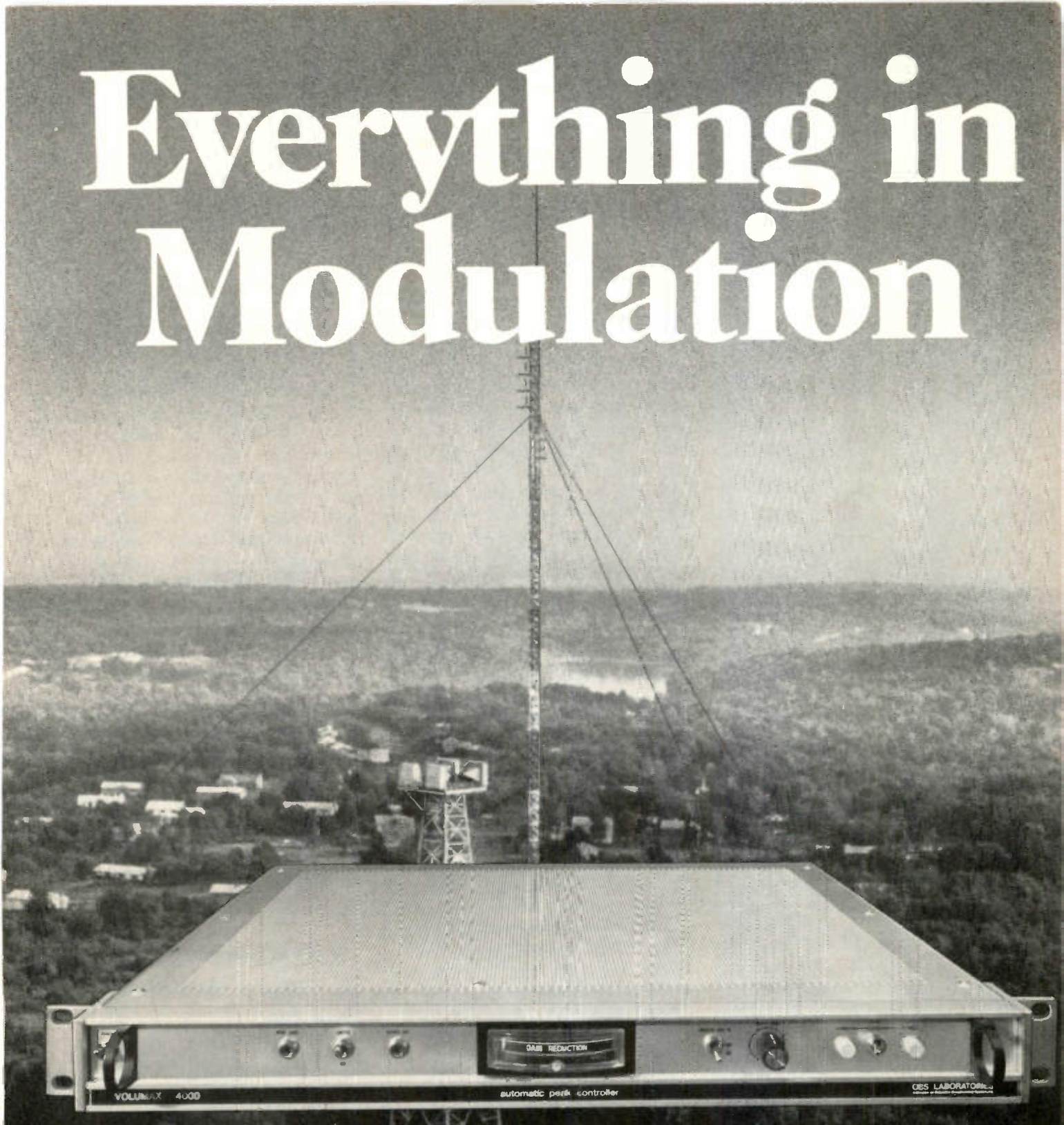
This equation says that any interfering signal strong enough to pass through the tuner is capable of getting into the receiver IF if the interfering frequency is between 86.75 and 92.25 MHz, which includes all of the educational portion of the FM band. An interesting aspect of this problem is that this could occur not only on Ch. 5, but on any other television channel. Most tuners, however, should exhibit sufficient selectivity to reject all except the strong FM signals.

At present, these frequency combinations are conjectural although there is considerable interference to Ch. 5 reception that can be explained no other way. We'd welcome reports of any interference which might be traced to this source

Short Circuits

A lifting of the AM "freeze" is imminent; emphasis is likely to be on improvement of existing facilities and service to ethnic minorities . . . The United States will propose at the Seventh World Administrative Radio Conference (WARC) to make the 2.5 GHz band available for satellite relaying of educational television . . . All broadcast stations may without specific authorization rebroadcast Weather Bureau transmissions originating on 162.4 and 162.55 MHz, subject to specified conditions.

Everything in Modulation



With the new CBS Laboratories Volumax 4000 automatic peak controller, the broadcaster, for the first time, has the ability to use all the modulation his transmitter can take while maintaining the highest signal quality ever attainable. The Volumax 4000 combines all the achievements of earlier Volumax models with new slimline design and silent automatic speech asymmetry control.

That's everything in modulation. . . .

Priced at $725. That's everything in moderation

Write or call to order (203) 327-2000.

CBS LABORATORIES

A Division of Columbia Broadcasting System, Inc. 227 High Ridge Road, Stamford, Connecticut 06905

Circle Number 7 on Reader Reply Card

LETTERS TO THE EDITOR

Tests Needed

High Positive Modulation

Dear Editor:

The current discussions on high positive modulation percentages appear to have gone off the track. For example page 15 of your July issue states "5 kW transmitters equipped with modulators intended for 10 kW units." Where have your writers been for the past thirty years. Ever since the RCA BTA-5DX and up till this year there have been no 5 kW transmitters made with modulators different to those supplied with 10 kW excepting one or two with minor audio drive tubes which do not affect the power output capabilities.

Again, poor old CBS are frequently despised in their production of the excellent "Volumax" peak limiter with optional imbalance of positive/negative half cycles. I believe the controversy began with a manufacturer offering their limiter and transmitter combination with the assurance of 125 percent positive capabilities.

If everyone would slow down and make a practical test of their own transmitter's capabilities, it would be very evident that very few transmitters made in the past ten years, even when fitted with new RF final tubes, can even meet 100 percent modulation levels with acceptable distortion. These same tests made with tubes of more than 2,500 hours use, would also show it is usually impossible to obtain more than 95 percent positive modulation with less than 5 percent distortion when fed with symmetrical sine wave tone. So in fact, current transmitters using plate modulation are governed by tube type, final tank Q, biassing methods, cooling etc. and certainly not by the power output of the modulators or how much attenuation is applied to the negative half cycles.

However, those transmitters made prior to 1955-60 are usually capable of at least 50 percent more carrier power than that detailed in their type acceptance. Tests with unbalanced audio drive permits these transmitters, such as the RCA BTA-5DX or 5F to operate in excess of 120 percent positive modulation with distortion meeting FCC Rules. Listening tests have proved under all manner of conditions of channel separation and relative field strengths between the test transmitter and the adjacent channel transmitter, that here is no discernible additional interference caused by increasing the positive modulation peaks from 100 percent to 125 percent.

Alan L. Roycroft
Broadcast Services, Inc.
Honolulu, Hawaii

I thought we made it quite clear in the news item on page 15 of the July issue that we were quoting the FCC. If you still think the "writers" are 30 years behind the times, your credit goes to the Commission. And since they do read this magazine, I think they'll get the message.

The Editor

10 kHz Beat Problem: BE Seeking Solutions

Dear Editor:

Lawrence Gahagan's letter in the September issue of Broadcast Engineering correctly identifies the 10 kHz beat problem which sometimes bothers SCA operations.

We wish he had gone a little farther in completing the picture by adding:

1. The problem is no respecter of transmitter "brands".
2. Alignment of receivers is also suspect.
3. The problem is complex. To our knowledge no one has yet gathered enough empirically-derived data from the field to be

(Continued on page 10)

Get "in" gear

Want to know about the latest in sophisticated terminal equipment?

Talk to TeleMation!

Or talk to any of literally thousands of smart satisfied users of TeleMation products who know our equipment has achieved a standard of excellence in quality, flexibility and reliability that others are hard-pressed to meet.

TeleMation's TMV-551 Video Distribution Amplifier provides four completely isolated outputs from one bridging input. Built-in power supply and connector panel, IC series regulator for constant power supply voltage standard. Top color performance.

The TSG-3000 Broadcast Color Synchronizing Generator with all-digital circuitry, the highest time base stability and lowest pulse jitter performance available. Plus programmable pulse widths and *digital* genlock for *Crashlock* (next-field, operator-controlled lockup) or *Ratelock* (adds or subtracts one line per field until lockup is achieved).

For the finest in gear,
TALK TO TELEMATION.

TELEMATION

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Circle Number 9 on Reader Reply Card

(Continued from page 8)

able to completely identify causes and/or solutions.

We, too, are most interested in comments from the field and in participating with interested parties, looking toward a satisfactory solution of an industry-wide problem.

J. M. Haerle
Director
Broadcast Comm.
Collins Radio

It wouldn't be fair to hang this problem on Collins. I really don't think there is any company whose quality and integrity have withstood the test of time in the field any better than this one.

We are aware that this problem has been knawing away at the industry for some time now. The reason for running the letter was twofold: we wanted to get some immediate ideas for Lawrence Gahagan's situation, and we wanted to open up the problem for discussion among engineers across the country.

As Mr. Haerle says, no one has gathered enough empirically derived data from the field to be able to completely identify causes and/or solutions. But we're doing something about that.

Jim Wulliman, chief engineer at WTMJ, is working on a paper for BE on this subject. I'm certain Jim would welcome your comments. He probably won't be able to answer all your letters, but I'm certain he would appreciate hearing from you. His address is: 720 East Capitol Drive, Milwaukee, Wisconsin 53201.

More On Operators And Theater Ushers

Dear Editor

I have been reading in your publication and others as the controversy of the NAB and broadcasters continues, pertaining to the use of third class licenses and engineering personnel problems.

It appears to me that the broadcasters are trying to evade the basic economics of business: if you have an industry, you need people (qualified) for conducting that industry or you won't have one (industry). And it is the responsibility of the industry to attract people into the industry, not drive them out, which is exactly all this controversy is doing.

As I see it, the use of a Third Class licensee to announce, run a board and be the operator is the same as having the projectionist in a theater also be the usher. Would you buy a ticket?

Richard R. Hayes
President
Teledex Corp.

While I'm not certain just how valid this analogy is, this certainly is an interesting point. Equally interesting is the fact that, despite the comments that have appeared over the past several issues, the NAB has yet to make any answers available through this column. We invite comments from all quarters, especially when we suspect the whole story has not been told. We can all gain something from the free market place of ideas.

The Editor

Start Planning for the NAB

What Ever Happened To Auto FM Petition

Dear Editor:

What ever happened to RM 1122, the petition for automatic FM transmitters? This was put out back in 1968, and I filed my comments, along with some others. Since then I have heard nothing, except the reply to one inquiry which stated that the Commission was collecting more information. I am thoroughly convinced that most broadcast transmitters built within the last ten years can run for weeks with nothing more than a third class man who is primed to yell if the readings change, or the equivalent in automatic alarm equipment. This goes double for transmitters located in relatively remote spots, requiring special vehicles, where adequate remote metering, and an off-the-air frequency and mod. monitor are provided. What can be learned about a modern ceramic-tube FM transmitter's operation except through the meters?

Joel S. Look
WTSV/WTSV-FM
Claremont, N.H.

Engineering Pioneer, BE Writer Is Dead

After fighting a long, hard battle against injuries sustained in an auto accident a number of years ago, Harry Etkin died in late September.

Harry had been a pioneer in radio broadcast engineering. And along with his achievements while working for some of the early giants in equipment manufacturing Harry received commendations and awards from no less than the Bureau of Ordinance and the Bureau of Aeronautics.

An author of several books, he also had written a number of technical articles for **Broadcast Engineering.** He was the CATV editor for BE until July of 1970.

Along with his achievements in industry, Harry had been a chief engineer at several radio stations and had been a consulting engineer in AM, FM, TV, and CATV.

Cards and letters of condolence may be sent to Mollie Etkin, 160 Twin Oak Drive, Levittown, Pa. 19056.


1.
Jim Reid
Program Manager
says:
2.
Les Corum
Operations Manager
says:
3.
Barbara Fisler
Promotion Assistant
says:
4.
Paul Weber
Engineering Assistant
says:
5.
Dave Wygant
Manager of Sales
says:
6.
Don Plumridge
Director of
Creative Services
says:
7.
Don Doughty
Chief Engineer
says:
8.
Jim Anderson
National Sales Manager
says:
9.
Milton Grant
V.P. & General Manager
says:

WDCA-TV on the 'cart' machine:

Now that station WDCA-TV in Washington, D.C., has been using a TCR-100 cartridge video tape recorder for almost six months, we thought you might like to hear what they have to say about it.

1. "With this new cartridge VTR, one man can run the station, as far as on-air presentation is concerned...three or four taped commercials in a row is easy, because you just don't run out of tape machines."

2. "There's no degradation of quality in the cartridge tapes, even after more than 100 plays...I've been tickled to death with this 'cart' machine; it just sits there and works."

3. "The TCR saves us time during station breaks...We're actually logging 30% more promos since we got it. And we're starting to piggy-back our promos."

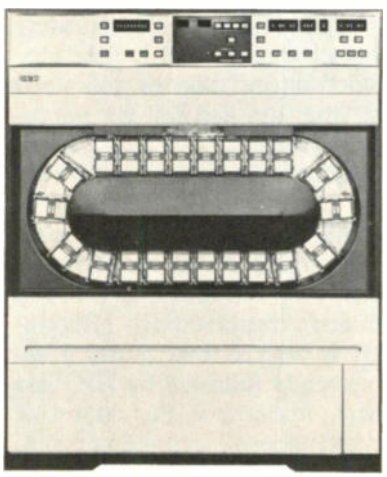
4. "I'd say the TCR-100 is a bigger advance over reel-to-reel VTRs than the audio cartridge was over reel-type audio recorders... and reliability has been terrific."

5. "It can help sell prospects because it really gives the station more production time...and that's going to help us become the most cooperative station in town."

6. "We're changing our station's whole visual image. We're redoing all promos and slides...and the 'cart' machine is giving us the extra production capability to get the job done."

7. "The TCR-100 is the equivalent of at least three reel-to-reel VTRs...I frankly don't think any of our engineers would trade it for five regular video tape recorders."

8. "It's the world's best machine for programming commercials. They run so smoothly that we sold more national accounts."



9. "Our staff—Production, Engineering, Traffic, Promotion, Sales—is united in enthusiastic acceptance."

Thank you, lady and gentlemen.

RCA

Circle Number 12 on Reader Reply Card

INDUSTRY NEWS

Rule Change Coming

TV Coding Hits Snag

Effective May 25, 1970, the Commission adopted an amendment to Part 73 of its rules and regulations (Docket 18605) FCC 70-386, which permits the licensees of television broadcast stations to transmit program material and spot announcements containing information in coded form, which, when intercepted and suitably processed identifies the transmitted program or announcement.

The presence of such coded information in transmissions of TV stations makes possible the operation of a monitoring network which, by largely automatic means, provides information as to the times when specific stations broadcast commercial materials bearing the coded identifications.

International Digisonics Corporation (IDC), the petitioner for the rule amendment of May 25, has established such a monitoring service, which now operates in the 25 largest television markets. IDC says that "more than thirty of the nation's largest television advertisers are coding commercials."

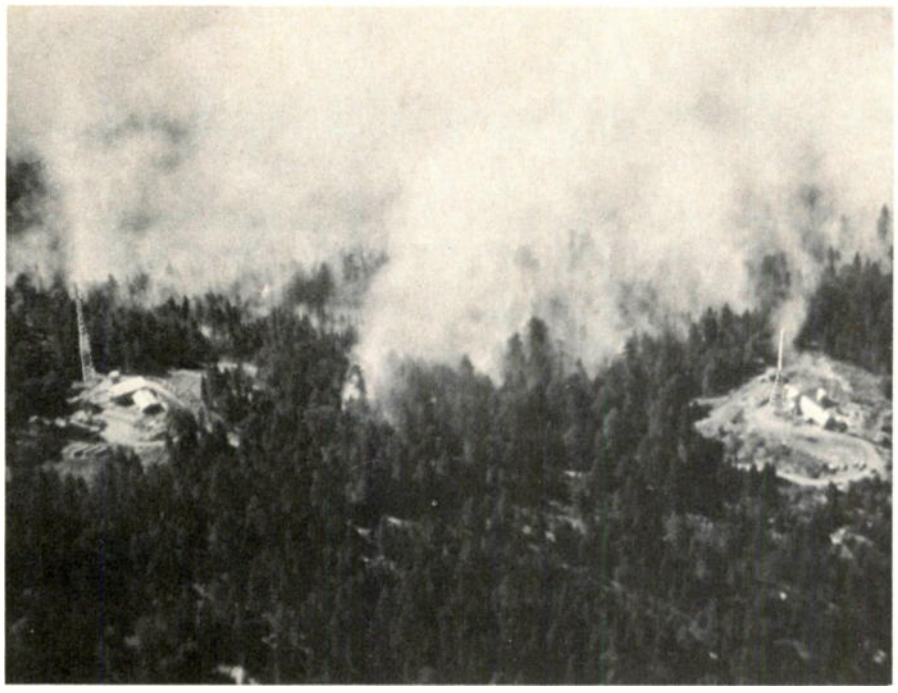
The choice of whether or not he will transmit programs or spot announcements containing coded identification information rests solely with each station licensee. However, if he chooses to transmit such material, the rules require that the coded information be contained within "the first and last ten microseconds of lines 21 through 23 and 260 through 262 (on a "field" basis)."

In this context, two problems have developed. Some broadcasters apparently do not desire to transmit the coded identification information. It is alleged that under practices presently followed by IDC and its client advertisers, the option of obtaining uncoded commercial material is effectively foreclosed to such licensees. Secondly, it would appear that either because of faulty placement of the coded patterns on some filmed material, or other than the usual film projector alignment procedures followed in a few stations, the coded information printed on these films may be transmitted on scanning lines other than those specified in the rules. Licensees who have encountered this problem claim that they can only transmit the commercials furnished them in violation of the rules.

No instances have been reported to the Commission where improper code placement has resulted in complaints by the public of degradation of the transmitted picture. The Commission is watching the situation closely and expects IDC and others to keep it fully apprised of developments in this matter.

The FCC says it expects licensees to make every reasonable effort to insure that transmissions of the identification code are made in compliance with Section 73.682(a) (22) of our Rules and Regulations. Nevertheless, under the circumstances outlined here, full compliance in all cases may be difficult, and the FCC says it believes that a relaxation of the rule, for a temporary period, in fairness, should be permitted. Accordingly, for a period of ninety days, beginning on the date of this Notice, the Commission will permit the transmission of the coded identification material within the first and last ten microseconds of lines 20 through 25, and 258 through 262. All other requirements of Section 73.682(a) (22) will continue to apply, particularly the stipulation that the code transmissions not result in significant degradation of broadcast transmissions.

For Late Breaking News Read "Direct Current" Page 4



Fires close in on KBAK-TV and KERO during recent forest fire in California. Fire is always a threat to station survival. Are you prepared to protect your employes and facility in case of electrical, gasoline, or lightning caused fires?

Stations Survive Fire Threat

The recent fires that raged through California almost destroyed the brand new $500,000 tower, antenna and transmitter facility of KBAK-TV, Bakersfield, California. But due to a last minute wind change the tower was saved. The photo shows how close the fire came to both KBAK's facilities on the left and KERO'S on the right. KBAK's new transmitter facilities were installed in January, 1970. The facilities consist of a 30,000 watt transmitter along with an RCA polygon antenna that put out effective radiated power of 1,720,000 watts. The tower is 7,775 ft. above sea level on Mt. Breckenridge.

Malibu Cable Survives

Within forty hours after a ravishing fire first hit the Malibu, California area, Cypress Communications Corporation personnel restored cable television service to their Malibu subscribers. Over 100 homes were totally destroyed by one of the most devastating fires in California history. The conflagration began on Friday, September 25. Steve Streeter, plant manager of the Malibu CATV system who was responsible for restoring service, estimated that approximately 80 subscriber homes and seven strand miles of cable were destroyed.

Aiding Streeter in repairing parts of the plant were Cypress personnel from its Palm Springs, California system.

At one point during the blaze, the Malibu system's south head end was within six feet of being engulfed by flames. The company's main office on the Pacific Coast Highway was also threatened and was temporarily evacuated.

The only injury to the cable company's personnel was a broken foot sustained by technician Carl Choquette, as a result of a fall caused by the high winds associated with the fire.

Streeter attributes the rapid restoration of service to the cooperation from Vikoa and Kaiser CATV and to the dedication of the company's employees.

The Malibu fire, which covered over 40,000 square acres, was just one of the several serious fires in Southern California that ran out of control during the week of September 25.

The Malibu system serves 2,300 subscribers.

IEEE And NAB

Major Industry Conventions In March

The Engineering Conference Committee of the National Association of Broadcasters named two subcommittees for the NAB's Annual Broadcast Engineering Conference to be held in conjunction with NAB's 49th Annual Convention March 28-31 at Chicago's Conrad Hilton Hotel.

One subcommittee will choose the recipient of the 1971 Engineering Achievement Award to be presented at the Conference, and the other will determine the Conference luncheon speakers.

Serving on the Award Subcommittee are Charles Abel, manager of engineering, KFMB Television, San Diego, Calif., chairman; William J. Clark, director of engineering, RKO General, Inc., New York; Leslie S. Learned, vice president for engineering, MBS, New York; and James D. Parker, staff consultant, telecommunications, CBS Television Network, New York.

Named to the Luncheon Speaker Subcommittee: Royce LaVerne Pointer, director, broadcast engineering, ABC, New York, chairman; Ralph F. Batt, vice president and manager of engineering, WGN Continental Broadcasting Co., Chicago, Ill.; James H. Hoke, vice president, Southern Broadcasting Co., Winston-Salem, N.C.; Lindsey G. Riddle, vice president, engineering, WDSU-TV, New Orleans, La.; Leonard A. Spragg, vice president for engineering, Storer Broadcasting Co., Miami Beach, Fla., and William H. Trevarthen, vice president, operations and engineering, NBC, New York.

Members of the subcommittee also serve on the Engineering Conference Committee.

IEEE Ready

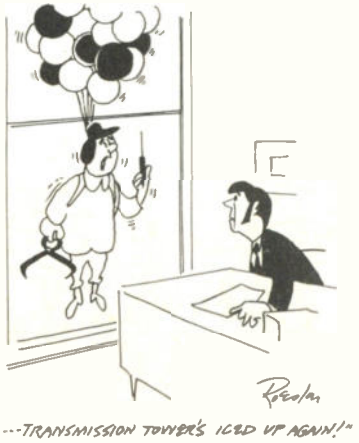
Program sessions covering technical applications will be much more numerous and cover a wider variety of subjects when the IEEE International Convention and Exposition opens on March 22, 1971. Based on a strong success trend dating back to 1968, a decision has been taken to increase the technical applications sessions offered at the Coliseum from seven in 1970 to around thirty for 1971.

As part of the overall technical program for the big IEEE annual event, the technical applications sessions are specifically designed to supplement the technical program meetings scheduled in the New York Hilton. The Hilton sessions are in general more long-range R & D oriented and designed to keep the non-specialist engineer abreast of the state-of-the-art of the electrical and electronics field. The technical applications program at the Coliseum is geared to provide practical information covering today's technology and direct applications to the engineer's working problems. The Institute of Electrical and Electronics Engineers has chosen for the theme of IEEE 71 "Technology for a Better World." The Technical Program Committee has for its chairman Frank H. Belcher, Bell Telephone Laboratories.

The much greater range of subjects should offer substantial added value, according to William J. Hilty, IEEE Director, Conference and Exposition Services. "We are planning to impart practical, up-to-date information, of direct value for daily use," he said. "We expect to cover a wider range of topics including integrated circuits, semiconductors, manufacturing techniques, computers, testing, and reliability, and many other subjects of interest to the engineer."

Detailed information relating to the program may be obtained from J. H. Schumacher, Secretary, Technical Program Committee, IEEE, 345 East 47th Street, New York.

Make Your Convention Plans Now



FCC Asked To Keep Mfgr's From Owning Cable TV Systems

Laser Link Corporation, developers of the proprietary Quasi-Laser Airlink CATV equipment, has filed a proposal with the Federal Communications Commission urging that it adopt rules prohibiting CATV equipment manufacturers and their affiliates from owning and operating CATV systems.

The proposal was contained in one of four documents filed by Laser Link in various CATV proceedings pending before the FCC. In its comments, the company stated that the reason for the position was to preclude manufacturers from being able to "underbid" applicants for franchises in one community and make up those losses by charges imposed on their subscribers in other communities.

"The viewing public should be served by CATV franchisees who will be free to choose their equipment on the basis of merit," Laser Link stated in its comments. "In a field as volatile and fast-improving as CATV technology, no CATV system should be the captive market for any given manufacturer."

Ira Kamen, President and Chief Executive Officer of Laser Link, who, in his career as a cable TV pioneer, has been a CATV consultant, designer and equipment manufacturing executive for RCA, Jerrold, Paramount Pictures, JFD, General Bronze and the U.S. Navy, among others, said "the Laser Link Corporation will not apply for CATV franchises. It will confine itself to the engineering, manufacturing and marketing of its airlink CATV system when the equipment is type-approved by the FCC."

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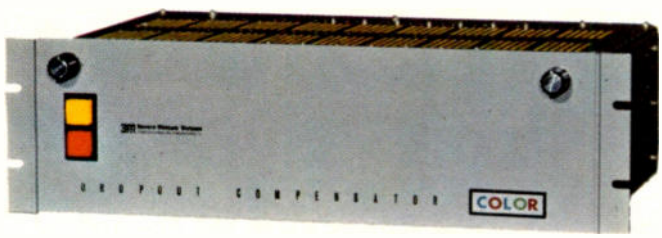

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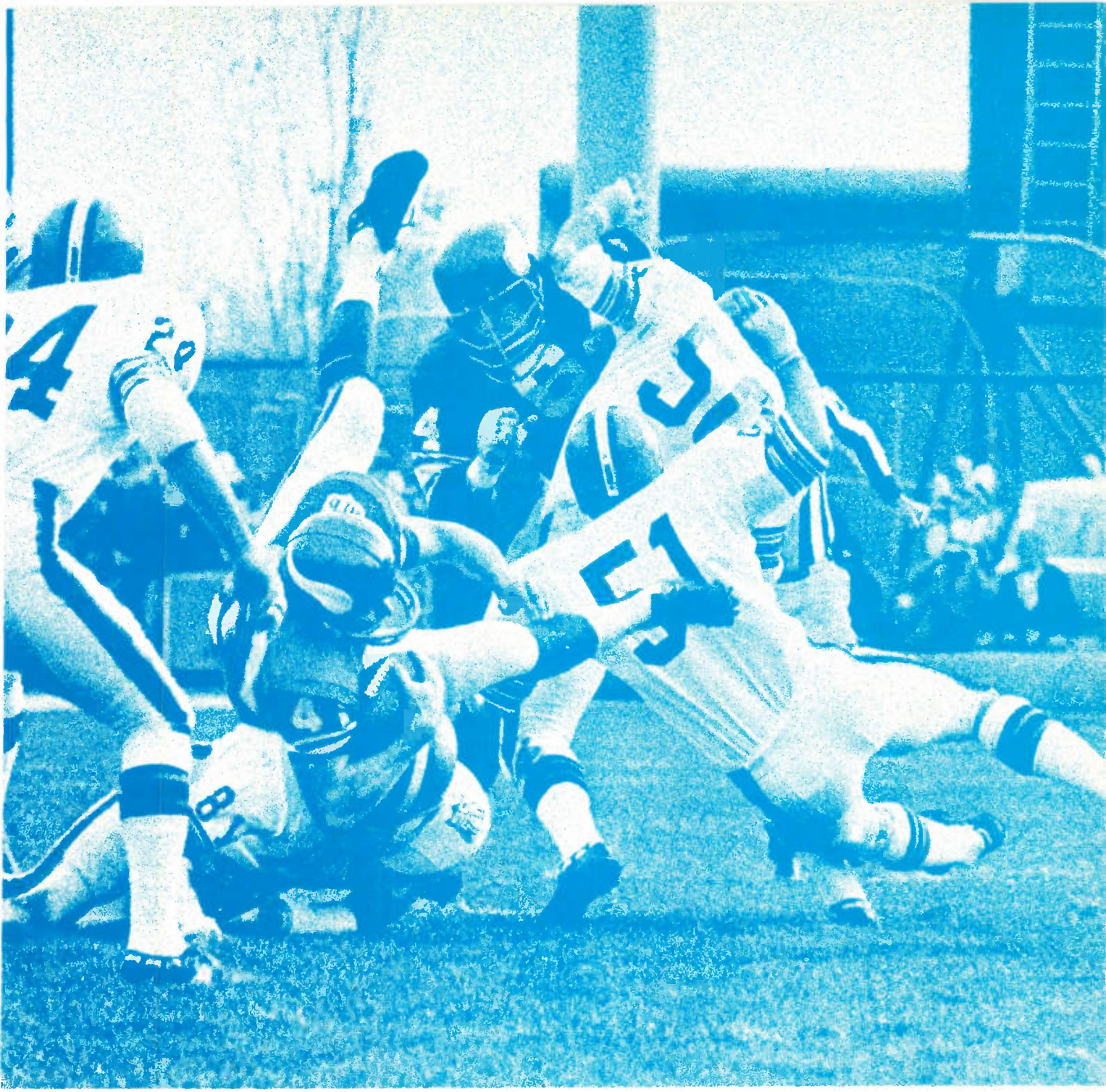
Director of Engineering
WCCO-TV, Minneapolis-St. Paul



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"We have ten Norelcos, seven in our studios and three in our 40-foot mobile unit, but we bicycle studio cameras back and forth for remotes and have used up to eight on some NFL pickups. We've handled remotes for every network—elections, baseball, news, you name it. We had beautiful color at 50-70 foot-candles for a Packers-Bears Shriner's Benefit in Milwaukee County Stadium.

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Circle Number 16 on Reader Reply Card

Optimizing stereo phonograph pickup performance

By John J. Bubbers

This paper was delivered by John J. Bubbers at the 24th NAB Broadcast Engineering Conference and is published here with the permission of the NAB. John Bubbers is the Director of Field Engineering and a vice president of Stanton Magnetics.

This paper has been written as the result of many inquiries which have been received, many of them showing that the use of modern phonograph pickups was not fully understood. It was considered important to present solutions to the most frequently posed questions since the broadcaster is confronted with many problems other than phonograph equipment.

The disc playback turntable is, for most broadcasters, one of the mainstays in his equipment lineup. There is much that could be done to bring this area up to date for many of the stations. Historically, the broadcaster has used magnetic phonograph cartridges. This paper will consider the questions related to the magnetic phonograph cartridge.

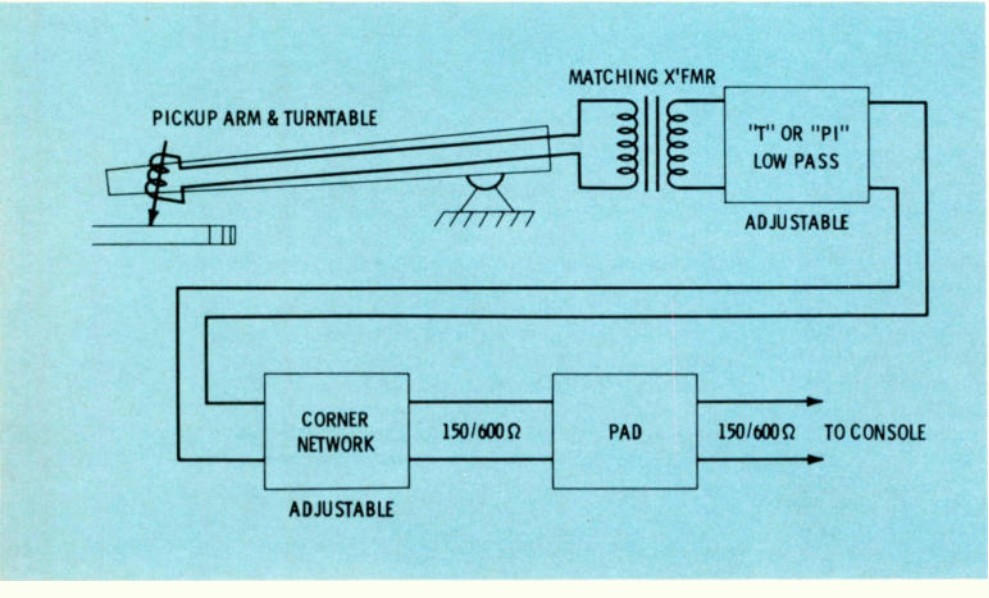

Fig. 1 Block diagram of a typical early broadcast equalizer.

Historical Background

In keeping with the input circuitry of audio equipment, the early pickups were low impedance on the order of 150 to 600 Ohms. The very low impedance moving-coil devices of the universal vertical-lateral type used transformers mounted in the arm to raise the impedance from ½ Ohm to something usable, such as 150 or 600 Ohms.

Concurrent with this era, from the earliest days to even the present time, the equalizers were passive networks which were combinations of classical filter design and corner networks—all of which were somehow put together to achieve "playback equalization". Precisely what the recording curve used had been a carefully guarded secret in the pioneer days so that, at best, most equipment manufacturers were hard put to design anything better than a good approximation of what was recorded in the disc. In addition, no two companies recorded with like equalization.

Not until standardization in the late 1930's was an attempt made to unify the problems of the great differences between recording curves. The NAB was one of the first to standardize with the transcription Playback standard of 1942. Early playback equalizers were also faced with the problem of shellac surface noise. The equalizer switch, for those of you not exposed to these turntables, had such markings as "flat", "worn", "old" and later the NAB position.

All of this added up to a period up to 1942 during which no definitive lines were drawn for the record companies on standard equalization; concurrently, equipment manufac-

turers were hobbled and ultimately the broadcaster was limited by the lack of what he could do in the way of supplying quality disc reproduction.

Types of Equalization

The development of the early equalization was rather a cut and try method as indicated but, until the post-World War II era, the designs were a combination of corner networks and "Pi" or "T" sections for low pass as in the case of 3500 Hz cut-off filters for scratch elimination. The impedance level was most frequently set at 150 or 600 Ohms and the output was fed into a mike input with appropriate level equalizing pads or into an intermediate gain input designed for playback level (See Figure 1).

The advent of inexpensive magnetic pickups at the end of the War made available excellent quality pickups for the home user in the newly emerging era of the LP and the embryonic hi-fi industry.

In order to make these pickups usable with the equipment in the home, an equalized pre-amp was made available which had its equalization limited to resistance and capacitance. There were no inductors since they were expensive and the cost to the home consumer would have been accordingly increased. Since adequate standards had been agreed upon, some of the guessing had been taken out of the equalizer design. High frequency roll off was provided by loading the cartridge so that the inductance and the loading resistor gave a corner frequency of something about 2000 Hz and the low-frequency lift was provided by a resist-

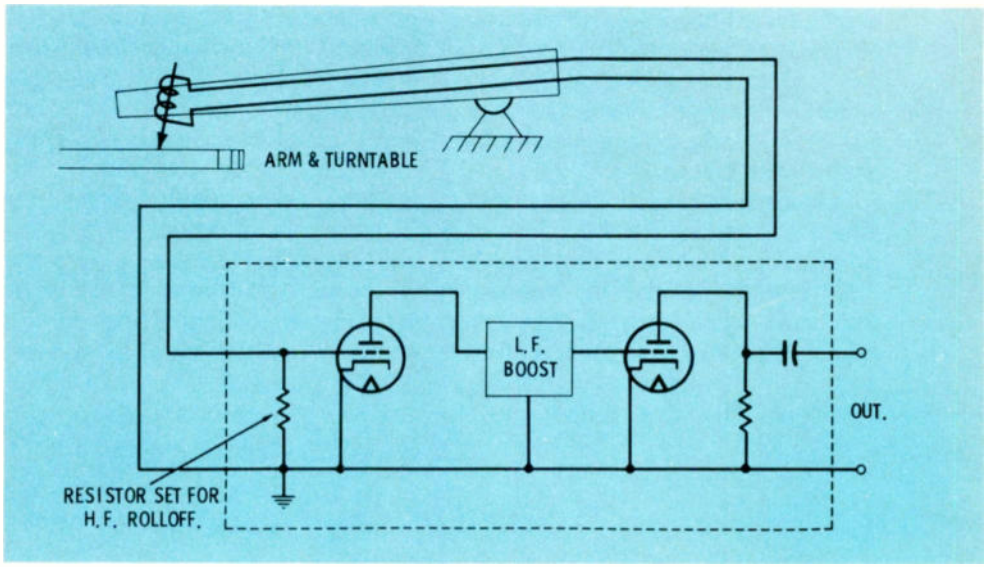

Fig. 2 Early magnetic phono preamp in use about 1947.

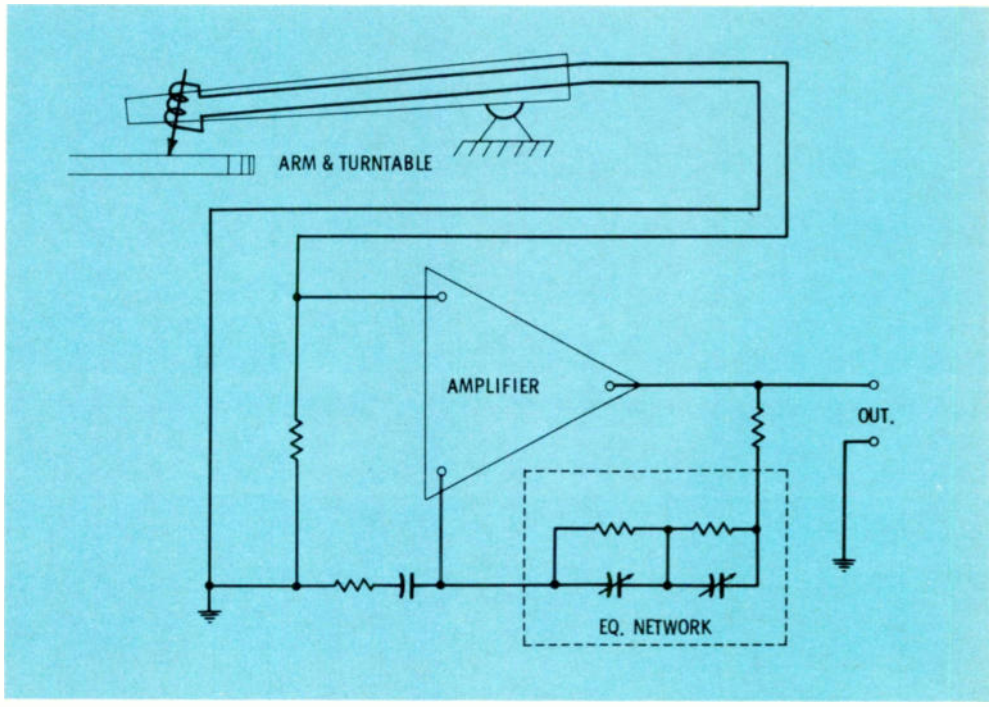

Fig. 3 Modern magnetic phono preamp.

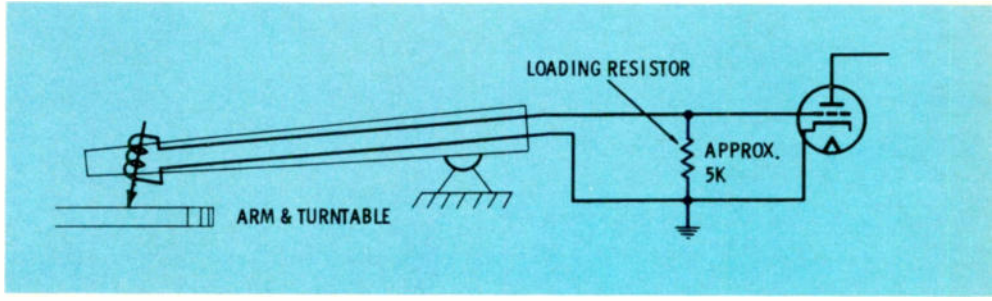

Fig. 4 This configuration is not applicable to most modern pickups for optimum performance.

ance-capacitance network. Additionally, the pre-amplifier increased the output to about ½ volt which was adequate to be used in the auxiliary inputs of the old reliable "parlour radio". This design offered relatively high performance; however, the broadcaster who tried it soon found its major problems: tube noise and lack of adequate reliability (See Figure 2).

Subsequent pre-amp designs went into the area of feedback to get rid of some of the noise problems of tubes and to stabilize the pre-amp with tube aging. It was then one simple step to include the equalization in the feedback loop of the amplifier so that the input was now loaded to terminate the cartridge. The standardized load was 47k ohms. It is significant that the phonograph pickup now had a standard of impedance into which it was to look. The agreed upon termination value was 47k ohms and a shunt capacitance of 275pF.

From 1939 to 1955, the tracking weight required went from 2 ounces, or 56 grams, to 5 grams and the upper frequency response of the pickups from 4 or 5 kHz to 20 kHz or better. These devices were available at nearly every corner parts house. Stylus replacement varied in these new pickups, but most of them had some sort of user stylus replacement feature (See Figure 3).

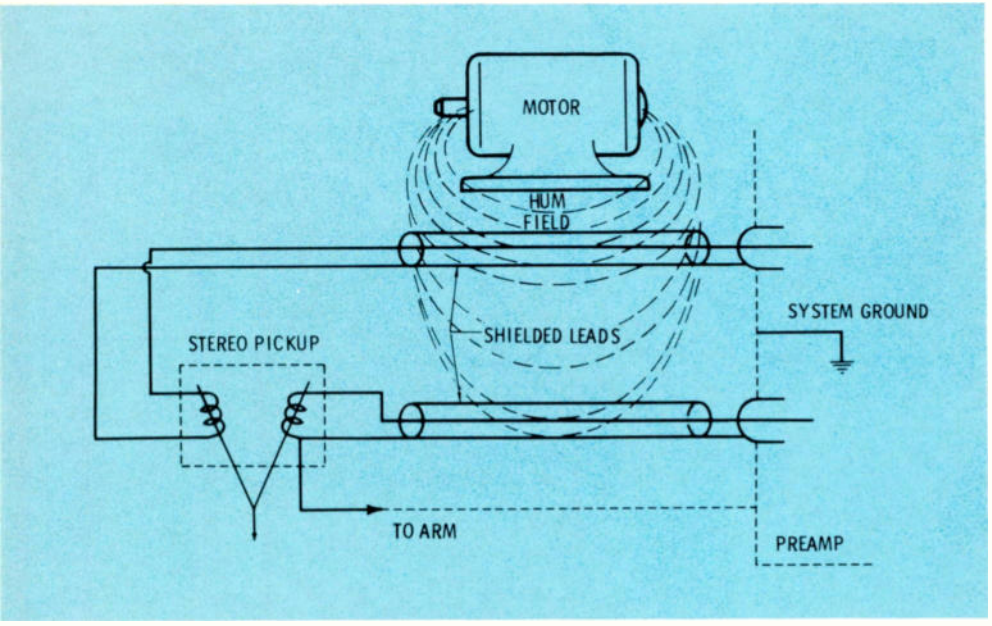

Fig. 5a Recommended grounding method.

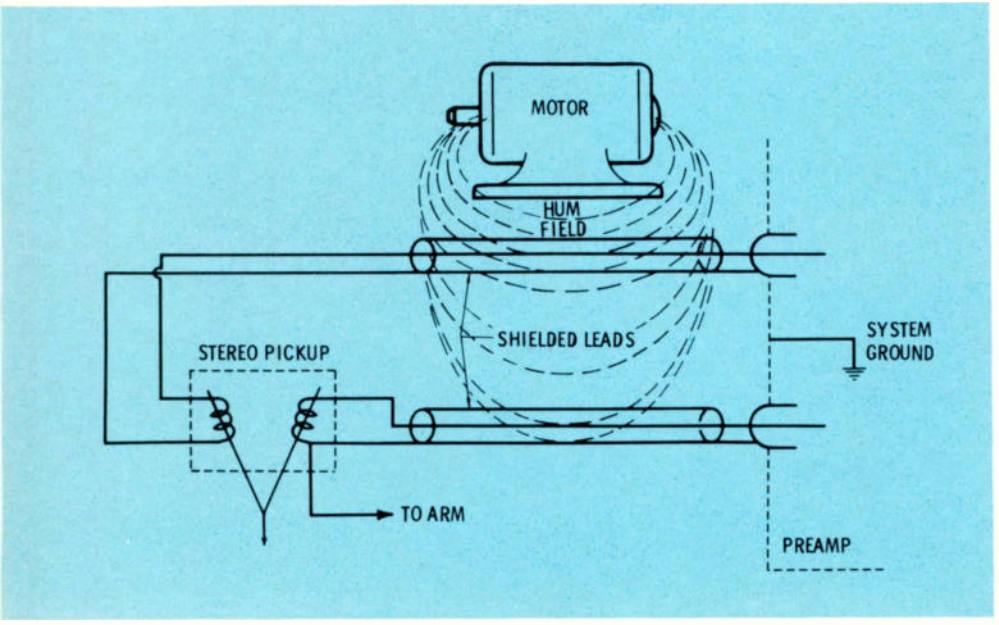

Fig. 5b Hum producing ground loops.

The Pro's and Con's

The early pickups offered a ruggedness that was in keeping with a tracking force requirement of 2 ounces. The armatures occasionally would be shifted off center but, in most cases, they could be field-repaired by a deft technician. The output was relatively high and the passive equalizers added little to the noise except in those cases where the inductors were set too close to hum fields. The performance was poor but really not any worse than most of the discs available at the time.

The active equalized pre-amp offered far better control over the response of the reproduction chain; however, it suffered the fault of adding tube noise. Transistors have taken the reliability problem out and have provided a low noise and accurately equalized system. Some of the equalizers even provide a trim control for trimming the high frequency roll off.

From a pickup manufacturer's point of view, there are several points which at this time perhaps need emphasis. Without the basic point of view of the transducer designer, it is our observation that less than the optimum result will be obtained.

It cannot be too strongly emphasized that modern high impedance cartridges are usually designed to be terminated in 47k ohms with a maximum shunt capacitance of 275pF. To use the cartridge inductance and low resistance load to achieve roll-off is no longer in keeping with the uniformity of performance of which the rest of the system is capable. Nor is it in keeping with the basic design concepts, especially in the area of stereophonic reproduction.

With a properly designed system, the tolerances of the NAB standard for disc reproduction are easily achieved terms of response. It is important that the equipment and system designer use the concept of 47k ohm loading and appropriate equalizer/pre-amp design if the optimum is to be achieved (See Figure 4).

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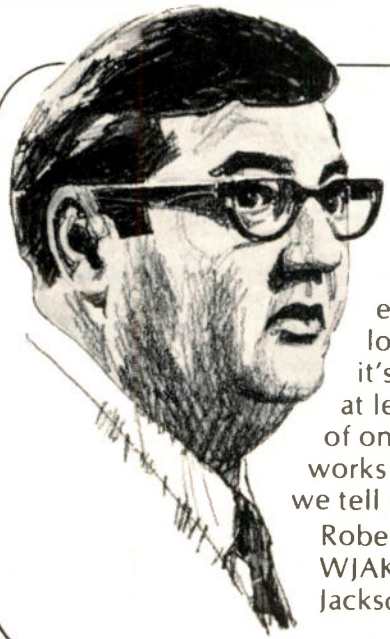

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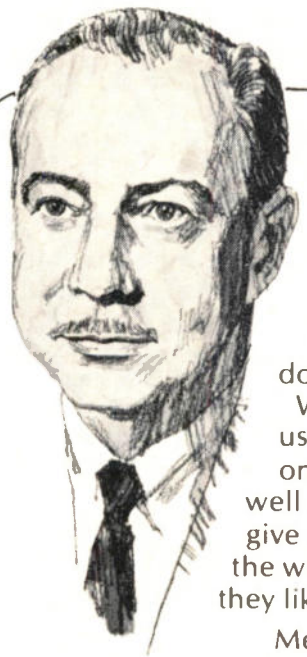

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Stereo Problems

The age of stereo has brought with it a new set of problems. The primary problem is one of ground loops. The use of two relatively low-signal level circuits from the pickup to the pre-amp not installed with the usual precautions of good ground loops and hum.

This is not a difficult problem to overcome if the usual practice of a single ground tie point is observed. The leads should be dressed to avoid any strong fields from motors or transformers. The grounding of the arm should be accomplished with a single positive lead to the head. The ground that relies upon continuity through the pickup arm bearings will inevitably have a problem since grease is generally a good insulator and the arm will tend to be intermittently grounded (See Figure 5).

Electrically, the method for tuning up a stereo system for broadcast use is well outlined in the 1963 NAB Standard. The requirements for frequency response are easily met with most modern systems and, for those who find they cannot meet the requirements, the solution will frequently be found in a new reproducer chain.

The broadcaster who is not meeting the standards runs the risk that the listener at home can frequently achieve better reproduction from his home disc reproducing system. Once discovered, I think that the tendency is to listen to good records than to the poor off-the-air broadcasts. The home units are frequently truly outstanding and at relatively modest investments so that the broadcaster is technically competing against the home unit. No longer is "broadcast quality" an undisputable hallmark.

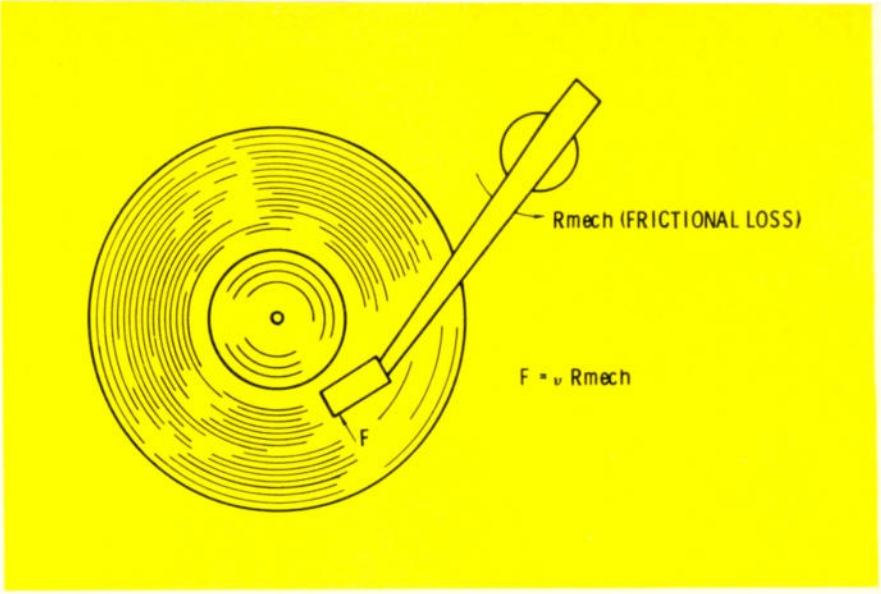

Fig. 7 Effective mechanical resistance.

Phonograph Arms

No critique of playback systems would be complete without mention of the arm in which the pickup is housed. Low tracking forces for the pickup have put new requirements on the arm. Since part of the force at which the arm is set is needed to keep the arm-pickup combination in the groove, the force required for things other than the pickup should be minimized.

In the case of heavy arms compared to light arms, relatively additional force is required to move the arm either as the groove proceeds to the center or to move the arm to and fro as in the case of an eccentric disc. In either event, massive arms are not desirable with modern low-tracking force pickups (See Figure 6).

Although the diagram indicates the force from the acceleration of the arm in the horizontal plane, measurements indicate the vertical force resulting from the vertical acceleration attributable to warped discs as being a greater problem than the eccentric disc. The lack of flatness of the disc surface is a fact of life and, as disc users, we simply have to minimize this problem.

In the same vein, the use of 16" arms leads to effectively increasing the dynamic mass which the stylus must move. A longer arm for the same unit weight will result in a higher effective dynamic mass, hence, again, this should be avoided where possible. The 12" arm is far more desirable for reasons of lower effective mass. Where this is not feasible, the user should not attempt to use low-tracking force pickups since this will frequently be less than an ideally mated setup.

Much has been done in the area of viscous damped arms and it must be recognized that the viscous damping force must be overcome by the force available at the stylus tip. Again, the low-tracking force styli cannot be utilized since this combination will result in insufficient force to override the viscous damping. For high performance, low-tracking force pickups, the viscous-damped arm is generally not suitable; on the other hand, the viscous-damped arm with a stylus at 6 to 8 grams might be a usable

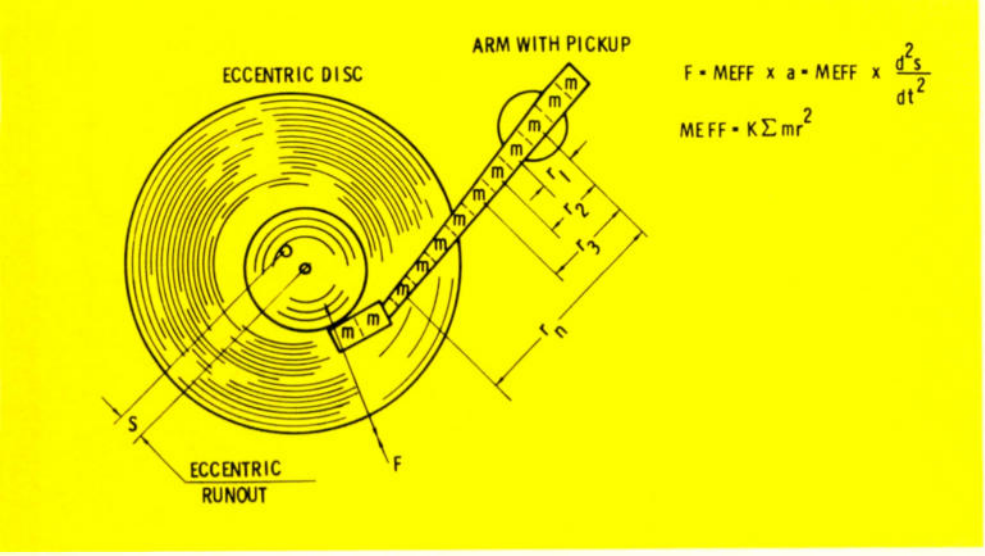

Fig. 6 Effective arm mass reactance.

combination in the studio dealing in the "Top 40" kind of format (See Figure 7).

In the stereophonic installation, frequently side thrust from viscous damping or high effective arm mass will give rise to the separation degeneration or distortion resulting from loss of groove wall contact.

In summary, the arm should be considered as contributing to the reliability and performance of a playback channel, stereophonic or monophonic. The best pickup chain can be reduced to poor quality by an arm not adapted to the job at hand. Broadly stated, the less force required to drive the arm the better.

RF Pickup And Interference Problems

The RF pickup problems in phonographic pickup systems generally divide into two classes: the pickup of RF voltage and subsequent rectification in the preamp input stage, and the direct rectification of the induced RF.

The rectifying characteristics of an oxided pin and clip are fairly well known; however, there are still many complaints from users which are easily cleaned up by the use of either mechanical brightening or chemical cleaning of the offending interface. The most desirable method of cleaning is, of course, to solder all junctions. This practice is not recommended in the case of the connections to the cartridge. The The broadcaster with a permanent installation may find the soldering of the remaining connections the best permanent solution to further maintenance. The elimination of an oxided joint in high potential RF fields is highly desirable.

Less easy is the elimination of AM RF interference from the preamp. Here the RF induced in the lead is of sufficient amplitude to be rectified generally at the input device. The transistor with its nonlinear characteristics and sharp clipping when the input bias is exceeded is somewhat more critical than the vacuum tube was. Generally, a small ceramic capacitor in parallel to the input fitting on the pre-amp chassis will correct the situation. If this does not clean up the problem, the addition of a small resistor in the order of 1 to 5K ohms in series with the input lead prior to the bypass should further attenuate the unwanted input signal. In the extreme case, the resistor can be replaced by an RF choke (See Figure 8).

Occasionally there are complaints of FM getting into the pre-amp. This means that the FM has somehow been converted to an AM signal. The leads from cartridge to pre-amp are suspect since they can form a quarter wave section. If you are lucky, the FM to AM conversion takes place across this high Q section and the signal at the input of the pre-amp is now AM. The solution is as above, although you may need to change the lead length to insure that no quarter wave lengths appear. In this kind of FM interference, the lead length is the main culprit since the resonant characteristic of the lead length acts as a FM to AM converter.

As in the case of induced hum, the use of good grounds cannot be overemphasized. Anyone who has had to struggle with low-level audio in RF fields is aware that no one solution is good for all situations; however, the practice of heavy station ground systems to reduce potential buildup is still the basis for at least a uniform ground. Beyond this, the individual situations must be worked out.

Life Expectancy

In the area of phonograph stylus wear much has been published in the way of data—some scientific, some folklore and some advertising.

The mechanisms of wear are no different from those of any classical system of abrasion. The factors are the coefficients of friction, the normal force available at the interfaces and the hardness of the materials. These are the primary parameters.

It is commonly believed that since diamond is the "hardest material known to man" that it is uniformly hard and will not be worn by a softer material. Neither idea is true. The fact is, there are certain diamonds which will wear better than others and the softer materials will abrade the diamond tip at a lesser rate than a harder material (compare vinyl discs to shellac).

As a practical problem, the storage of discs is best done to exclude dust and dirt which will increase the wear of both disc and stylus tip. Most modern discs are made of vinyl and produce a minimum of wear.

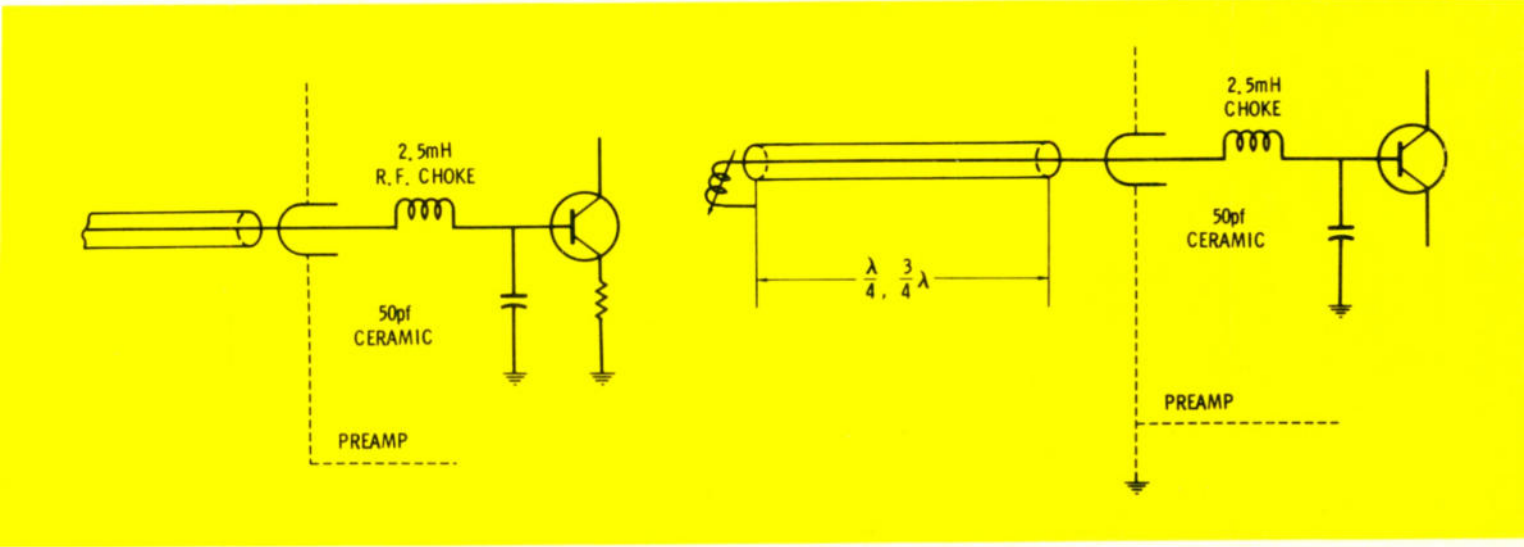

Fig. 8 Typical circuits for eliminating RF interference.

The tracking force on the stylus will increase the normal force, hence, the wear. While this statement sounds as if the tracking force should be reduced to an absolute minimum, the trade-off in reliable performance must be considered. Bearing friction and viscous damping will additionally add to the wear of the stylus tip. All of this then leads to the obvious question.

How long will the diamond stylus tip last? As in grounding, there is no pat answer. With a sufficient amount of abuse, a stylus can be destroyed in a few hours and, yet, with a sufficient amount of care, will last 500 to 1,000 hours. The best insurance is, of course, to keep a log or return the stylus for inspection to the manufacturer. Most manufacturers maintain a free factory service. The most of a replacement is far less than the potential cost of ruined discs.

One added word of caution—the care of modern styli does NOT include cleaning the assembly with any of the commercially available fluids. These cleaners and modern styli are NOT compatible and their use will lead to partial if not complete disintegration of the armature assembly. The best care is still a clean environment and, if there is a buildup on the stylus, it can be carefully removed with a gentle swabbing with a dry "cue tip".

Final Performance Expectations

With a modern playback system, the frequency response will be well within the requirements of the NAB Disc Playback Standard of 1963. The channel separation will most likely be beyond the measuring capability of the average user. With discs recorded at standard levels, the distortion contribution of the playback system will be negligible.

Hum and noise should be below —50 dB referenced to 5 cm/sec. lateral at 1 kHz. As a matter of fact, it is not infrequent that the tape noise from the master tape is discernible on the finished disc.

Periodic maintenance and replacement of the stylus will give long trouble-free reproduction of the discs available in the radio station and at a cost lower than that of earlier times with better than ever quality.

The necessity for a good disc playback setup is a pragmatic problem for the broadcaster. In earlier days the quality of home equipment was limited and the broadcaster had a virtual monopoly on good-quality playback systems. The growth of the hi-fi industry and general affluence have improved home equipment to where much of it performs at a level equal to a good broadcast setup. The receivers and speaker systems available in the home will oft times show up broadcast system limitations. The broadcaster today is literally competing with the home playback system for the attention of the listener.

The modernization and maintenance of the disc playback system is relatively inexpensive while the rewards in listener acceptance cannot be overemphasized. Conversely, the well-equipped listener with his state-of-the-arm receivers and loudspeaker systems can become an appreciative recipient of quality phonograph disc reproduction. ▲

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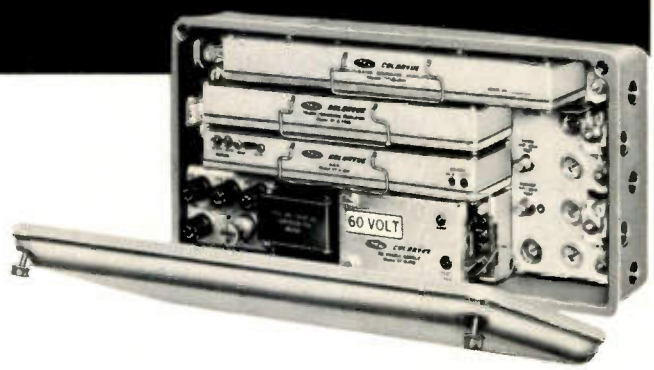

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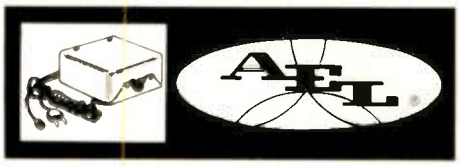

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Circle Number 19 on Reader Reply Card

Ready for an inspection?

By John H. Mullaney*

Broadcast stations are receiving more and more citations along with fines from the Commission because of technical and non-technical violations of its Rules. Many of the violations are due to simple carelessness of the station operators or engineers; others are due to station personnel not understanding the Rules.

Stations receive citations either as a result of an actual inspection, or at renewal time, the Commission in its analysis of the station's logs note the violations.

This article will present a Check List for station inspection which, if properly conducted by the station, should avoid the majority of the typical citations given by the Commission.

Those stations preparing for renewal should remember that the logs required for renewal for stations whose licenses expire in 1972 will be determined by the Commission picking seven days between September 1970 to July 1971. Therefore, one way to prepare for renewal is for each station to conscientiously strive to make sure its station complies with the following Check List.

This Check List is a helpful digest of FCC Rules (Part 73) of those applicable to AM and FM broadcast stations. It includes the primary items that an FCC inspector will check during a station inspection. Ordinarily an inspector will not measure the field intensity in accordance with 73.189 (b)(2) of the Rules for a non-directional operation; however when they do, the items shown in paragraph III (b) must be determined.

It will be noted from a study of the following questions concerning the Commission Rules that many are a so-called catch-all type, and they do not specifically call out what is asked for in the question. It should be understood that the question asked is assumed to come under the rule cited, or at least the Commission in the past has interpreted the Rule to cover the question.

The Rules should be kept up to date by each station. The simplest way to accomplish this is for a station to subscribe to the FCC Rule service provided by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C., 20402.

Technical questions should be checked by the station's chief engineer; whereas the non-technical items should be checked by the station manager or someone under his direction who is familiar with the subject matter.

*Consulting Engineer, Potomac, Md.

The best way to use this Check List is to take the station's copy of the Rules and read each section of the Rules shown to the right of the question asked. This technique will help you understand what is being checked, and probably help to give you a better understanding of the Commission Rules.

Although this check list is not complete, if you are able to pass the items listed, you have an excellent chance of passing a real FCC inspection.

Licenses and Authorizations

All licenses and authorizations should be posted conspicuously at one location. The licenses should be framed, and either hung above a bulletin board, or placed in some type of rack made for the frames. Telegraphic and letter notifications or authorizations should be placed on a bulletin board. In addition, the station's EBS and other instructions should be on this board. It is also suggested that any emergency instructions to operators be posted at the same location.

Technical Inspections

This section consists of thirteen parts. Some of the items will not pertain to your operation so use the symbol # within the brackets ( ) to mean, does not apply. Keep in mind that the check list is for either or both an AM and FM operation.

Maintenance logs, proof of performance data and other technical records of the station should be kept in file folders (properly fastened in) within a file case or cabinet readily available to the operator on duty. The station that keeps a neat set of files up to date seldom gets citations for failure to have required information available.

Inasmuch as the Commission requires that certain measurements be made within a definite period of time. It is recommended that the chief engineer take a calendar and mark off the dates when certain measurements must be made. If one of the stenos in the station also keeps a card or tickler file on the same items, it will act as a double check for the station so that they would not fail to make required measurements within the proper time limits.

It should be noted that the Commission inspector will cite a station that took its measurements as little as two days late, so it pays to have a way to keep track of due dates.

Many station engineers judge their antenna system for full efficiency by checking the ground system, base current, and operating efficiency of

This Sony is for the birds

...and for sporting events, location TV and motion picture sound track recording, and any other situation where you want to get crisp, clear, "close-up" sound from a distance.

Crisp and clear because the C-77 uses three condenser capsules for minimum distortion, smoothest frequency response, and unbeatable transient characteristics.

"Close-up" because the C-77 zeroes right in on the sound source, isolating the sound you want from surrounding noise. It's the most uniformly directional microphone on the market.

The Sony C-77 comes complete with windscreen, shock mount, and an ingenious pocket-size boost/monitor amplifier which lets you hear where you're aiming.

The C-77 is available at select Superscope Special Application Products dealers for just $495.00 including all required accessories. For the dealers' names, as well as complete details and specifications, please write: Special Application Products Division, Sony/Superscope, 8150 Vineland Avenue, Sun Valley, California 91352.

SONY SUPERSCOPE

the transmitter for changes. Although this indicates any changes that may have taken place, it really does not tell too much about the antenna's efficiency. The method outlined in list (b) of this Check List is another way of determining the antenna's efficiency.

Go through the following paragraphs carefully and you will find how your station would look to an FCC inspector.

Transmitter

	AM	FM
( ) Operating power correct.	73.52	73.267(b)
( ) Required meters working/accuracy OK.	73.58 73.39(f)	73.258 73.320(d)
( ) Meters incl. ant. base meter labeled.	73.39(i)	73.320(f)
( ) Meters have correct scale divisions.	73.39	73.320
( ) Normal readings in proper meter range.	73.39	73.320
( ) Operator can see meters and monitors OK.	73.93(a)	73.265(a)
( ) Interlock and safety provisions OK.	73.40(b)	73.317(b)
( ) Provision to adjust power output.	73.40(a)(8)	73.317(a)(8)
( ) Power change day to night OK.	73.40(a)(8)	.....
( ) Operators instructed or instructions posted.	73.93(b)	73.265(b)
( ) Operator's primary duties for transmitter.	73.93(d)	73.265(d)
( ) Satisfactory efficiency factor.	73.51(i)	.....
( ) Stereo generator can be turned off during mono.	.....	73.322

(b) Tower and Antenna System:

( ) Tower lights, photo/switch control.	17.24(a)(4)	to	17.34(a)(4)
( ) Stock of spare bulbs.	17.41		
( ) Correct orange and white bands on tower.	17.23		
( ) Base fence in good condition.	73.40(b)(3)(iv)		
( ) Tuning house secure-key with operator on duty.	73.40(b)(3)(iv)		
( ) Tower paint clean and in good condition.	17.39		
( ) Remote antenna current agree 2% of base meter.	73.39(d)(2)		
( ) Radials buried and in good condition.	73.189(b)(4)(5)		
( ) Antenna and transmission line not hazardous.	73.40(b)(3)(v)		
( ) Satisfactory field intensity @ 1 mile.	73.189(b)(2)		

Determined as follows:

1. Field intensity measured at..mile/s. ____mv/m
2. Antenna radiation taken from FCC charts or computed tower height. ____mv/m
3. Conductivity taken from M-3 map (or other source_____). ____mmho/m
4. Ground attenuation factor from section 1. (Rules) 73.184, Graph No.____ _____
5. Factor for power of station ( ). _____
6. Expected field intensity computed. ____mv/m
7. Variation in percentage between measured value and computed value. _____%

(c) Station Monitors:

	AM	FM
( ) Frequency monitor installed and working.	73.60(a)	73.252(a)
( ) Modulation monitor installed and working.	73.56(a)	73.253
( ) Peak light calibrated and flashing OK.	73.56(a)	73.253
( ) Carrier level set reading OK.	73.56(a)	73.253
( ) Maintaining 85 but not over 100% modulation (negative).	73.55	73.268
( ) Frequency within tolerance.	73.59	73.269
( ) Satisfactory alternate means for defective mon.	SEE MONITOR RULES	

(d) Directional Antenna Systems:

	AM
( ) F.I. measurements made if required by license.	TERMS OF LICENSE
( ) F.I. Meter available and working if required.	TERMS OF LICENSE
( ) Phase angle agree with license terms.	TERMS OF LICENSE
( ) Field at monitor points agree with license.	TERMS OF LICENSE
( ) Base current ratio agree to 5% of license values.	73.52(b)
( ) Loop meters have calibration chart or scales.	73.39(d)(1)(vi)
( ) Monitor points satisfactory location/described.	TERMS OF LICENSE
( ) Directional points satisfactory.	TERMS OF LICENSE
( ) Sample loop meters calibrated against graph plot.	73.39(d)(1)(vi)

(e) Notice to be Filed with Engineer in Charge:

	AM	FM
( ) Permanent discontinuance of operation.	73.91	73.271
( ) Equipment test notice.	73.95(a)	73.216(a)
( ) Program test advance notice.	73.96(a)	73.217(a)
( ) FM stereo schedule/changes.	.....	73.297
( ) Defective meters.	73.58(b)(2)	73.258(b)(2)
( ) Defective modulation monitor notice.	73.56(b)(2)	73.253(b)(2)
( ) Defective frequency meter.	73.60(b)(2)	73.252(b)(2)
( ) Reduced power.	73.52(a)	73.267(c)

(f) Equipment Performance Measurements and Station Records:

	AM	FM
( ) Measurements available for inspect.	73.47(b)	73.254(c)
( ) Measurements records maintained for two years.	73.47(a)	73.254(c)
( ) Measurements made yearly or 4 months prior to renewal.	73.47(a)	73.254(b)
( ) Description of equipment and methods and signature, date of engineer making measurements.	73.47(b)	73.254(c)
( ) Measurements made through studio equipment.	.....	73.254(b)

(g) AM Station Equipment Performance Records:

	AM	FM
( ) ( ) Data and curves of AF response 50 to 7,500 CPS at 25, 50, 85 and 100 (if possible) percent modulation.	73.47(a)(1)	
( ) ( ) Data and curves harmonic distortion 50 to 7,500 cycles, 25, 50, 85 and 100% modulation.	73.47(a)(2)	
( ) ( ) Data showing carrier shift for 25, 50, 85 and 100% modulation using 400 CPS tone.	73.47(a)(3)	
( ) ( ) Noise and hum below 100% Mod. overall or by bands.	73.47(a)(4)	
( ) ( ) Check for harmonic and spurious emissions.	73.47(a)(5)	
( ) ( ) Equipment performance meets AM standards.	73.40(a) all	

(h) FM Station Equipment Performance and Records:

	FM
( ) ( ) Records of 25, 50 and 100% Mod. 50 to 50 to 15,000 CPS.	73.254(b)(1)
( ) ( ) Distortion at 25, 50 and 100% Mod. 50 to 5,000 CPS and 100% Mod. at 10,000 and 15.000 CPS.	73.254(b)(2)
( ) ( ) Noise level below 100% FM Modulation (FM Noise).	73.254(b)(3)
( ) ( ) AM noise in dB below 100% AM modulation.	73.254(b)(4)
( ) ( ) Equipment performance meets FM transmitter standards.	73.317
( ) ( ) Manual showing transmitter efficiency for all powers.	73.267(a)(3)
( ) ( ) Equipment meets FM standards.	73.317(a)

(i) Maintenance Log:

	AM	FM
( ) Weekly reading of base-remote antenna meter/corrections.	73.114(a)(1)(i)	.....
( ) Time and result of auxiliary transmitter tests.	73.114(a)(1)(ii)	73.284(a)(1)
( ) External frequency checks with		

correlation and adjustments.	73.114(a)(2)(iii)	73.284(a)(2)
( ) Calibration of auto log equipment and adjustments.	73.114(a)(1)(iv)	73.284(a)(3)
( ) Entry for removal/defective meters or monitors.	73.114(b)	73.284(a)(4)
( ) Daily tower lighting check and results.	73.114(a)(3)	73.284(a)(5)
( ) Quarterly tower lighting inspections (17.49(d).	73.114(a)(3)	73.284(a)(5)
( ) Transmitter inspections/results/ signatures.	73.114(b)	73.284(a)(7)
( ) Weekly field monitor intensity measurements terms.	73.114(a)(5)	.....
( ) Experimental period operations described.	73.114(a)(4)	73.284(a)(6)
( ) Details of repairs.	73.114(b)	73.284(b)
( ) Daily base current reading for directional.	73.114(a)(5)	.....
( ) Time devoted to daily inspection.	73.114(b)	73.284(b)
( ) Auxiliary transmitter test on main antenna midnight—9:00 A.M.	73.63(d)	.....
( ) Auxiliary transmitter test on main antenna Midnight—6:00 A.M.	.....	73.255(d)

(j) **Emergency Broadcasting System:**	**AM**	**FM**
( ) Required receiver installed and working/exempt.	73.933	73.933
( ) Facilities to make alert transmission.	73.932	73.932

(k) **Remote Control:**	**AM**	**FM**
( ) Positive on-off and fail safe circuit OK.	73.67(a)(2)	73.275(a)(2)
( ) Transmitter securely housed.	73.67(a)(1)	73.275(a)(1)
( ) Remote meters have true calibration or charts.	73.67(a)(4)	73.275(a)(4)
( ) Provision for remote tower light check.	73.67(a)(4)	73.275(a)(4)
( ) Weekly calibration of remote antenna current.	73.39(d)(1)(vii)	.....
( ) E.B.S. Alert can be made at remote location.	73.67(c)	73.275(c)
( ) Modulation being monitored at remote location.	73.67(a)(4)	73.275(a)(4)
( ) Modulation and frequency monitors calibrated.	73.67(a)(4)	73.275(a)(4)
( ) Power can be adjusted up and down.	73.67(a)(4)	73.275(a)(4)
( ) Daily phase, base, common point and loop current for each pattern.	73.67(a)(6)	.....
( ) Stereo can be turned off for Mono programs.	.....	73.275(a)(4) 73.322
( ) Remote control operation terminated when required.	73.67(a)(3)	73.275(a)(3)
( ) Remote meters have correct scales and ranges.	73.39	73.320
( ) Direct remote ant. meter dial or calibration curve.	73.39(d)(1)(vii)	.....

(l) **Operating Logs:**	**AM**	**FM**
( ) Operators signing logs at start and end of duty.	73.111(a)	73.281(a)
( ) Logs legible and orderly with data available.	73.111(b)	73.281(b)
( ) Corrections made properly.	73.111(c)	.....
( ) RF to antenna start and end time.	73.113(a)(1)	73.283(a)(1)
( ) Duration and cause of interruptions/signature.	73.113(a)(2)	73.283(a)(2)
( ) 30-minute meter and monitor readings before ADJ.	73.113(a)(3)	73.283(a)(3)
( ) Notation of adjustments.	73.113(a)(3)	73.283(a)(3)
( ) Daily base current meter reading if required.	73.113(a)(4)	.....
( ) Antenna current read without modulation effects.	73.113(a)(3)(ii)	.....
( ) Hourly phase meter and sample loop currents.	TERMS OF LICENSE	
( ) Pages numbered and dated—A.M., P.M. marked.	73.111(b)	73.281(b)

(m) **Miscellaneous:**	**AM**	**FM**
( ) 5 days/week transmitter inspections.	73.114(5)	73.284(g)
( ) Excessive spurious or harmonic radiations.	73.40(a)(12) (13)(14)	73.317(a)
( ) TVI, FM harmonic/spurious.	.....	73.317(f)(2)
( ) Standards of good engineering practice.	73.46(a)	

NON-TECHNICAL INSPECTION

(a) **Availability of Required Logs, Reports and Records:**	**AM**	**FM**
( ) Program, operating and maintenance logs available.	73.116(a)	73.286(a)
( ) Equipment performance available—2 years.	73.116(b)	73.286(b)
( ) Most recent antenna/common point impedance data.	73.116(c)	.....
( ) Most recent FI measurements for DA proof.	73.116(d)	.....
( ) FM transmitter efficiency factor in manual.	.....	73.267(a)(3)
( ) FM circuit diagram at transmitter.	.....	73.37(e)
( ) List of sponsoring corporation officers or committees (other than commercial).	73.119(f)	73.289(f)
( ) Political file available with required data.	73.120(d)	73.290(d)
( ) Logs and records maintained for two years.	73.115	73.285
( ) Agreements for part time 1st class operator.	73.93(c)	73.265(c)

(b) **Program Logs:**	**AM**	**FM**
( ) Pages numbered and dated—A.M. and P.M. marked.	73.111(b)	73.281(b)
( ) Operators signing logs at start and end of duty.	73.111(a)	73.281(a)
( ) Logs legible and orderly with data available.	73.111(b)	73.281(b)
( ) Corrections properly made—no obliterations.	73.111(c)	73.281(c)
( ) Station ID times shown.	73.112(a)(1)	73.282(a)(1)
( ) Program name, sponsor, and description shown.	73.112(a)(2)	73.282(a)(2)
( ) Program start and ending times shown.	73.112(a)(2)	
( ) Entry showing sponsor was announced/identified.	73.112(a)(3)	73.282(a)(3)
( ) Recording or transcriptions identified as such/time (see also 73.118).	73.112(a)(2)	73.282(a)(2)
( ) Political affiliation for political programs/talks.	73.112(a)(2)	73.282(a)(2)
( ) Network of origin for net programs.	73.112(a)(4)	73282(a)(4)
( ) Key to abbreviations contained in log.	73.111(b)	73.281(b)

(c) **Other Operating and Program Requirements:**	**AM**	**FM**
( ) Required station identification.	73.117	73.287
( ) Sponsors identified on air.	73.119	73.287
( ) Identification of recordings if required.	73.118	73.288
( ) Lottery results or advertising.	73.122(b)	73.292(b)
( ) FM-SCA rules and operations.	.....	73.293-73.29

....
Technical Inspection by Date

....
Non-Technical Inspection by Date

A Check List has been presented which, if used by a station, could help prevent Commission citations for violations of its Rules. The Check List is not complete to the last detail, but it does cover the majority of items an FCC inspector, or the Commission staff will use in analyzing your station's operation.

Are you ready for an FCC Inspection? Try the Check List and see. ▲

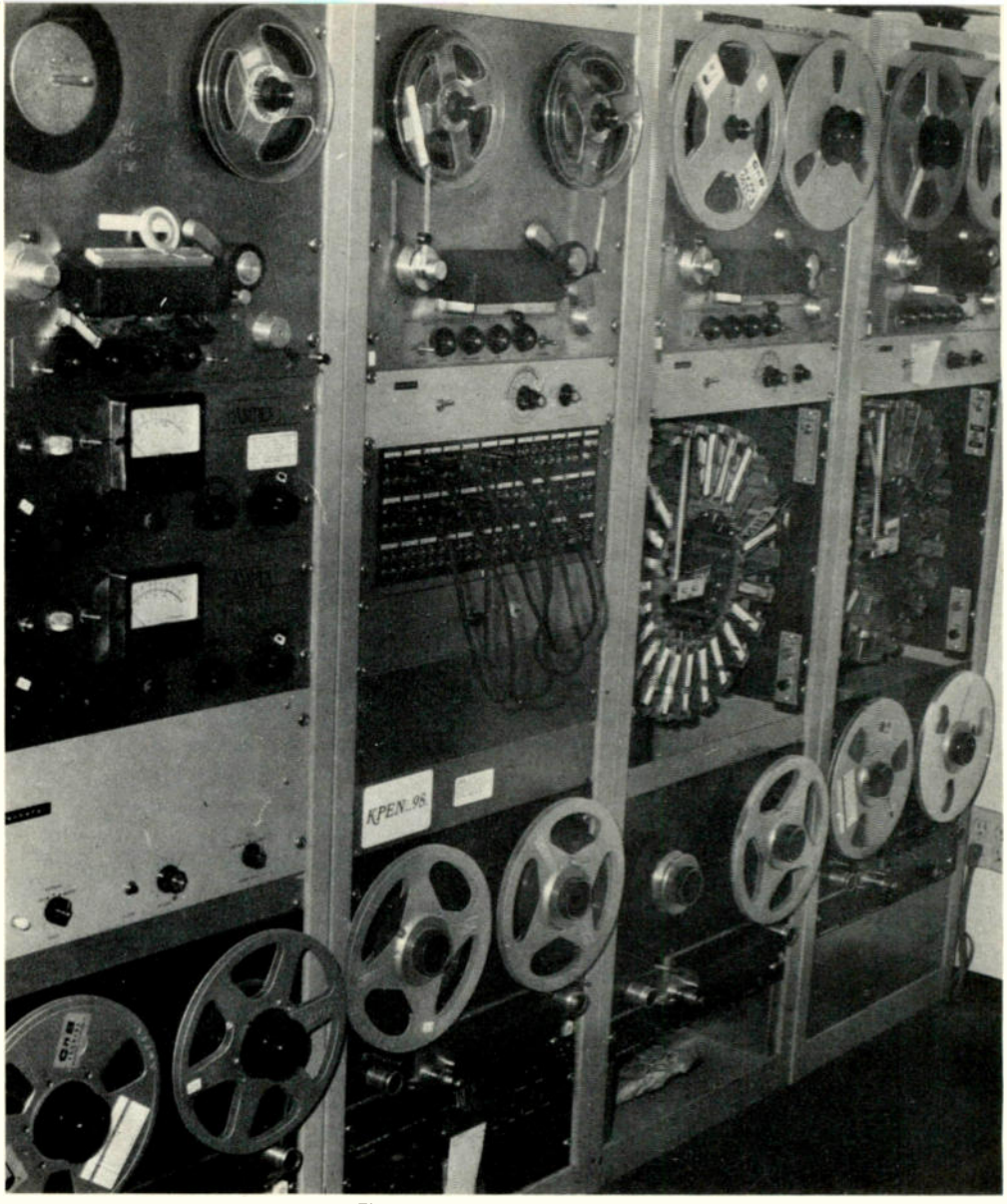


Fig. 1 The heart of KPEN's automation system is a Schafer 800.

Automation:
A give and take operation

By Morris Courtright*

Highest quality audio and flawless automation were two design goals of stereo FM station KPEN in Mountain View, California. A few hours of listening and a chat with general manager Lawrence Gahagan confirms that these goals have been met to provide one of the cleanest signals on the lower San Francisco peninsula. Everything in the technical facility has been brought up to state-of-the-art standards to assure high audio quality, and a Schafer 800 program automation system (See Figure 1) executes the format instructions for a smooth on-air program. KPEN is a station truly designed for automation and an excellent example of the quality that can be obtained with automation.

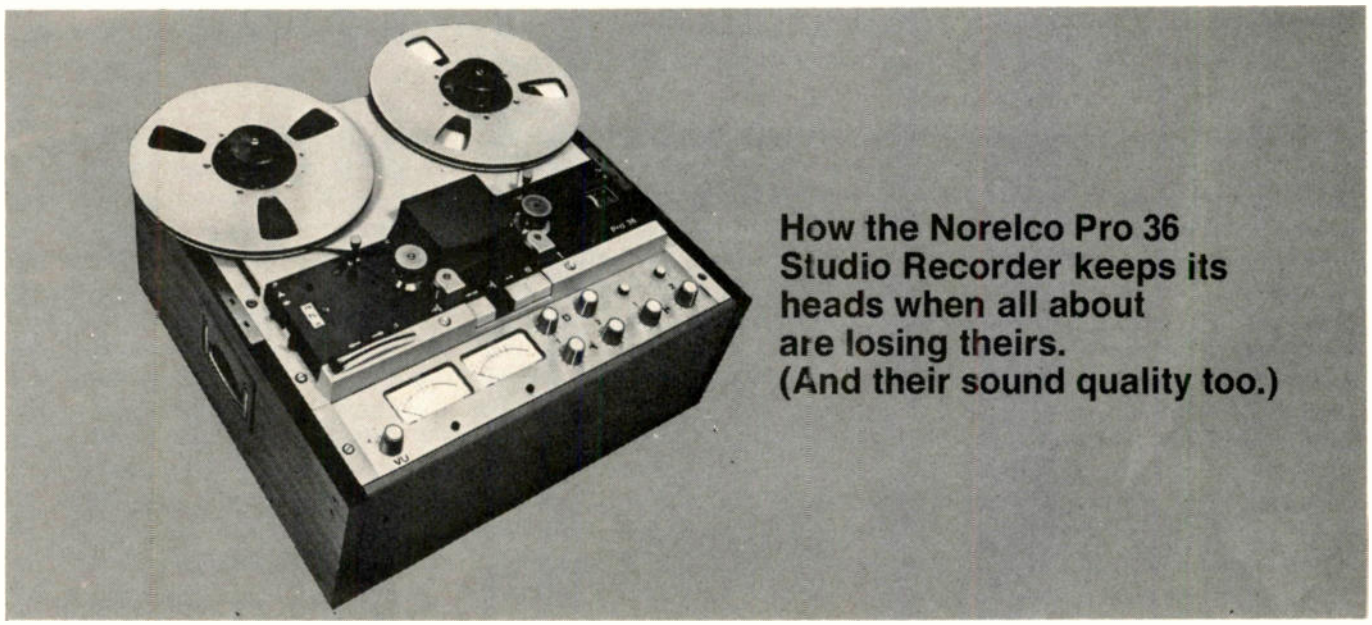
Nerve center of the Schafer system is the control unit which automatically brings up the music transports, audio clock and cartridge machines to assemble the desired program (See Figure 2). The format may be changed without affecting the on-air program, and varying the number of musical selections in the sequence assures station break and commercial play without pre-timing all material.

All standard tape transport, stereo or monaural, may be used, but they must be modified to include a time delay for deadroll to bypass any switching noise picked up during recording. A 25 Hz cue is used for the beginning of the tone pre-starting the next event and the end of the tone switching off the current selection. With four music transports, the system may run unattended for six hours or longer. The actual number of units used in a particular station installation depends on the length of unattended time and variety of programming desired.

Two tape transports, one with even minute signals and one with odd, comprise the audio clock. The transports advance to the next increment at 30 seconds past the minute so the correct time signal is always cued and ready for play. The use of bi-directional transports provides a perpetual clock.

*BE Automation Editor and consulting Engineer.

Announcing the recorder with 10 times normal head life.



Conventional recording and playback heads wear out within a couple of thousand hours of use. But long before then, their electrical characteristics change . . . so your sound changes too. With the Pro 36 studio tape recorder, these problems are non-existent.

Reason: Norelco's exclusive glass-bonded Ferroxcube heads. Made of material almost diamond-hard, they take 10 times the wear of conventional heads. But that's not all. The unique glass-bonded construction maintains precise gap width and electrical characteristics in spite of wear. Amplifier adjustments are virtually never needed. And precision head mounting also makes azimuth adjustment a thing of the past.

The rest of the Pro 36 lives up to the heads. It's the only professional tape recorder with 3 speeds. You get 15, 7½ and 3¾ IPS. Electronically switchable.

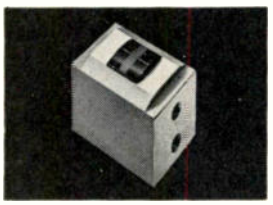
Then there's the new ultra-stable Servo tape transport control. A photocell counts capstan revolutions, compares them to line frequency, (or external 1 volt reference source) and provides instantaneous speed-correction signals. To this, Norelco adds constant capstan loading. Plus automatic tape tension control. All together, they hold wow and flutter down to 0.04% maximum.

Other features: total remote control, push-button semiconductor switching, NAB and CCIR equalization, provision for fourth head, controlled tape lifters, horizontal or vertical operation, and much more.

Every broadcast studio, production studio, and sound studio deserves the tape recorder that keeps its head... so you won't lose yours. The Pro 36! Contact Norelco for all the technical data now.

PERFORMANCE SPECIFICATIONS

Wow and Flutter:
weighted peak value at 15 in/s: max. 0.04%
Overall Frequency Response (NAB Specs):
at 15 in/s: 30 . . . 15,000 Hz ±2 dB
at 7½ in/s: 30 . . . 15,000 Hz ±2 dB
at 3¾ in/s: 50 . . . 10,000 Hz±2 dB
Signal-to-Noise Ratio: NAB unweighted (reference standard operating level)
62 dB at 15 in/s
60 dB at 7½ in/s
56 dB at 3¾ in/s



Glass-bonded Ferroxcube heads make possible an incredibly precise gap width and hold that precision throughout a wear life 10 times longer than conventional heads. The Pro 36 is the only studio tape recorder that has them.

Norelco®
PHILIPS BROADCAST EQUIPMENT CORP.
A NORTH AMERICAN PHILIPS COMPANY

One Philips Parkway, Montvale, N.J. 07645 (201) 391-1000

Circle Number 21 on Reader Reply Card

Equipment Interface

Carousel and single cartridge machines may be configured randomly, and the sequence established will repeat itself when the last event is reached. A random access spot locator transport and network switcher may be used with the Schafer. A production unit is used to prepare material for play and a low speed tape logger satisfies the program logging requirement.

Music for KPEN is transferred from virgin discs to low-noise tape using Metron turntables equipped with Shure SME arms and Shure V-15II cartridges. The tapes are recorded on a custom modified Ampex 351-2 to provide program segments for play on the Schafer 800.

The audio control console was custom built by Orban Associates and offers a number of advanced features in spite of its small size. Among them are eight stereo inputs, dual 50 watt monitor amplifiers, an automatic gain control cueing amplifier, and full stereo program and audition channels. Using the integrated circuit active operation amplifier combining network technique of mixing, circuitry is simplfied and noise held to an absolute minimum. Distortion in the program crcuits is typically below 0.15 percent.

The stereo signal is generated by a Collins 830 series solid state FM exciter/stereo generator combination, boosted to 3000 watts by a General Electric RF amplifier and fed to a Jampro circularly polarized antenna. Signal quality is protected by a custom built overload prevention system using field effect transistors, integrated circuits and other solid state devices. Loud peaks are controlled with low perceived distortion and steady state distortion is less than 0.2 percent. In addition to the normal complement of monitoring equipment, an oscilloscope is used to monitor the signal so malfunctions may be quickly identified and corrected. The latest addition is electrostatic headphones, which must be tried to be believed.

It is apparent this station has exerted considerable effort to insure that all possible sources are held well below the 0.5 percent level of the exciter. An operating technique aimed at listening pleasure is the compression of popular music dynamic range for an environment of constant melody, but no compression of classical music so that serious listeners may enjoy the full dynamic range of the music.

Originally on the air 18 hours per day with 12 automated, KPEN now operates 24 hours with 12 automated. The reason for not increasing the automated time is indicative of the rather strange situations that can occur with automation. The increased programming consists of classical music. Since classical music is aired with its full dynamic range, long quiet, or even silent, passages occur. The automation silence sensor has a nasty habit of interpreting these passages as audio missing, causing the next event to occur. Most disconcerting for concert fans.

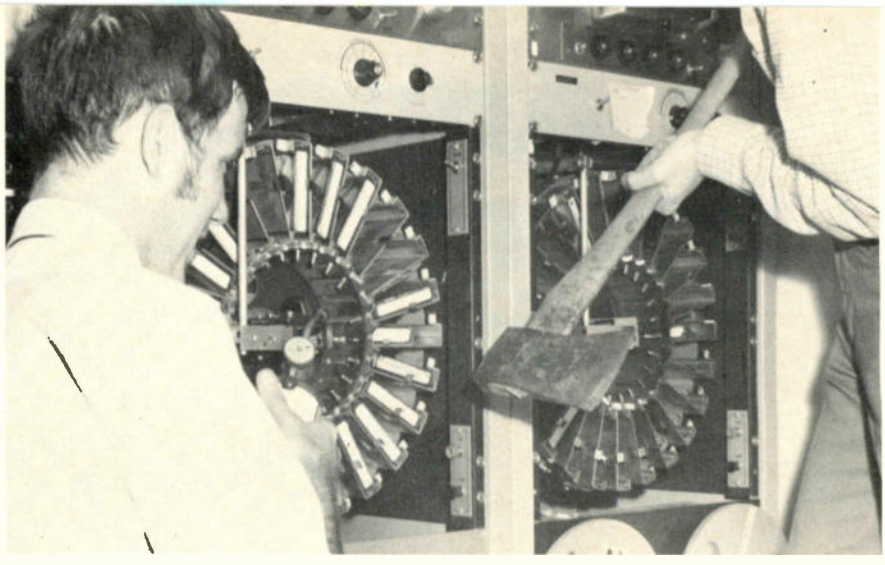


Fig. 3 Automation can allow the technical staff more time for being creative and to make certain FCC citations and fines are eliminated. This engineering response to a cart jam is more a dream than a reality.

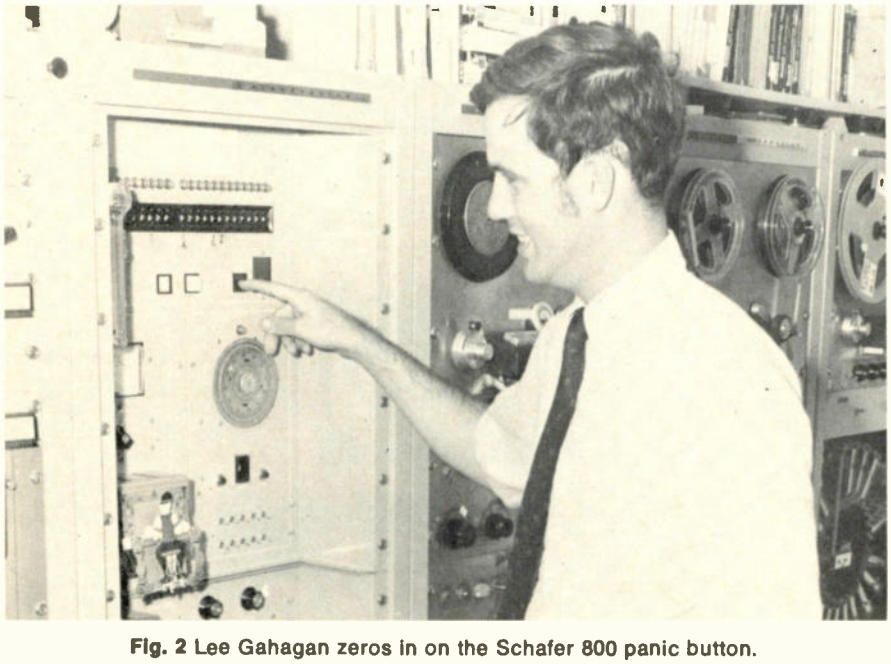


Fig. 2 Lee Gahagan zeros in on the Schafer 800 panic button.

Doing More With Less

Gahagan says a prime benefit of the automation system has been the ability to do more without adding people to the staff. As a matter of fact only two fulltime announcers are employed, and with these working pretty much at their own time and pace a consistent sound is maintained throughout the program day.

Before howls of anguish rise from my engineering brethren, let me interject that this kind of operation is possible only with a first rate engineering department to assure that

all does operate flawlessly. KPEN has such a department, and freed of routine air duties they, too, enjoy the luxury of flexible working hours.

About 2½ hours of prime time ensued while taking pictures of the station for this article, involving the entire on-duty staff. In many stations this would have been impossible because of the disruption to programming. With automation, however, programming smoothly continued throughout as if nothing was going on. Proof that the station staff is indeed free to do more creative, imaginative work than riding gain, cueing records, switching turntables, and so on. If tapes from a music service are used, such tasks may never occur in the station. Staggering thought, not even a record library.

KPEN records their own tapes, so they do have records and recording sessions. The major difference being that the announcer is not under pressure to cue up, compile news and answer the phone simultaneously with no dead air. He can record at a more relaxed pace, do so at a convenient time, and his efforts are not gone forever since the tape can be used over. How else can the regular staff fill in for themselves while on vacation?

Operating Problems

As to be expected, all is not really sweetness and light with automation. A prime requisite is a good engineering staff (See Figure 3). When the equipment performs, it's great. But, if the system should hang up, it's panic. Quality maintenance will minimize the problem, and haphazard practices will lead to disaster. Operating problems such as the classical music/silence sensor one will crop up, but are not insurmountable. On some equipment a "pop" is recorded on the tape when bias current is applied to the record head and "clicks" occur during switching. This can be countered by deadrolling all tapes a few seconds to bypass the noise or by using solid state switching. The system can do this automatically. Minor problems? Yes, they really are when weighed against the benefits.

Not so minor though is format flexibility. After long, happy experience with the system, KPEN elected to make a slight change to their news format. Rather than blocks of news at fixed intervals, short single stories were to be aired throughout the day. Simple change, but difficult to accomplish because the on-air format is directly related to equipment capability. An interim solution meant using an expensive tape transport for ID's and promos rather than music. The final solution is addition of another cartridge unit. The only answer to such problems is to be sure the equipment selected suits the desired format, limit format changes to what the installed equipment can do, or be prepared to spend money to change to systems to handle new formats. Major problem? Not really, unless your station is one that continually changes format. Again, the benefits can outweigh the problems.

Editor's note: The array of equipment used at KPEN is in no way suggested as the only choice or positively the best individual choices. Each station must work within its budget and around its format. Neither should one conclude that every station needs to be fully automated. ▲

Snowmobile Racing

A new look for winter remotes

Fig. 1 The WELF snowmobile and "ski-boose" ready for remote origination on the ice.

A new winter sport that offers northern broadcasters a means for spurring listener and sponsor interest through remote coverage. By Robert A. Jones and Bruce Micek*

Radio today is a versatile, mobile medium. To succeed in it one must go where the action is. Here in the great North Woods area, this means snowmobiling in the winter time. WELF was the first radio station to construct and to operate a snowmobile remote pickup unit. This article deals with some of the problems and solutions to such an operation.

Before the invention of the snowmobile, and before driving them became such a booming winter time activity, the winter time was a gloomy time; a time of hibernation. Most radio stations were gloomy with decreased sales and activities. But since that time, there has beeen a never ending growth in winter time activities, connected mostly with and/or around the snowmobile and snowmobiling. Many of the summer resort owners now realize a two-season year. They now look forward to extra winter time financial rewards.

In Tomahawk, Wisconsin we have learned that 85 percent of the people own one or more snowmobiles. By contrast, in this same community less than 50 percent own more than one car. We think this exemplifies the great enthusiasum for this new sport, making it a target for radio coverage.

The Problem

Once we recognized the need for covering snowmobile sport activities, we were faced with the problem of how to pull it off. Some stations have, in the past, used announcer booths and, in effect, covered these events much in the manner you would cover a local high school football game. But today the station manager and engineer should recognize that radio is much more portable than TV. And once recognizing this fact, he should adapt his broadcast equipment to fit this aspect of portability.

In our case, we believed this could be accomplished by broadcasting directly from a snowmobile in motion. In fact one of our first live broadcasts featured a quarter-mile drag race, with the WELF announcer participating as one of the dragsters. Try this little stunt if you like a challenge.

The various types of other activities we plan to cover will include not only snowmobile drag races, but USSA sanctioned oval races and other competitive events. In addition, we plan to broadcast a weekly Trail Ride in the Tomahawk area. It goes without saying that a snowmobile can also be used in news reports where the scene can not be reached by normal means.

As you can see, a challenging solution is to install and to operate directly from a snowmobile.

Electrical Mechanical Problems

There are usually two separate problems with any new piece of equipment or program. We found that they were interlocked and that one solution depended upon the other. In some ways we had to deal with the same kind of problems faced by the Apollo spaceship engineers. Basically we had problems of size, weight, balance, useful life, and of course, protection against cold weather.

Our first need was to select a remote pickup transmitter having reasonable efficiency and range. In the case of WELF, we already owned a Marti unit. This piece of equipment weighs about 30 pounds and has a proven record of reliability. Physically it is the same width as the seat on our snowmobile. In addition it can be operated on either 110 VAC or 12-14 VDC. This was good, we thought, since

*Robert Jones is the GE Facilities editor and consulting engineer, LaGrange, Ill.

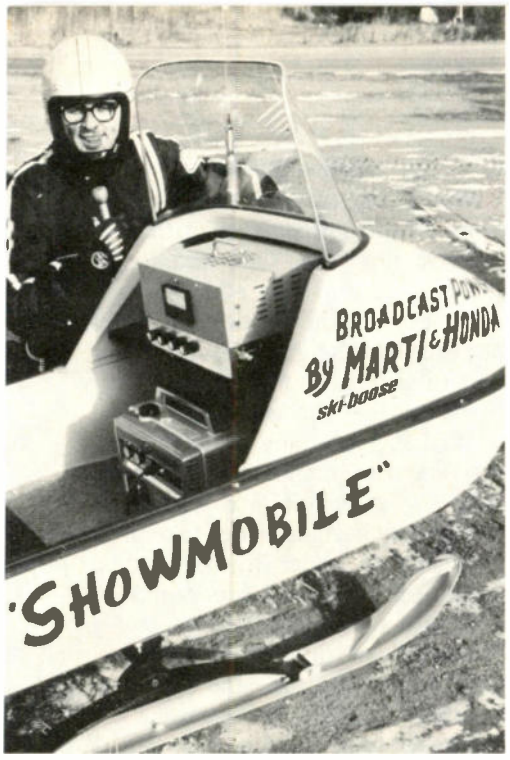


Fig. 2 The "showmobile" sled closeup shows that even with the equipment aboard there is plenty of room for a rider.

our Ski-Doo had a 12 VDC electric system.

Our plan was to install the Marti unit inside the snowmobile's rear back-rest, for protection against the weather, and to allow access to the snowmobile battery. We quickly discovered that the battery was too light to power the Marti for more than a few minutes of broadcast time. To correct this we installed a larger heavy duty battery and to keep it charged. Unfortunately, this did not work. First, it was not possible to find a large enough alternator that we could gear down to match the high RPM of the snowmobile two-cycle engine. And second, the weight of a heavy duty battery, which mounts in the rear seat back-rest was excessive.

Our second approach was to install a gasoline powered electric generator to supply power for the Marti unit. After studying the various types available, we selected a Honda model E300. This unit is small, (as shown in Figure 3), is weather proof and weighs only 35 pounds. We might point out here that it is very important to protect the equipment against low temperatures and against snow getting into the housings.

Our plan was to use this generator plus the Marti unit and to install them in a new built-up back-rest. This approach failed. In talks with the manufacturer of the snowmobile, we were told that this much weight and height, located at the rear of the machine would cause the snowmobile to be unweildy and would produce a loss of stearing ability.

The third approach, which we found did work, was to install all the equipment in a sleigh, called a Ski-Boose, and tow it along behind. In a sense this was similar to the idea dreamed up and used by George Palo at WERL. He installed all his equipment in a Red coaster wagon and had the announcer tow it along by the handle, for broadcasts in the summertime from the streets of Eagle River, Wisconsin.

We had hoped to avoid placing the gear in a sleigh since it would make the system more cumbersum to operate. Again referring to the photographs, the reader can see that the Marti and the Honda were mounted in our sleigh. This method has worked out even better than we had expected.

The Honda generator was mounted directly to the metal floor of the sleigh. We should point out that the rubber shock mounts on the generator are fastened down with bolts using a European thread. We had to re-tap these holes before we could install longer bolts up from the bottom of the sleigh through the rubber mounts and into the generator. Since the sides of the Ski-Boose are plastic, the floor was the logical place to mount this piece of gear. And mounting the generator on the bottom helped keep the center of gravity low. Because this unit is weather tight, it was unaffected by snow that blows into the sleigh or from snow kicked off the feet of anyone riding in the sleigh.

The Marti remote pick-up transmitter was mounted on a shelf, using the standard Marti mounting tray. No shock mounts were added. The shelf does not come with the sleigh and must be added. In our case we constructed a shelf of marine plywood and secured it at each side with an aluminum angle piece. As can be seen, this shelf was so installed that the Marti unit could be located within the front cowl and below the windshield. This protects the transmitter from wind and snow and yet places it at a very convenient height for the operator.

The normal seat in the sleigh runs the full length of the bottom, so that two or more people can ride. We had to cut it down to seat just one person. This allowed room to mount the generator unit and to provide floor space for the operator. The only other change in the sleigh was to install indoor-outdoor carpeting on the bottom of the sleigh.

Antennas

Two remote pick up antennas were mounted on the sleigh. These can be seen in the photographs.

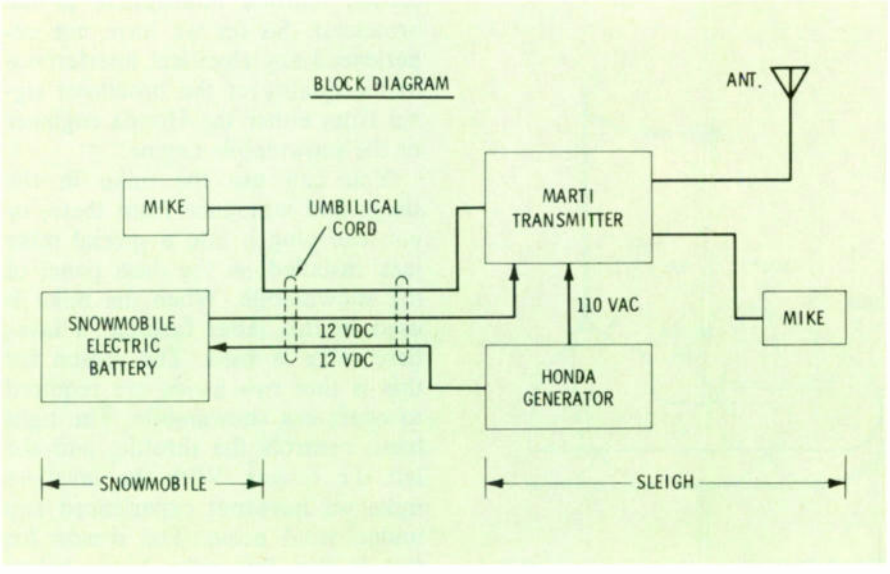


Fig. 3 Block diagram of the skimobile and ski-boose system.

One of these is located in front, to the right of the windshield. The second is located in the rear, atop the back rest. The rear mounted one is that used with the Marti transmitter. The forward antenna is to be used with a low-band FM transmitter, at a later date.

Several points of interest should be noted with regard to the choice and mounting of the antennas. For the Marti unit we selected a vertically polarized whip antenna. Several reasons dictate this choice. First, we wanted a light weight antenna. Second, we wanted an antenna that would not catch or get hooked on tree limbs. Third, we wanted an antenna that was flexible and would not break off in the event the sleigh turned over. Had we used a horizontally polarized antenna, like the common "Ring" antenna, we would have had trouble. In addition these "Ring" antennas are usually mounted on a stiff pipe or tubular mast, which could break the plastic on the sleigh. Also, it must be recognized that the disadvantage of directionality (inherent in a horizontally polarized antenna) are eliminated by using the vertical whip. After all, it would be impractical to keep turning the antenna every time the snowmobile altered its direction.

Electrical Connections

The Honda type E300 gasoline generator is operated with its 110 VAC output. This was connected directly to the Marti, without the need for any additional filtering. This generator was also wired so that its 14 VDC output could be connected to the snowmobile starter in the event the snowmobile battery failed. This gasoline generator is a four-cycle engine capable of delivering about 300 watts.

So far we have operated as long as two hours continuously with the one-half gallon or so held in the generator gas tank. For longer broadcasts it might be necessary to carry along a five gallon can.

One of the reasons we selected a Nordic Electric starter for the snowmobile was so we could then make a special cable or umbilical cord to connect between the snowmobile and its sleigh. One purpose of this cord is to assist in starting the machine. Another is to permit the 12 volt battery in the snowmobile to supply power for a short period of time to the Marti transmitter in the event of a failure of the gasoline generator.

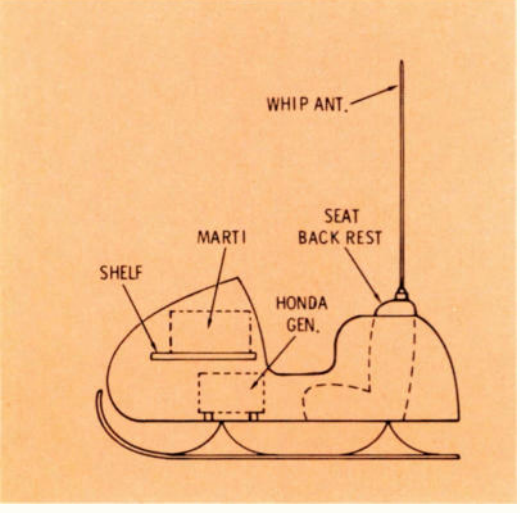


Fig. 4 Side view of the equipment layout in the ski-boose.

Electronic Features

The mikes for the Marti are installed in two clips which are bolted to the inside of the sleigh. In our case, we used Electro-Voice model 635. This is not a noise cancelling mike, and while the listener can hear the snowmobile motor running the background, it is not very loud. In fact, the motor noise adds a certain realistic atmosphere to the broadcast. So far we have not experienced any electrical interference to the quality of the broadcast signal from either the Honda engineer or the snowmobile engine.

You can use the mike in the sleigh and announce from there, or you can plug it into a special mike jack installed on the dash panel of the snowmobile. When the mike is used in this latter fashion, a lavaliere mike is used. The reason for this is that two hands are required to operate a snowmobile. The right hand controls the throttle, and the left the brakes. With the lavaliere mike we have not experienced any undue wind noise. The reason for this is that this mike hangs below the windshield on the snowmobile.

Future Plans

Our plans call for several additions to and refinements of the system we now use. One addition in the near future is to add extension arms to provide lighting, at night, powered by the gasoline generator, and to include a P.A. system, also to be run off the generator.

WELF, like many radio stations, is a daytimer. This is a handicap, from a snowmobiling viewpoint, since many such activities take place at night. In order to cover these events on a delayed program basis you must tape record the programs. It would be impossible to use a tape recorder in the sub-zero weather at night. To overcome this we have used, within our WELF Automation system, one of our solonoid operated tape recorders. A source input switch, that will select inputs and crystal functions (we call it a Delegation Panel) is used to switch this tape recorder to either the automation or to the output of the remote pickup receiver.

The signal to start the tape recorder comes from the squelch relay in the remote pickup receiver. Thus the announcer in the field on the snowmobile can start and stop the tape recorder back at the studio by merely turning on or turning off the Marti transmitter. Editing and triming of program material to usable lengths can be done later. But the unique feature here is that it takes only one man.

Future plans also call for WELF to cover a six-county "safari ride" of about 350 miles. Since this would be too long a ride and would cover more area than one remote pickup unit can serve, we plan to install or make use of other remote pickup mobile units for the purpose of relaying our snowmobile signals, as permitted by Section 74.431 of the Rules.

In conclusion, remember to keep mike cords short, since they become stiff and brittle in cold weather, and if too long could be run over by a passing snowmobile. Also, any controls or switch must be so employed that they can be operated with cumbersum clothing on. After all, you don't want to be playing around with your gloves off all the time.

Drivers, start your engines. . . ▲

Warning: Antenna Icing May Be Hazardous To Your Station

By William E. Stacy*

Although the problem of ice formation on antennas and antenna towers is not new to the broadcaster, it is one which has received much attention in recent months. The increase in the numbers of FM and Television stations and the associated increase in antenna arrays operating above 80 megahertz has brought the problem to the fore. With much of this new equipment operating unattended on remote mountain top locations the importance of keeping antennas ice free has much greater significance.

For many years the approach to Ice control was simple. Transmitter engineers merely kept an eye out the window and when conditions dictated would throw the heater power switch. This tended to be a rather hit or miss situation as the station engineer was often occupied with repair of equipment, or other duties and didn't notice that the temperature had dropped 10 degrees, or that the top of the tower was covered with low level cumulus. Many incidents of "off air" occurred merely because of the human element.

After a few finals were blown, most stations added a thermostatically controlled power switch to their heater contractors. This provided what seemed like a logical answer to the problem, and probably served most stations admirably, as long as the antenna consisted of one or two bays. Then growth caught up, and elements were added to increase effective radiated power and cover larger market areas. Antennas went from two to four bays, then to eight, then twelve, and even sixteen bays to meet competition.

The simple forgiving, no nonesense, one kilowatt transmitter became five, then fifteen kilowatts, and fussy. VSWR levels became very important as the replacement costs for output tubes soared. What was once a very simple problem, in this day of automation had become a rather complex one. Hourly operating costs of the heater systems went from pennies to dollars as heater power requirements kept rising. Some directly heated television antennas require as much as fifteen kilowatts, several times the power of the transmitter a few years back.

Review of experimental data from antenna designers shows that VSWR swings from nominal values of 1.05 to 1 to 3.00 to 1 can be experienced when antennas are covered with ice and temperatures are near the melting point. This degredation in efficiency is primarily due to the effective change in element size and spacing, which causes detuning. Al-

*Gray Research

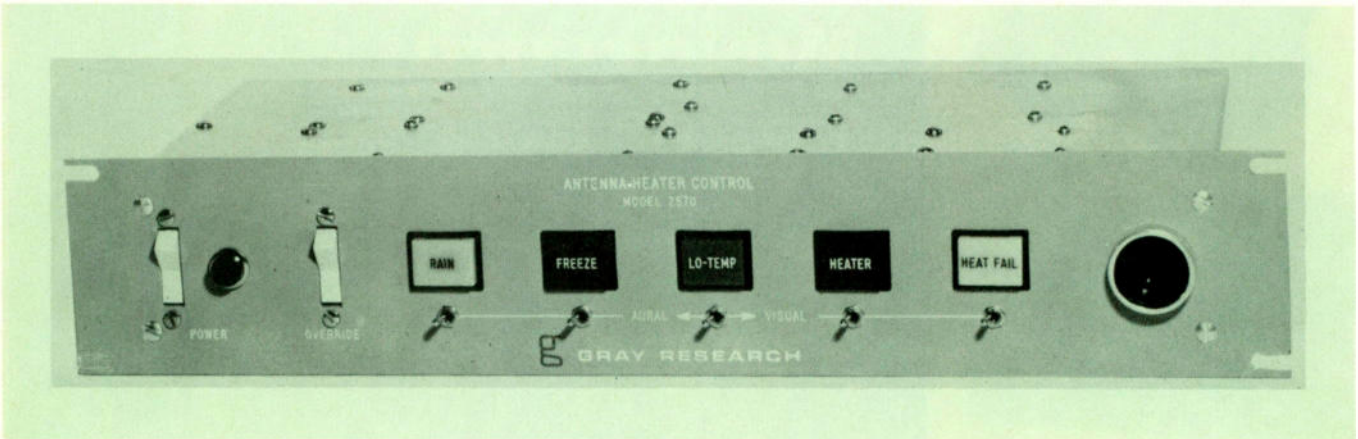


Fig. 1 Gray's antenna heater control panel designed for rack mounting.

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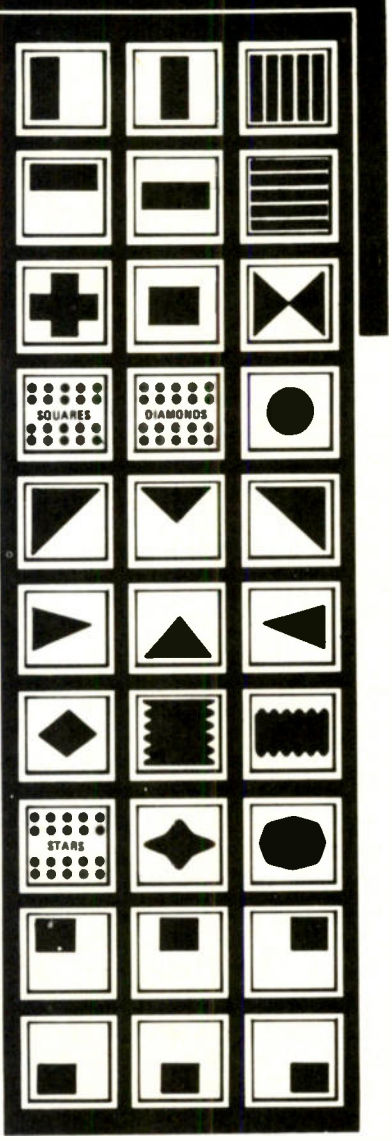

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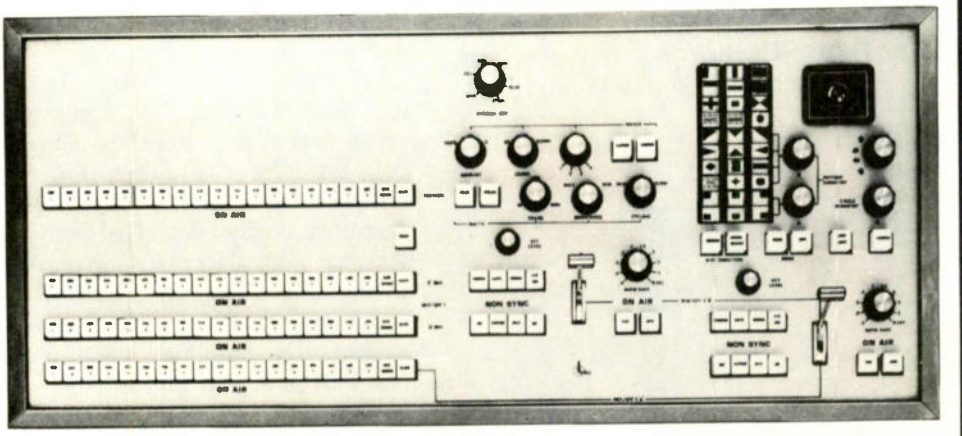
MODEL: VPM 2006 20 INPUTS, SIX BUSSES WITH THREE SPECIAL EFFECTS AMPLIFIERS



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though this lesser efficiency may not cause total failure of any circuit element, less RF power will be radiated and the effective coverage area will be reduced. Ice deposited irregularly on the array may cause pattern changes which could change the quantity of signal delivered to the prime market area.

Operational Hazards

Operational costs also become a factor. With an antenna system using "thermostat only" type controls, heaters run about 95 percent of the time for no reason. In most arrays the power consumption costs alone would justify the installation of a weather oriented control. The map shows the number of days each year, for various areas of the United States, that below freezing temperatures can be expected. Most FM and television transmitter sites are located at high elevations which would make these numbers extremely conservative.

Along with any discussion of antenna icing, it seems appropriate to mention tower icing. Although effective methods of ice removal or prevention have not been proven at this time, the National Association of Broadcasters has found the problem significant enough to form an engineering study committee to evaluate solutions to it. Discussion with Albert Chismark, chairman, has disclosed plans for field tests of tower deicing systems this winter. Two field locations are ready; one in the southeastern United States, the other in the midwest, with a third possible, to evaluate the feasibility of application of both chemical and heat transfer methods.

Chismark indicated that performance and economy of operation would be the major factors reviewed, and said "that no recommendations would be made by the committee until the results of the tests were complete."

Chismark also pointed out that tower icing problems are not primarily related to antenna system performance, but involve the hazzard of falling ice. It is easy to understand that a five pound piece of ice falling from the height of a typical broadcast tower is a danger to both life and property.

Systems Needed

One thing is clear about tower icing. When suitable methods of ice removal or prevention are found, control systems very similar to those required for antenna deicers will be required. As a matter of fact it seems reasonable that the same control could operate both.

It becomes obvious with all of the problems involved with ice that better deicer control systems are required to keep pace. Two such suitable systems are currently available for broadcast applications, the Model 2570 Automatic Antenna Heater Control System from Gray Research, and the Ice Warning System from Rosemount Engineering.

As with most problems as complex as predicting the weather, these two engineering teams, one a well known name in the broadcast equipment field, the other manufacturers of pressure, temperature, altimeter and ice detection equipment for aircraft, have come up with two entirely different approaches in dealing with the problem. The Gray system detects conditions suitable to cause icing and energizes antenna heaters in anticipation of freezing, the Rosemount unit detects the actual formation of ice and then actuates the heater elements.

The theory of operation behind the Gray 2570 unit is application of a resistive humidity detector coupled with two thermistor type temperature probes. The heated, thermostatically controlled humidity detector actually senses all types of precipitation. Fog, rain, wet and dry snow, and sleet cause this sensor to excite a DC amplifier which drives one half of a two input "And" cir-

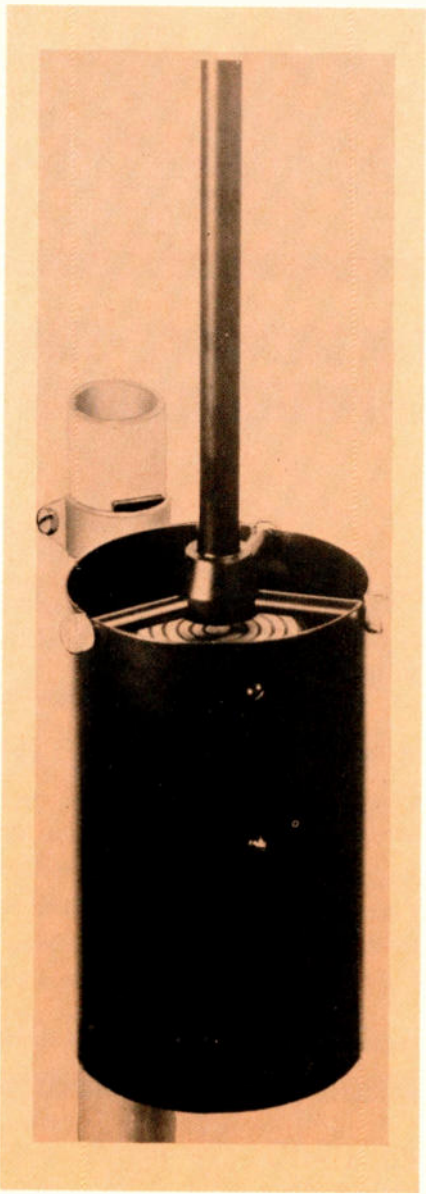

Fig. 2 Precipitation indicator senses fog, sleet and snow as well as rain.

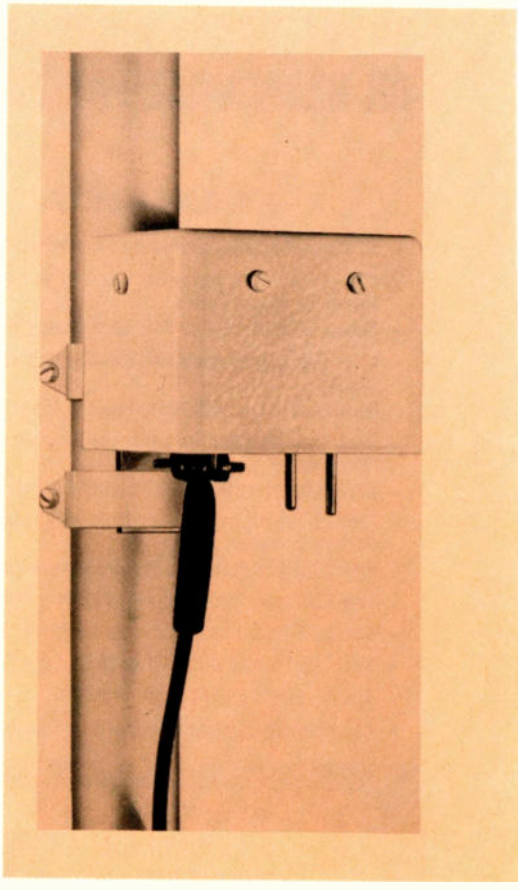

Fig. 3 Temperature probe for the Gray system.

cuit. One of the two thermistor temperature probes sets the high side of a preselected "ice probable" temperature range; thirty-six degrees. When the temperature falls to this level the thermistor provides an input to a second DC amplifier which in turn drives the other half of the "And" requirement.

The "And" circuit then turns on, and through a relay which in turn operates the heater power contractors. Thus when freezing temperature and precipitation are both in evidence, the antenna is heated and ice cannot form.

The second thermistor probe sets the low side of the "ice probable" temperature range; twenty-one degrees. When the temperature falls below this level, this thermistor, through a DC amplifier, overrides the "and" circuit and causes the heaters to turn off.

Observation has shown that preciptation falling with temperatures above this range will not cause icing. However, to satisfy the engineer who likes his independence, both edges of this range are adjustable plus or minus five degrees from the nominal, with rear panel controls.

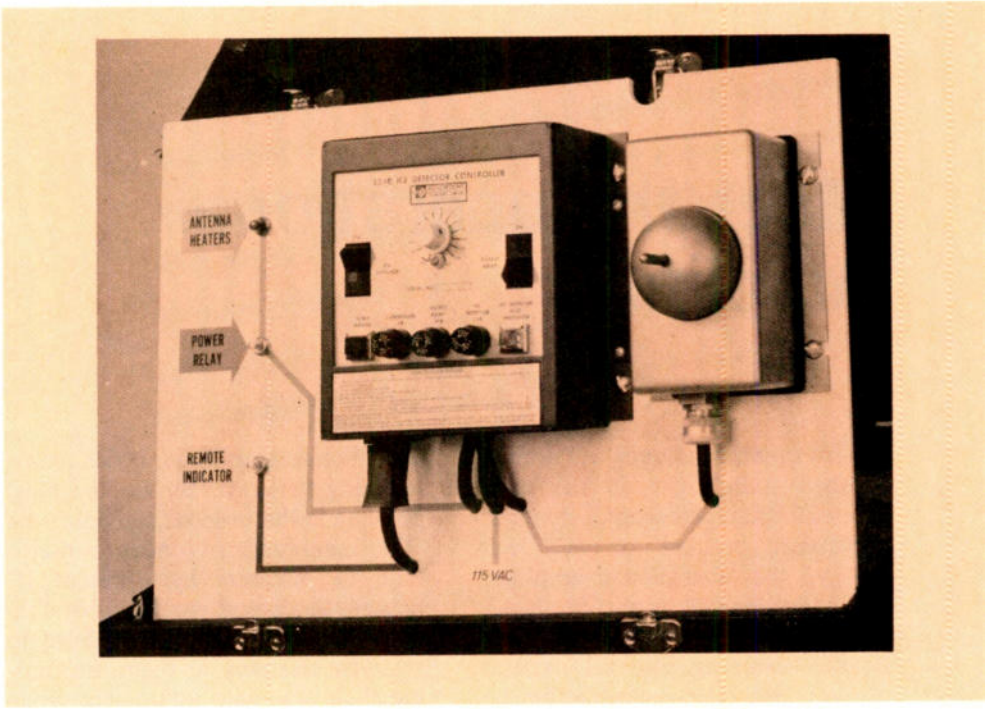

Fig. 4 The Rosemount ice detector control panel and mockup of system.

Rosemount System

The operational principle of the Rosemount 871CB1/524B1 Ice Detector—Controller system is application of the physical phenomenon of magnetostriction. The effect of this principle is that when certain materials are placed in a magnetic field their physical characteristics change, i.e., the length.

In the Rosemount unit, the magnetostrictive element is a tube .25 inches in diameter and nominally 1.1 inches long fabricated from Ni-Span C. This nickel alloy probe, used as the frequency controlling element of an oscillator, has a natural resonant frequency of 40 kHz.

As ice forms on the exposed Ni-Span cylinder, its resonant frequency becomes lower and the oscillator frequency follows. When the shift reaches a factory preset value, relative to the thickness of ice allowed to form, a frequency detector registers the change, and through a relay driver, closes a relay which provides an output signal to activate deicing heaters in the probe, and to turn on the antenna heaters.

After approximately ninety seconds, a time delay built into the detector opens the relay. The probe heaters, which have removed the ice from the detector, are turned off and if icing conditions still exist the cycle starts all over again.

The control panels of the two systems are quite different. Gray's unit is a 3½ inch high by 19 inch relay rack mounting panel which houses all of the electronics for the system. In addition lighted push button switches, for indication and test of each of the circuits, a solid state audible alarm, toggle switches for selection of any of the various indicators to the audible alarm, a power on-off switch, and a control override switch are provided. Fuses, calibration adjustment controls, and connection points are located on the rear panel.

The Rosemount controller unit is a 7 inch by 7.3 inch panel which houses the switching and fusing equipment for the system. As the electronics are closely associated with the magnetostrictive probe they are mounted separately in the probe housing. Controls on the panel include a power on-off switch, a output relay switch, an icing signal indicator, an ice detector fuse indicator, an adjustment knob for setting the minimum length of time the antenna heaters will operate, and various fuses.

It is interesting to note that both Gray and Rosemount agree that a minimum period of operating time for the antenna heater elements is required. In the Gray unit the period is fixed at approximately 12 minutes, while the Rosemount control provides an adjustable timer offering any period from 8 to 150 minutes. The prime purpose of the timers is to minimize the turn on turn off of the antenna heaters to lengthen element life.

The Gray control provides one additional function; a heater failure indicator. This is a simple, current transformer driven, circuit which has an adjustable threshold to accommodate different antenna configurations. The circuit is sensitive enough to register a single element failure in a multi bay installation, and provides an alarm on the front panel.

Look out your window. If it's not snowing or raining and the temperature is below freezing, I'll bet your antenna heaters are running. It's a good time to rethink your antenna heater system. ▲

Meet the operational Amplifier

By Walt Jung

This month's column will attempt to shed some light on the many potential broadcast uses of that microlectronic marvel of IC technology, the operational amplifier. Many readers are probably already familiar with op-amps as they are steadily creeping into all varieties of electronic gear, broadcasting being no exception. But for the sake of those who may not yet regard it with familiarity, perhaps this look will open up some new vistas of electronic experimentation when its overwhelming potentialities are appreciated.

Even if you don't use them for your own electronic projects, sooner or later you'll be called upon to trouble shoot a piece of equipment using an op-amp. With a sound knowledge of its basic function, you'll be able to diagnose the problem by a few quick scope readings, and then be back on the air. So, while we can't hope to cover op-amp theory to the "nth" degree in this session, we can at least cover the basics and head you in the right direction for further exploration.

Linear IC sales volume today is a multi-million dollar market. Of this, the largest portion is spent for operational amplifiers which come in many varieties. By far the most popular is the original standard, the 709, manufactured under a multitude of numbers by different IC houses. Since you can buy this chip for under a dollar, its not hard to see why so many of them are finding their way into equipment when its versatility is understood.

Op Amp As A Block of Gain

Now let's look at what an op-amp is so we can appreciate how to use it in a circuit. The first thing you'll see when anyone begins talking about an op-amp circuit is a triangle representation of an amplifier as in Figure 1. This is the trick to using the operational amplifier successfully and understanding its function. Think of it as a large block of gain. By large we mean 50,000 or so on the average. This seemingly large voltage gain is used to advantage by applying negative feedback around the amplifier to create a desired function, as we will see in a moment.

An op-amp is a differential input amplifier with a single-ended output. It is entirely direct coupled within the chip and the biasing is set up so that the output will be zero when there is zero potential difference between the two inputs. This means that the input terminals are insensitive to their potential with respect to ground and respond only to differential signals. The output stage is designed to deliver voltages both above and below ground and can supply about 5 ma. or so of current and swing ± 10 volts. This of course requires a split power supply arrangement.

Although the amplifier amplifies differences between the input terminals, this by no means limits its applications to only push-pull signals. Either of the two input terminals can be grounded and the other used (which one depending on the desired polarity) as a single ended input. Using the inverting input will give an output 180 degrees out of phase, reversing the pair will give an in phase output. And since this amplifier responds right down to DC, it amplifies DC levels as well as AC variations.

Op Amp Gain

So much for the elementary basics. Let's now take a look inside to see where all this gain comes from. Figure 2 is a schematic of what exists on a 709 chip. This amplifier consists of 3 basic stages —the first stage the input differential pair (Q1-Q2), the second stage a differential to single ended converter (Q3-Q6), and a push-pull class B output stage (Q9, Q12-14). The high voltage gain of the chip is the result of the product of the individual gains of these 3 stages.

A moderate amount of output power is available from the class B emitter-follower output stage. To keep input base currents to Q1 and Q2 (which of course must come from the outside world) low, these transistors operate at a collector current of 20 microamperes, making the input bias currents about 300 nanoamperes. Q1 and Q2 are biased in their common emitter leg by transistor Q11 which maintains their total emitter current constant regardless of the voltage common to both inputs (this is known as common-mode rejection).

Several circuit nodes are brought out to control the frequency response of the amplifier, the collector to base path of Q4 (termed input compensation), and the out-

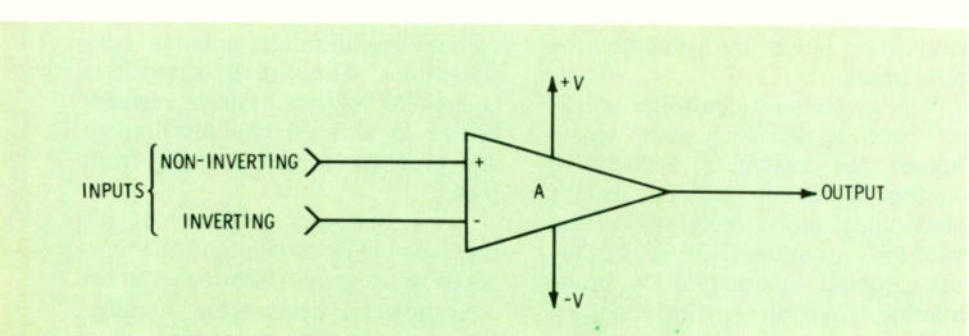

Fig. 1 Operational amplifier symbol.

put terminal back to Q12's base (output compensation). External RC networks at these points shape the open loop response to give a uniform 6 dB per octave roll-off which is necessary to prevent oscillation under closed loop applications.

There are many other design subleties of the circuit which are far from obvious just by inspection. But for our purposes it will suffice to note the key specifications of the circuit as a whole, listed as follows.

Supply Voltage:
±18v max, ±15v standard—will operate with voltages as low as ±6v

Differential Input Voltage:
The voltage that can safely be applied between the input terminals. Is limited by emitter-base breakdown of Q1-Q2: ±5v maximum

Common Mode Input Voltage:
The voltage that can be applied between the input terminals and ground (or circuit common) without affecting normal operation: ±8v minimum, ±10v typical

Input Offset Voltage:
The DC voltage difference between the input terminals necessary to obtain zero output from the amplifier. Is due to imperfect match between Q1 and Q2—

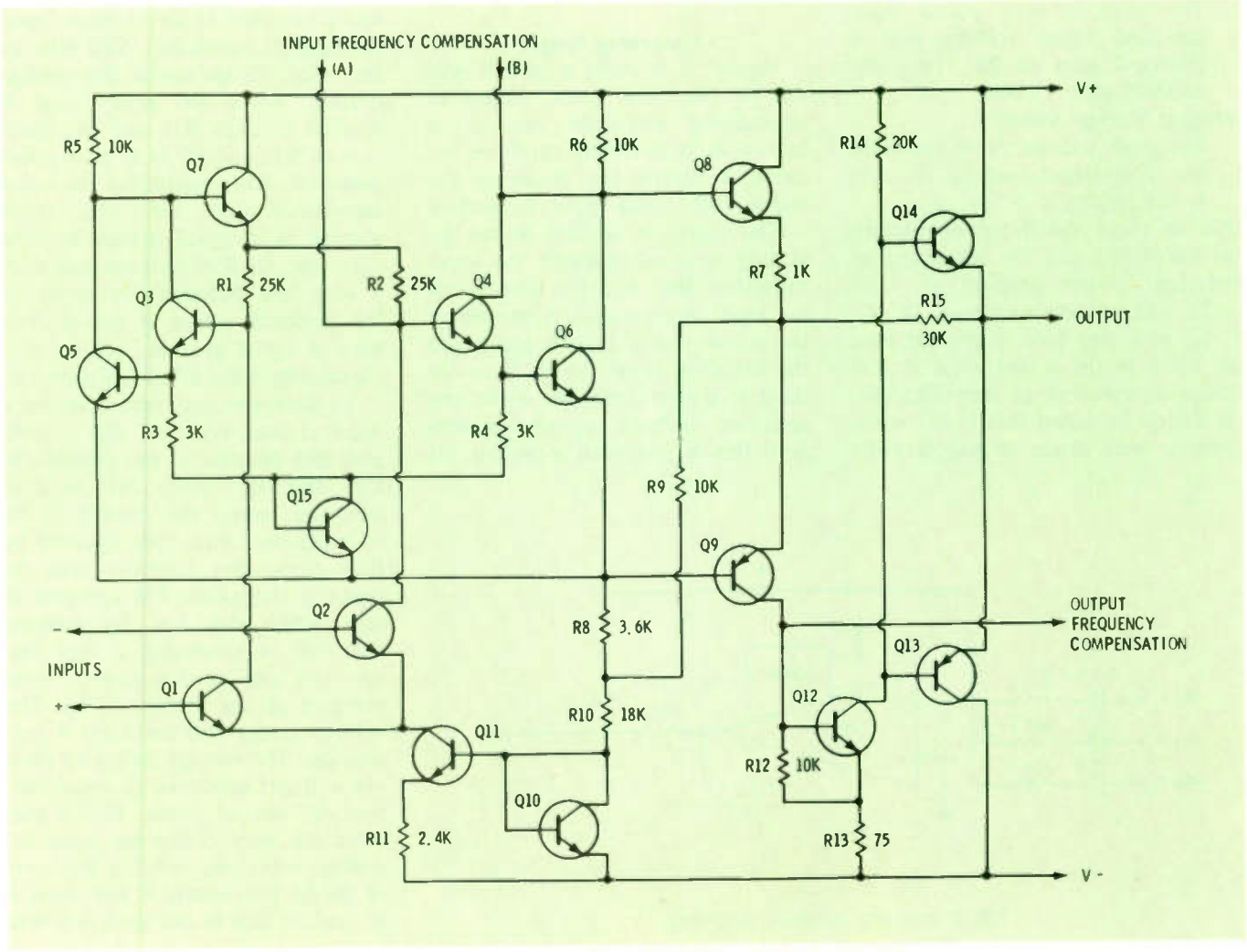

Fig. 2 Schematic of 709 amplifier.

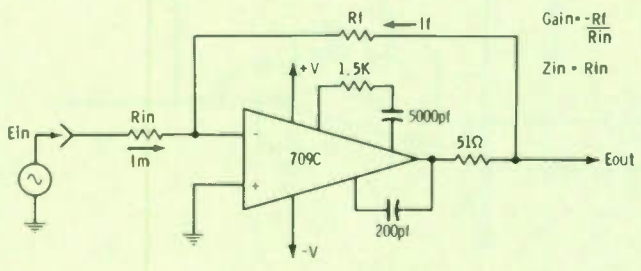

Fig. 3 Basic operational amplifier inverter.

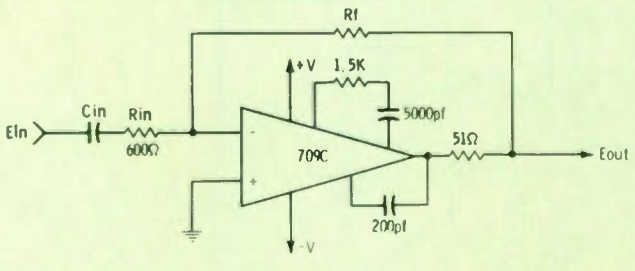

Fig. 4 Audio inverting amplifier.

Typically 2 mv, max 7.5 mv

Input Offset Current:

Similar to offset voltage in that it is caused by imperfect Q1-Q2 match. It is the difference in input currents required to obtain zero output voltage: Typically 100 na, max 500 na

Input Bias Current:

The DC flowing into the input terminals required to bias Q1 and Q2: typically 300 na, max 1500 na

Voltage Gain:

The ratio between output voltage and input voltage into a standard load of 2k: Typically 45,000, min. 15,000

Output Voltage Swing:

The peak voltage swing available into a standard load of 2k: min ±10v, typically ±13v.

All of these specifications pertain to the 709C and are measured at standard power supplies of ±15 volts and a temperative of 25° C.

So now you have a general idea of what a 709 is and what it provides in the way of amplification. It should be noted that it will work over a wide range of supply voltages, has a high common-mode input range, moderate output current and voltage and also that it can maintain these performances over a wide temperature range, —55 to 125° C for military grades and 0 to 70° C for industrial grade devices (709C).

Now all of this probably will mean little to you until we see how to apply the device to do some actual work. Let's look at a practical circuit using a 709C as a simple amplifier.

Inverting Amp

Figure 3 is such a circuit and this is the most basic circuit of operational amplifier use. It is known as an inverting amplifier because it inverts the phase of the signal 180° from input to output.

The signal is applied to the inverting terminal through the input resistance Rin, and the non-inverting input is grounded. A sample of the output signal is also applied to the inverting input via Rf. Now the thing to always remember about any negative feedback op-amp system (and this is just such a system, Rf providing negative feedback) is that the high gain amplifier will amplify the voltage difference **between** the input terminals, and the negative feedback will tend to maintain this difference or error voltage at a small potential. It will be small because of the large open-loop gain of the amplifier, usually 50,000 or so.

To put this into perspective, visualize a 10 volt output from an amplifier with a gain of 50,000-the input will be only 200 microvolts! So this amplifier will have a very small potential at the negative input terminal in operation. This tells us two more things about this configuration. Since the input signal is applied through Rin and the junction of Rin and Rf is at a very low potential, Rin constitutes the input impedance since the entire input voltage is dropped across it. And since the Rf-Rin junction has such a very low potential by virtue of the feedback action, it acts as if it were a signal ground, and so it is commonly called a "virtual ground."

By now you may have guessed a third characteristic of this circuit, and that pertains to the currents in Rin and Rf. Since the negative feedback causes the current in Rf to precisely cancel that injected by Rin, these two currents must be equal in magnitude but opposite in sign, which they are. By carrying this line of reasoning a step further you can quickly deduce what the gain of the circuit will be. The voltage across Rin produces a current Iin. The voltage across Rf (output voltage) produces an equal current, if, out of phase. If the currents are numerically the same the voltage ratio can only be the ratio of Rf to Rin which is just what it is, and so this is the gain, Rf/Rin.

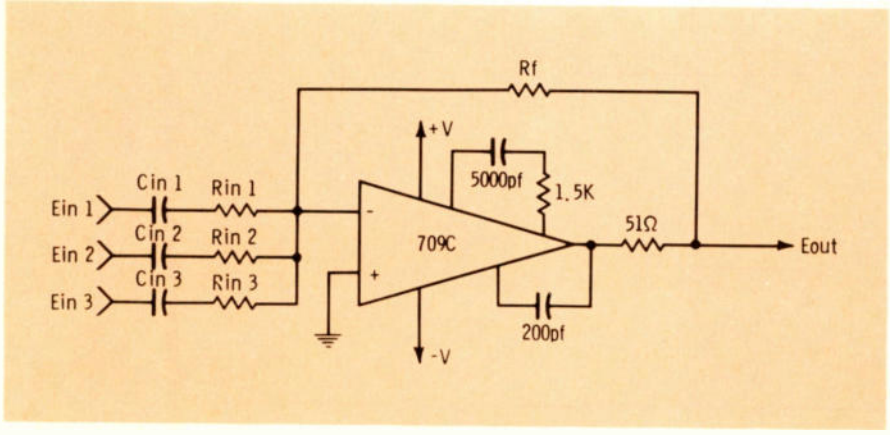

Fig. 5 Inverting summing amplifier.

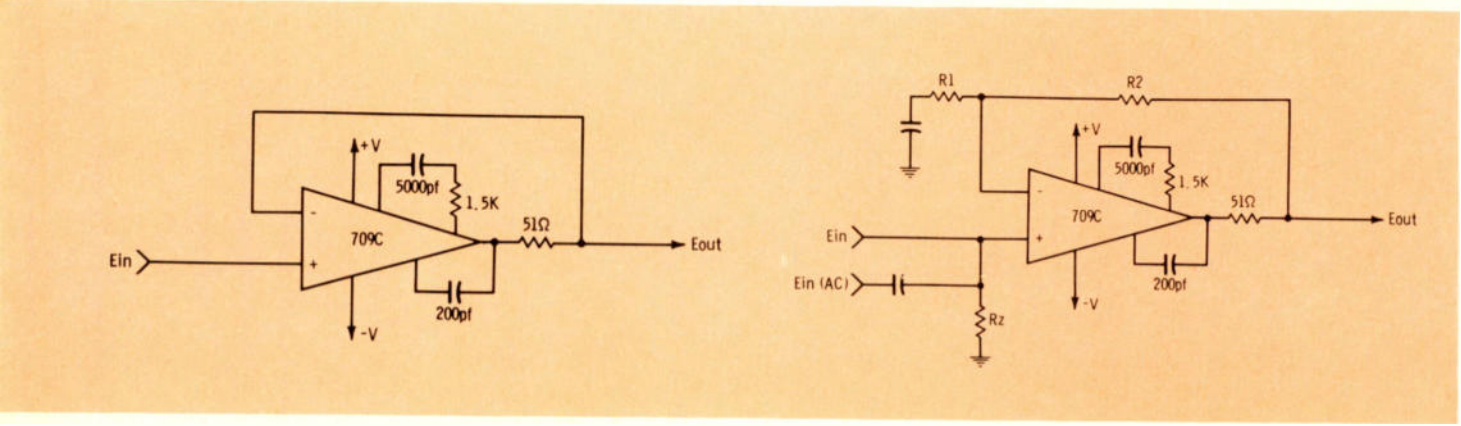

Fig. 6 Unity gain non-inverting buffer.

Fig. 7 Non-inverting amplifier with gain.

So there you have it, the inside-out explanation of an op-amp inverter circuit. It now should be obvious just why this sort of technique is so powerful and why it is used so widely. You can design an amplifier circuit whose salient features are determined almost solely by passive components. This is true not only of this simple inverting circuit, but of all operational amplifier circuits. This is where the device gets its name, as an amplifier which performs an operation on a signal.

This operation is not limited to just plain amplification either, it can be integration, differentiation, rectification, multiplication, division, filtering, oscillation or any application where active gain, negative feedback and differential comparison can be used to perform an operation. Fortunately the fantastic advances of integrated circuits in the past few years have made these circuits available at prices where even the home experimenter can develop sophisticated electronic processing systems. So it is pretty obvious these chips are here to stay, and the future can only hold further usage of them in more and more applications.

Additional Uses

To get back to what can exist right now in the practical world, let's run through a few more op-amp circuits.

The circuit of Figure 3 is useful as a inverting audio amplifier, and can be set up for various gains by scaling Rf and Rin. As shown, it will amplify DC as well as AC, so an audio amplifier for broadcast use might look more like Figure 4. Making Rin 600 ohms gives a 600 ohm line termination, and Cin can be selected for the desired low frequency roll-off. The ground on the ± input references the output to ground, so no output capacitor is needed.

A common audio requirement is a mixing or summing amplifier where two or more audio lines are to be mixed without interaction or loss of level. Figure 5 will do this for you, mixing the signals with no interaction because of the virtual ground at the 709C's negative input, and can even provide a gain to boot by ratioing Rf to the various Rins. If an equal weight for each input is desired, make all input resistors equal in value.

Figure 6 is a circuit useful for an impedance conversion from high impedance sources to low impedance loads. In this circuit the non-inverting input of the 709C is driven by the source and 100% voltage feedback from the output is returned to the inverting input. Thus the high open loop gain of the 709C forces the output to "follow" the input due to the small voltage differential between the 709C inputs. This is a good example of a common-mode input as the audio signal at the input rides up and down with respect to the ground and the amplifier must operate differently over this entire signal swing. The input impedance of this circuit is very high, making it ideal for bridging applications.

This configuration can also be used to obtain non-inverting voltage gain as in Figure 7. Here the output signal is divided by the R2-R1 divider before being applied as feedback. The voltage gain of the circuit is the inverse of the division ratio or R2+R1/R1. Either of these two amplifiers may be AC coupled by inserting a capacitor in series with the input and returning the inverting input to ground through a resistor whose resistance equals R2. The input impedance will then be equal to this resistor. The feedback network is AC coupled by returning the ground end of R1 through a capacitor.

Equalization Preamp

You can carry this technique further by placing equalization networks in the R2-R1 leg, and thus cause the gain of the amplifier to be a function of frequency. The obvious application of this method is for disc and tape equalization preamps, one of which is shown in Figure 8.

We could go on and on with this series of circuit applications, but there is just so much ground we can cover in one crack. Before wrapping up this installment we should point out that application of these circuits is by no means limited to the 709 op-amp. There are many newer improved types available now (some costing much more money) which can be used. The LM301 and 741C are two examples which are improvements over the 709. The 741C is very simple in application as it requires no frequency compensation components (the 709 requires 3) and is short circuit protected (the 709 is not). Next month we'll go into these circuits and see what they can buy for us over the 709.

Since this is the final issue of 1970 it is an appropriate time to look back and review what has passed in these pages. We've hit upon a few technical areas, hopefully shedding illumination for some. How well we've been on target is determined by your appreciation of our efforts, so let us know what you feel is needed in this column. We feel we have some ambitious plans for 1971 editorial coverage, but we can plan things even better by knowing your needs. Look for exciting developments in BE next year; new broadcast gear, new techniques, new ideas. We hope you'll be part of it. ▲

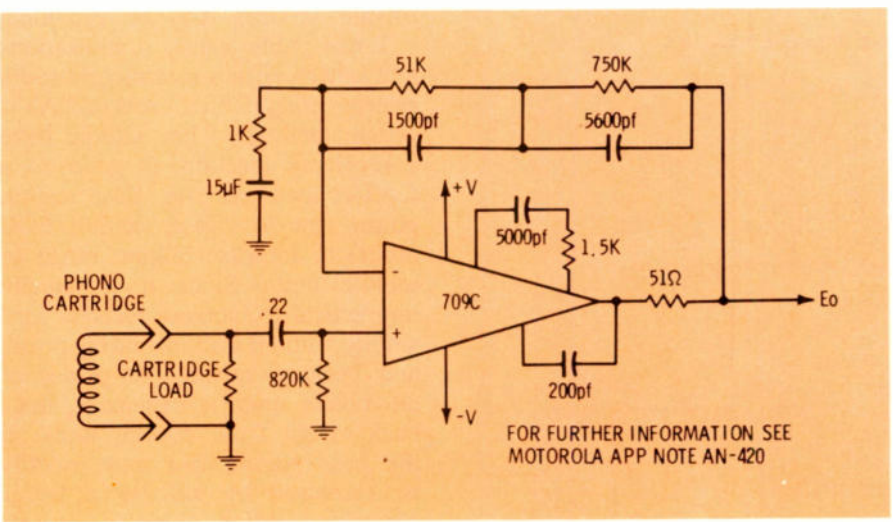

Fig. 8 Equalized phono preamp.

SCA broadens scope of CATV system services

By Leo G. Sands*

The one-way transmission capabilities of a CATV system are numerous, but seldom utilized. In addition to distribution of television and aural programs, a CATV system can be used as the transmission medium for many additional services. Some of these services can be provided on a fee basis, and some to attract more subscribers.

Subscription music system operators, for example, could use CATV facilities for distributing programs to their own subscribers. Most now transmit their programs over an SCA (subscriber carrier authorization) channel of an FM broadcast station. Subscribers utilize an FM receiver, SCA demodulator and a sound distribution system.

The service area of a subscription music system, currently utilizing an FM station's SCA channel, could be expanded by making arrangements with CATV system operators to pick up its SCA signal and distributing it to music service subscribers via cable.

At the headend, the SCA signal can be intercepted with an FM receiver and demodulated by an SCA demodulator. Its output is fed to an SCA modulator which in turn feeds an 88-108 MHz band FM modulator, as shown in Figure 1.

A simple way, of course, is to pick up all within-range FM stations at the head end and distribute all of these signals via the CATV system, as is normally done. Music service subscribers would simply tune in the appropriate station and feed the output of the SCA demodulator to the sound distribution system, in the same manner as when using direct off-the-air pickup. However, by using the technique shown in Figure 1, signal quality could be considerably better because of the relatively narrow bandpass of the head end receiver. Furthermore, the CATV system operator might not be able to exact a fee for distributing SCA programs when using the full-band technique since nothing beyond normal service is being provided. Using the technique shown in Figure 1, the CATV system operator obtains an extra FM channel for public aural transmissions.

How It Works

SCA works the same way on CATV as it does the FM broadcasting. The FM modulator is essentially a low power FM transmitter. Normally, it is used for transmitting mono programs with modulation frequencies confined to the 50-15,000 Hz range. For transmitting FM stereo programs or an SCA channel plus a direct FM program, the FM modulator must have much wider modulation frequency response.

An SCA modulator is simply a narrow band FM (± 7.5 kHz deviation) transmitter whose carrier center frequency is usually at 67 kHz. It may operate at other frequencies above about 20 kHz as long as interference is not caused to the direct FM program. The SCA signal is fed to the FM modulator simultaneously with the direct FM program. When an FM modulator with adequate frequency response is used, as many as eight SCA channels can be piggy-backed above the direct FM program.

Other SCA Services

An SCA channel derived in this manner can be used for many other purposes. Subscription music service can be provided by feeding the program directly into an SCA modulator at the head end. In fact, it is possible to distribute two or more different subscription music programs simultaneously, each on its own SCA channel, over the same or different FM channels. The CATV system could furnish subscription music service or provide facilities to other entrepaneurs.

Facsimile, slow-scan TV, teletypewriter signals, data and other forms of intelligence can be transmitted over an SCA channel. Under FCC rules, an FM broadcast station may utilize the SCA channels only for "broadcast type" services. The same limitations do not apply to CATV systems. Both public and private services may be provided.

Local public safety organizations and other operators of mobile radio systems are potential users of CATV system facilities. They seldom have a receiving location as good as a CATV head end site. Base station power can be raised (within FCC limits) to increase talkout range to mobile units. Since it is usually impractical to increase receiver sensitivity without also increasing noise, and because raising the power of all mobile units is expensive, talkback range from mobile units to the base station can most readily be increased by utilizing a better receiving location, or by adding satellite receivers.

*BE CATV Editor and president of Leo. G. Sands & Assoc., N.Y.

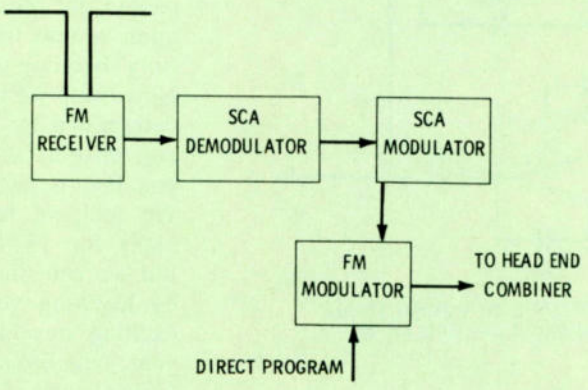

Fig. 1 Back-to-back SCA program repeater system.

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A CATV head end site can be a good satellite receiver location. An appropriate antenna, a fixed-tuned communications receiver and an FM modulator can be installed at the head end, with the modulator output fed into the channel combiner as shown in Figure 2. The modulator, of course, may operate at a frequency within the 88-108 MHz FM broadcast band. At the distant base station control point, the signals can be intercepted with a conventional tunable FM receiver, or a special fixed-tuned receiver.

Or, the modulator could operate just outside of the FM broadcast band. It is also possible to utilize a 72-76 MHz band FM exciter in lieu of the 88-108 MHz band FM modulator, and a fixed-tuned 72-76 MHz band communications receiver at the base station control point.

When operating within the 88-108 MHz band, any CATV subscriber can tune in and listen to the communications traffic, except when an SCA modulator is also used, as illustrated in Figure 3. In addition to an FM receiver, an SCA demodulator is required at the base station control point.

So manual tuning won't be required, and to avoid frequency drift problems, a tunable FM receiver can be readily modified for crystal controlled reception on only one carrier frequency. Or, a 138-174 MHz fixed-tuned base station receiver can be modified to operate at a frequency within the 88-108 MHz band.

In addition to utilizing such an arrangement to increase the talk-back range of a mobile radio system, the same techniques can be used to enable a public safety organization to intercept signals from distant base stations operated by the state police, sheriff's department, or police or fire department in a neighboring community.

CB Emergency Monitor

The same technique can be used to monitor citizens band Channel 9 which is now reserved exclusively for emergency communications. Some police departments now monitor CB Channel 9 as do thousands of CBers (citizens band operators). By making this channel available to the public via CATV on an FM broadcast band channel, subscribers who are also CBers will be able to Monitor Channel 9 with an FM receiver while monitoring or operating on some other channel.

In areas where organizations provide emergency services to pleasure craft, either or both of the marine distress channels (2182 kHz, 152.8 MHz) can be relayed via CATV using the same techniques.

To enable reception of several communications channels, one at a time, a scanner type receiver can be installed at the head end. Receivers of this type automatically scan two to eight or more selected communications channels for activity. When an active channel is found, the receiver locks on that channel until the signal goes off the air. Then the receiver resumes scanning. Receivers of this type are available for the 30-50 MHz, 150-174 MHz and 450-470 MHz bands. Some scan selected channels in both the 30-50 MHz and 150-174 MHz bands.

Mentioned here are only a few of the special services that can be provided by a CATV system operator. Which are worth considering, of course, depends upon economics —the market size, demand, cost and revenue potential. What other services can be provided are limited by lack of imagination and sales effort, not by technology. ▲

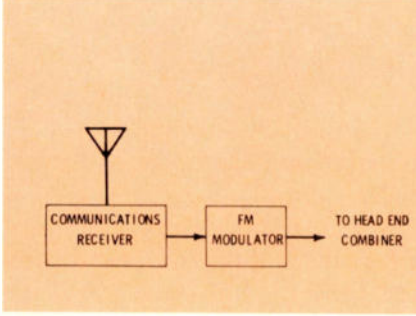

Fig. 2 Direct communications relaying facility.

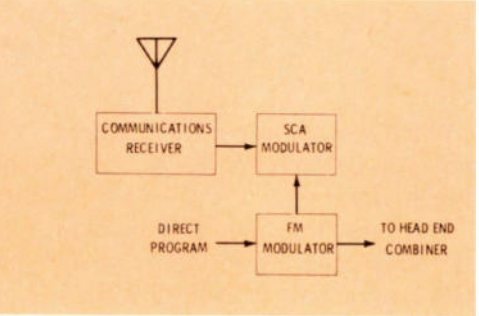

Fig. 3 SCA channel communications relaying facility.

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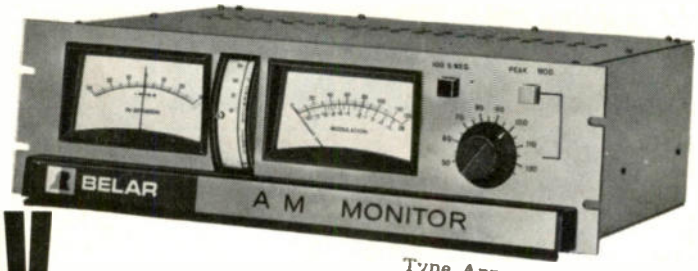

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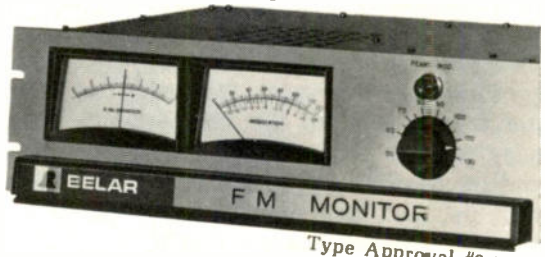

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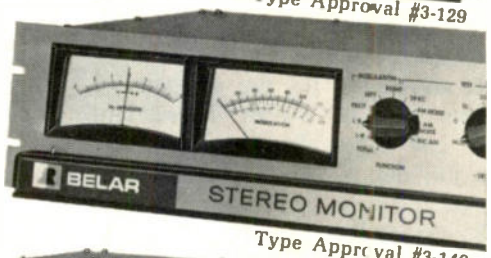

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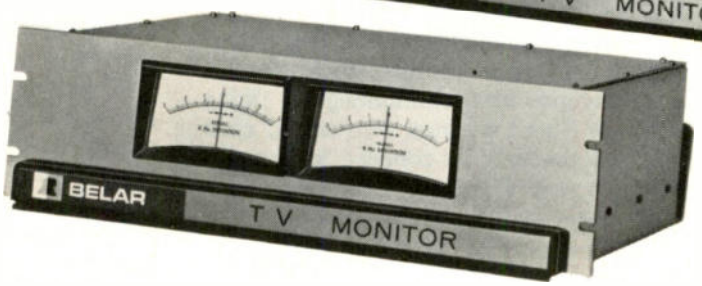

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Automation:

Eliminating Dead Air

Most broadcast automation systems use some sort of alarm to alert the operator in case of a malfunction. However, the usual type of alarm is connected to the silence-sensing portion of the system and comes on only **after** there has been "dead air" and the silence-sensor has tripped. In the belief that it is better to prevent "dead air" in the first place, simple alerting circuits were developed for the automation system at KUDE-FM. These circuits can be employed by any station utilizing Ampex 350-series tape decks.

Resistor "R" shown on the schematic may have to be determined experimentally for best operation. With the relays we used, a value of 1750 ohms at 10 watts gives satisfactory results. The idea is to keep the relay current as low as possible and still have reliable operation. We find that a 12-volt relay may operate on as little as 80 ma.

The coil of Ryl is connected to the 115-VDC power supply in the Ampex control circuit. This appears in many places in the deck, such as across C502 or from the "hot" side of the rewind or fast-forward button to the "neutral" side of the stop button.

A simple DC power supply is used to operate the warning lamps to guard against any hum being coupled into adjacent wiring.

If it is desired to utilize only one warning light (or a buzzer) instead of individual lamps for each deck in the system, all Ryl outputs could be connected to the solenoid of a normally-open relay which then actuates the warning device.

This alarm circuit will alert the operator in case of tape runout, tape breakage, a blown fuse or almost any other common outage in broadcast automation equipment.

Oceanside, California
Glen H. Kippel
Chief Engineer
KUDE AM & FM

Turned On—Turned Off Engineer Blushes

Like many other stations, I'm sure, our FM transmitter occupies one of the highest locations in the area. Needless to say, when the lightning flies, I just sit near a phone waiting for the inevitable call.

One of the more recent storms took out the freq. monitor, and we had to send it back to the factory for repair and recalibration. Since we were on the air when the time came to reinstall it, I made a temporary hook-up that would not interrupt our programming. In doing so, I used a pigtail with an AC cord on the end to connect to the AC line. After allowing the unit ample warm-up time, we made the adjustments which were necessary, and went home.

I had no sooner reached home when the phone rang, and the operator on duty informed me that the unit was no longer operating. So I went back up, opened the door, and examined the unit; It was working perfectly. I shrugged my shoulders, and went home, only to be met at the door by my wife, phone in hand. "It's not working again."

I went back up, found the unit to be working perfectly again, and reported to the G.M. that the freq. monitor was out of service again, with an intermittent problem apparently related to opening the shack door. I went back home, and sat musing at my wife about the problem.

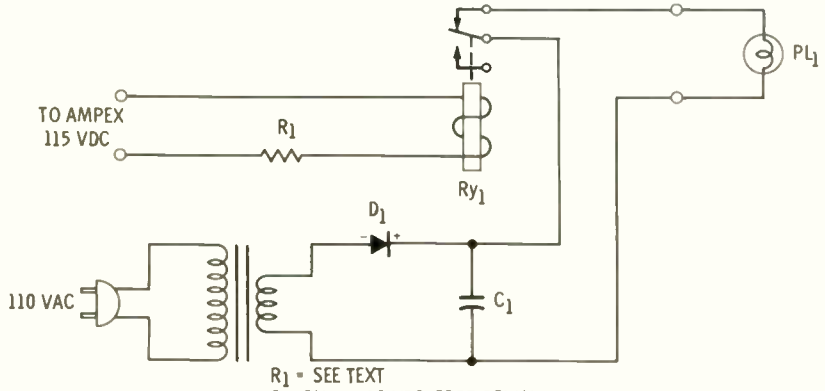
In wifely fashion, she asked me to detail everything the unit did and didn't do and when, saying that "it must be something simple." Seething below the surface, I snarled "Well, I drive up to the shack, unlock the door, enter, turn on the light, and look . . . THE LIGHT!! THE #*&%#@¢ LIGHT." The power outlet I had chosen was switched. Every time I left, I was shutting off the monitor when I shut off the lights, and when I went back in, I turned it on. Then I remembered that the crystal oven indicator showed an unusually long on cycle when I first arrived each time, obviously because it had cooled down, during the time the lights were off.

Rewiring the unit to its normal power source in the rack after sign off solved the problem, and for the balance of the night before sign-off, the lights stayed on.

The moral: When faced with an impossible situation, re-examine the obvious. Murphy's Law may be at work again.

WHUN AM, FM
J. M. Bixby
Huntingdon, Pa.

(Continued on page 54)



R_1 = SEE TEXT
Ry RY_1 = 12 VDC SPDT RELAY
PL_1 = 12-VOLT PILOT LAMP
T_1 = 12.6 VAC FILAMENT XFRMR
D_1 = 1-AMP, 200 PIV DIODE
C_1 = 100mfd, 50-VOLT ELECTROLYTIC CAPACITOR

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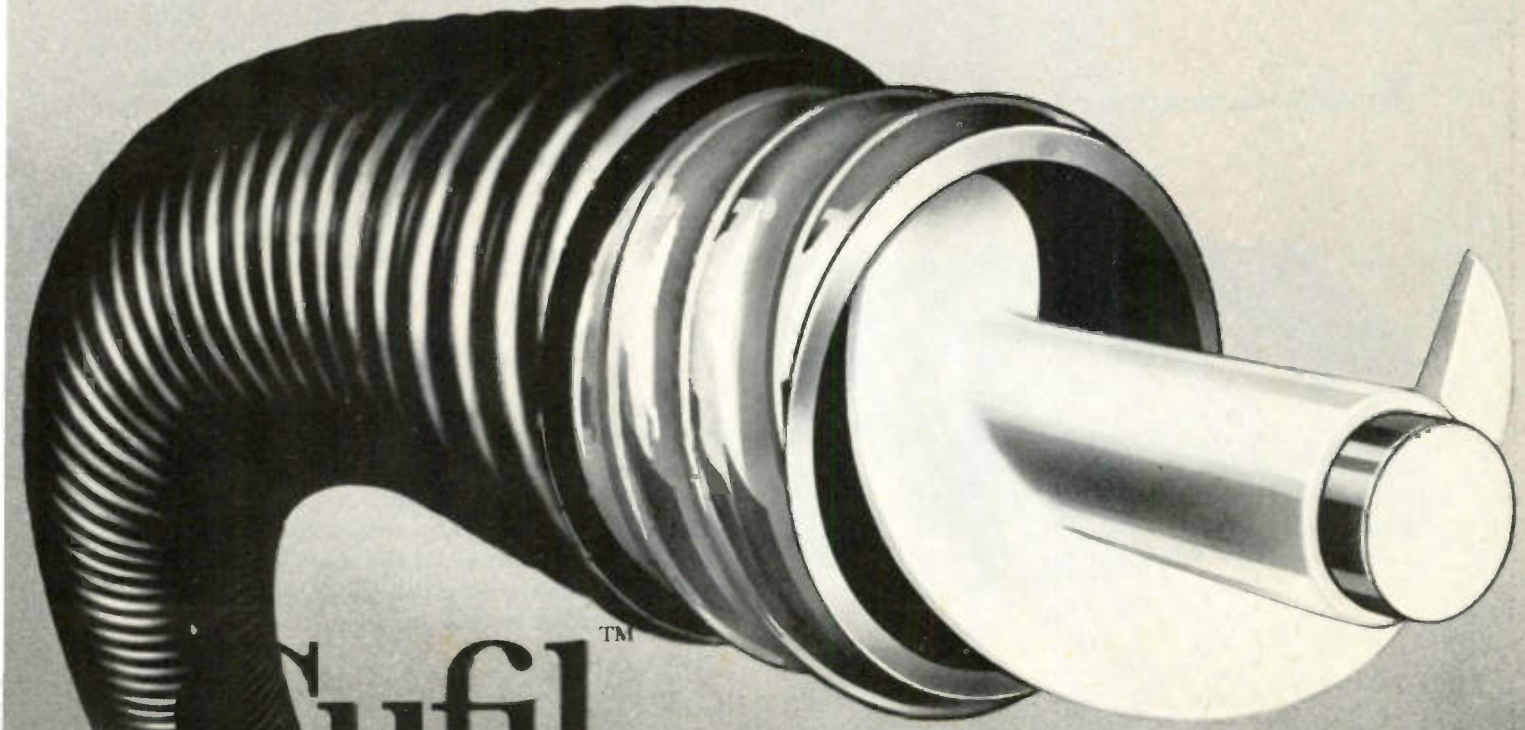


Cufil.™ The new air dielectric coax with the copper corrugated outer conductor.

(Continued from page 52)

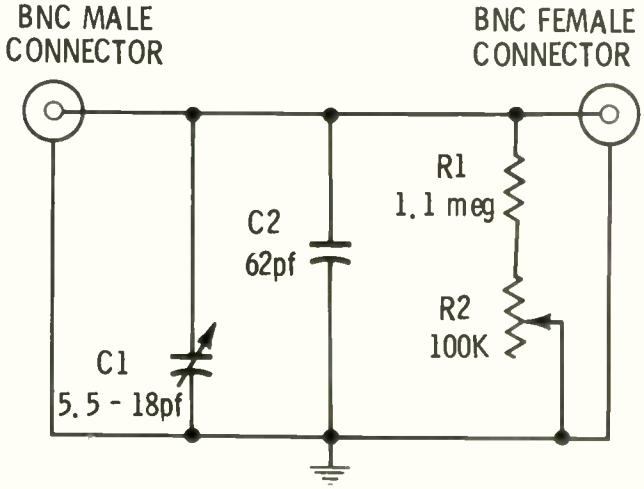
Scope Attenuator

We have a Model 453 Tektronix oscilloscope in daily use but difficulty has been found in setting up video levels because of parallax on the NTSC composite Graticule. Using the parallax-free graticule on the scanning side of the CRT required that a time-consuming calibration of the scope vertical gain be made each time this mode of operation was desired.

The following fixed external attenuator was added to increase the speed and accuracy of video level set-up. When video levels were being checked the attenuator was placed in series with the 10 to 1 probe. With the scope vertical gain attenuator set for 10 mv/div. (calibrate position) the fixed attenuator was adjusted for one volt equal to 28 divisions of deflection. This gave us one scope unit equal to five IRE units on the parallax-free scale. Following is a list of commonly used video waveform levels:

Volts	IRE units	Scope units
1.0	140	28
.714	100	20
.54	75	15
.286	40	8
.054	7.5	1.5

The attenuator was constructed in a small shielded box with BNC connectors. The scope input is simply shunted by the proper value of capacitance and resistance in order to obtain the desired 28 units/volts deflection sensitivity. The frequency response at all video frequencies remained flat when C1 was adjusted for flat squarewave response. Input impedance of the probe was reduced by 5 percent.



Parts List

1 ea Pomona Type 2391 shielded aluminum box with BNC connectors.
1 ea Bourns Type 3292 trimpot, 100Kohm
1 ea IRC Resistor, metal film, 1% ½W, 1.1 Meg ohm
1 ea JFD Capacitor, type 18A, variable disc trimmer capacitor
1 ea CDE Capacitor, 62pf 5%, silver mica, 500V

Arnold E. Monday, C.E.
KORN-TV
Mitchell, South Dakota

bookreview

A new **linear integrated circuits manual** (IC-42) that has been extensively revised and expanded to cover the latest innovations in integrated-circuit technology and applications is now available from RCA Solid State Division.

The 416-page manual may be used as a guide for circuit and system designers in determining optimum design specifications. It is also helpful to educators, technicians and others who have a basic understanding of solid state devices and circuits.

The basic fabrication, packaging, mounting, and interconnection techniques are explained, and the fundamental building-block elements for linear monolithic integrated circuits are analyzed. Circuit descriptions and applications information are provided for a broad family of RCA integrated circuits designed for use in a wide variety of general- and specific-purpose linear applications.

In addition, the IC-42 manual features a new application guide that indicates circuit types recommended for specific applications, and technical data and outline sections that provide ratings, characteristics, and package details for RCA linear integrated circuits.

The IC-42 Linear Integrated Circuit manual has an optional price of $2.50 each and is available in quantity from RCA distributors. For more information, contact RCA Commercial Engineering, Harrison, N.J. 07029.

Color Film for Color Television has been written for operating people in both the motion picture and television industries. The author, Rodger J. Ross, shows in a practical way how to produce high quality color televisions with film. He sets out to show why television program production with film needs a different approach than motion picture production.

He also describes in an easy-to-understand manner a unified film-television system that will satisfy the most stringent broadcasting requirements. After a concise yet comprehensive introduction to the principles of color television, the author describes the currently available color films and process in detail. The practical information ranges through exposure and the use of exposure meters, control of processing solutions, color printing and duplicating, adjusting color balance, the preparation and use of color slides, and sound track characteristics. The most recent proposals for television film rooms and for standardized film reproduction in telecine are dealt with at length.

The book is available through Hastings House, Publishers, Inc., 10 East 40th Street, New York, N.Y. 10016.

NEW PRODUCTS

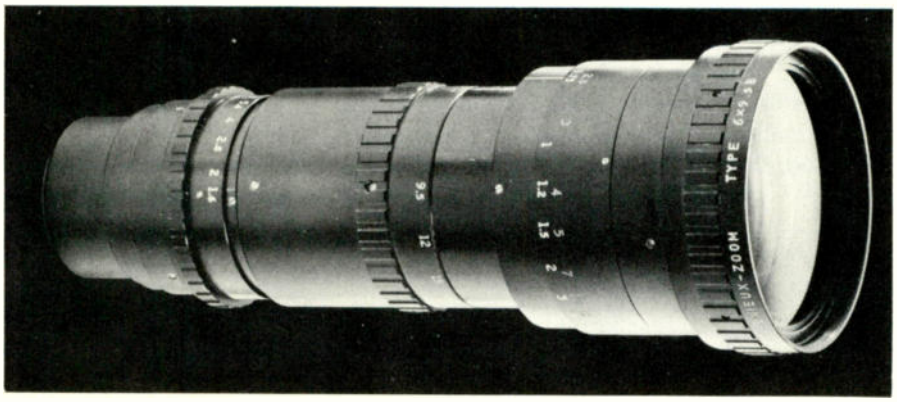
(Use circle number on reader service card for further information)

Angenieux Zoom Lens

Photokina '70 marked the introduction of a new functional concept in the design of zoom lenses. Because of the great need in the television news and documentary film industry for a high aperature, wide angle, close focusing zoom lens, **Angenieux** has created the 6x9.5 zoom lens.

With a geometric aperature of f/1.6, the new Angenieux 6x9.5 opens new areas to cameramen which were previously possible only with fixed focal length lenses. The very wide angle (68°) rendered by the 9.5mm focal length makes this lens ideal for shooting in really tight spots. Actually, the 6x9.5 covers an infinite number of focal lengths in the most practical range up to 57mm.

To make this lens even more useful, the 6x9.5 has been designed to allow focusing, at full aperature, as close as 24 inches from the focal plane to the subject without accessory lenses.



Circle Number 50 on Reader Reply Card

Cartridges

The new **Pickering** XV-15 cartridge has unique ability which enables each and every instrument of an orchestra to be heard (according to the manufacturer) as it was intended—distinctly and clearly with its true tonal qualities—throughout the entire fundamental and overtone frequency ranges.

Since the overtones give each instrument its full bodied sound and character, any loss in this range means loss of quality. For instance, at 75% Music Power, which some cartridges deliver, the instruments seem a little faded in the upper frequencies; at 50% Music Power, loss of definition of instruments and tone begins; at 25% Music Power, serious loss of definition occurs.

The XV-15 Series is rated on the Dynamic Coupling Factor concept —a concept which gives meaning to the term 100% Music Power.

DCF is a carefully calibrated measurement which defines the cartridge's applicability to its intended application. In other words, there is an XV-15 DCF-rated cartridge for the most simple to the most complex playback equipment which enables the audiophile to select the right Pickering cartridge designed to meet his desired specifications.

Circle Number 51 on Reader Reply Card

Tape/Head Cleaner

A brand new cleaner formulated for VTR, audio heads, magnetic tape and photo film is now available from **Nortronics.** The new cleaner, designed especially for professional recording equipment, is available as both liquid and spray. In either form, its use contributes to improved performance and extended life for magnetic heads and tapes, says Roger Czerniak, Nortronics Distributor Sales Manager.

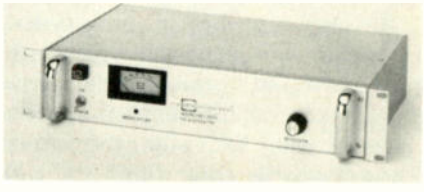
The new cleaner can be used on cassette and cartridge tape recorders as well as conventional reel-to-reel equipment. "Clean tapes and clean heads mean better sound," Czerniak says. Nortronics Tape/Head Cleaner preserves tapes and improves fidelity by eliminating accumulated dirt, film, and oxides. Since it is silicone free, it can also be used to clean guide parts, capstans, and pinch rollers. Most other available cleaners contain silicone, and therefore cannot be used for these applications.

Nortronics Tape/Head Cleaner is now available from Nortronics distributors in a 16 oz. aerosol spray can, with a 5 inch extender tube that directs the spray into crevices and hard-to-reach areas, and in liquid form in 8 oz. and 32 oz. cans.

Circle Number 52 on Reader Reply Card

CATV Modulator

Designed for CATV operations with less than 12 channels off air, **Catel's** new modulator (model FMS-2000) supplies system subscribers with audio programming and clean video blanking. The modulator



takes audio from any source such as FM or AM tuner, record turntable, tape deck or microphone and transmits it on any unused VHF TV channel in the cable system

Catel achieves this by providing an unmodulated picture carrier at the desired TV channel frequency and a modulated sound carrier 4.5 MHz above the picture carrier. The FMS-2000 is factory-tuned to any desired VHF channel.

Fitting any standard 19-inch equipment rack, the FMS-2000 stands only 3½ inches high. Output level is 50 dBmv with frequency stability of ± .005 percent.

Circle Number 53 on Reader Reply Card

Multi-Beam Light

Berkey-ColorTran, Inc. (a Division of Berkey Photo, Inc.) announces a new version of the popular Multi-Beam 1000 (code number 100-301).

The Multi-Beam 1000 features a built-in accessory holder with ColorTran's exclusive safety clip lock for accessories. It is continuously variable focus from spot to flood, with a smooth field—no filament pattern. A new heavy duty socket provides increased cooling and longer lamp life. There are a variety of quartz lamps available in 120 volt or 230 volt for foreign locations.

The Multi-Beam 1000 weighs only 6½ lbs. A full range of accessories are available which are interchangable with the Vari-Beam 1000 fixture.

Circle Number 54 on Reader Reply Card

Synchronizing Generator

Control Concepts Corporation of Rockville, Maryland, announces the availability of a new concept in sync generation, the Model 601. Intended for master color sync generation or single line pulse distribution systems, the 601 incorporates a number of design advances which not only solve long standing timing problems but while doing so significantly advance the state of the art.

The time base oscillator of the 601 provides a new level of subcarrier stability by using a precision cut high temperature quartz crystal in an actively driven proportionally controlled oven. This eliminates the gross phase/frequency transient characteristic of a thermostatically controlled oven. The aging rate of this oscillator is better than 1 part in 10^8 per year, thus necessitating re-calibration only once every three years. Extremely low FM content and high immunity to power variations is provided by precision integrated circuit power supply regulators.

This high purity, jitter free subcarrier is used as a master clock for a completely synchronous divider with a division ratio of 455. Synchronous clocking reduces potential divider jitter to that of a single logic transition and the 50 MHz logic elements used in the 601 reduce this jitter to an indetectable minimum. Appropriate taps on a digital delay line allow user programmed selection of all pulse timing transitions, leading and trailing edges for all pulse outputs with a resolution of 70 nanoseconds.

Intended also for complete pulse fanout and subcarrier regeneration in single line pulse distribution systems, the 601 will lock to a composite color signal or remote cw subcarrier. The remote lock circuitry utilizes a digital timing window to place incoming sync within a

(Continued on page 58)

Number 83 in a series of discussions by Electro-Voice engineers

STEREO SQUARED

HOWARD DURBIN
Senior Vice President and Technical Director

Four channel sound is coming. Fast. And it will pose a fascinating challenge to broadcast engineers, management, and programming executives.

Already major set manufacturers, specifically RCA and Motorola, are offering 4-channel tape players and cartridges, thus insuring a library of program material. And their promotion of these new products will focus consumer attention on this new form of sound reproduction.

But within the framework of present FCC regulations, the problem of presenting 4 discrete channels of information from a single FM stereo station are formidable. To date most 4-channel broadcasts have involved two cooperating stereo stations . . . hardly a permanent solution.

Electro-Voice has investigated the various possible systems currently being advocated. But to avoid any basic conflict with current SCA channels and/or shortcomings of limited-range multiplex techniques, we have concentrated our development efforts toward a matrixing system completely compatible with present stereo FM broadcasting. Indeed, the system can be added to any FM stereo station without additional FCC rule-making, or change of present broadcast standards.

The E-V Stereo-4 system* devised by Leonard Feldman and developed by E-V uses an encoder to reduce four channels to two for broadcast or recording. Previously encoded records or tapes can be broadcast without additional processing by any stereo station. Listeners, using a simple decoder plus an additional stereo amplifier and speaker pair, are able to enjoy all four channels of information. Those without the decoder hear a normal stereo (or mono) signal with no loss of signal level or quality.

Encoders designed for broadcast/recording are currently in production at Electro-Voice. Decoder production has also begun, and the basic circuit is available to other manufacturers as a hybrid micro-circuit chip for inclusion in any type of stereo system, including mass production models.

Other compatible matrixing systems are also under consideration by the industry, including the Scheiber systems, the Hafler (Dynaco) system, and one by Columbia Records. Since there are significant differences in these systems that might limit the universality of 4-channel broadcasting, E-V is pressing for standardization of encoding techniques at the earliest possible opportunity.

A special mailing list is being developed at E-V for those stations wishing to keep abreast of the developments in this area. An informal discussion of the current state of the art will be sent to all who request it, plus information on the E-V Stereo-4 encoder system and products.

*Patents applied for.

For further information on 4-channel stereo, or technical data on any E-V products, write:
ELECTRO-VOICE, INC., Dept. 1203V,
638 Cecil St., Buchanan, Michigan 49107

Electro-Voice®
a GULTON subsidiary

Circle Number 29 on Reader Reply Card

(Continued from page 57)

105 nanosecond interval and accomplishes tight lockup via the phase-locked subcarriers. The completely digital remote lock provides extremely rapid H locking by alteration of divider ratio, and the window principle allows incoming sync to jitter appreciably without effecting output sync. By moving the relative position of this timing window the 601 can be advanced or retarded with respect to remote sync. A binary thumbwheel switch selects time comb outputs in increments of 7, 0.7, and 0.07 useconds allowing output sync to lead or lag up the 13 useconds. Vertical lock is accomplished in one field, and vertical sync can be digitally advanced in increments of 0, 1, or 2 lines.

Circle Number 55 on Reader Reply Card

AM Transmitter

Continental Electronics Mfg. Co. has developed a new AM Broadcast Transmitter that through extensive use of solid-state devices requires only two tubes. It is offered as either a 10 kW (Type 316F) or 5 kW (Type 315F) transmitter.

The transmitter consists of two basic sections; a completely transistorized exciter having a modulated output and a two-tube linear amplifier. The solid-state exciter contains 22 NPN transistors with only two types being used. The RF line-up consists of a 2N697 crystal oscillator, two 2N697 and a DTS-423 buffer stages driving a single DTS-423-RF driver. This drives the RF output stage made up of four DTS-423 transistors.

The audio line-up consists of a 2N697 first amplifier followed by a DTS-423 direct coupled phase inverter that drives the high-efficiency push-pull modulator which utilizes six DTS-423's in a "single-ended push-pull" totem pole arrangement.

By eliminating all transformers in the audio circuit and using dual-level collector modulation, the exciter provides a high fidelity signal with 100 percent modulation capability from 20 to 20,000 Hertz.

Frequency Equalizer

Shure Brothers Inc., Evanston, Illinois, has announced a unique frequency-equalizing audio control center for numerous sound shaping and control applications in sound systems and broadcast and recording studios.

Called the M63 Audio Master, the new component is designed for use with Shure M68 and M67 Series of Microphone Mixers and other high level output devices to obtain an almost unlimited variety of response curves.

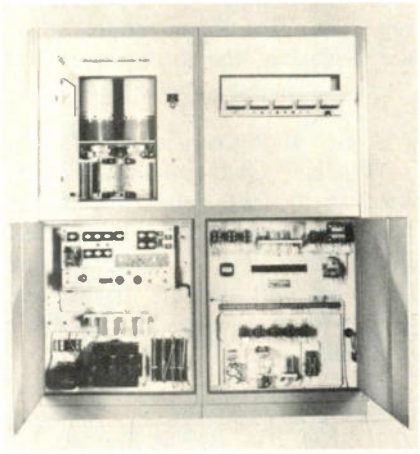
Applications for the Audio Master include converting the output device to a remote amplifier—with equalization—in broadcast stations, equalizing music and program material in broadcast and recording studios, frequency shaping to reduce feedback and enhance sound quality in sound systems, removing objectionable high or low frequency noise in public address systems, and providing audio control and monitoring facilities in multiple mixer applications.

Bass and treble controls, along with variable high-pass and low-pass filters and a volume control, give the Audio Master its sound-shaping abilities.

The Audio Master accepts two high level inputs, and has outputs for headphones, 600-ohm balanced line, high-low impedance microphone level, and auxiliary high impedance, high level. For monitoring applications, the new component has an illuminated VU meter.

Circle Number 56 on Reader Reply Card

Continental's Magniphase Antenna Protective Circuit is a part of the exciter and uses five 2N697 transistors. A "fault" condition in the antenna system or transmission



line, such as an arc caused by a short or lightning strike, is detected by a line coupler that causes a pulse to momentarily cut off the transmitter output, allowing the arc to clear.

The 40 watt modulated output from the exciter drives a linear amplifier which is operated Class AB_1 at approximately 60 percent plate efficiency. The 10 kW version uses two 4CX15,000A and the 5 kW uses two 4CX10,000D tubes. Long tube life is possible through conservative operation, reduced filament voltage, low plate dissipation, large emission reserve and no grid current.

Circle Number 57 on Reader Reply Card

Air Operated Vacuum Pumps

Two distinct types of venturi-type pumps are now available for either vacuum force or vacuum cleaning applications from **Air-Vac Engineering.** The AV Series Transducers are recommended for VACUUM FORCE ("Hg). The four different size units in this series have a straight-through compressed air passage producing up to 28" HC. vacuum and a vacuum flow up to 7.5 scfm. These pumps are not designed for vacuum removal of solid material. The TD SERIES Transducers are designed for vacuum cleaning applications. The straight-through vacuum passage allows solid materials to flow through the transducer without disrupting the vacuum flow. Three different sizes make up the TD Series.

AV and TD Transducers oper-

(Continued on page 60)

(Continued from page 59)

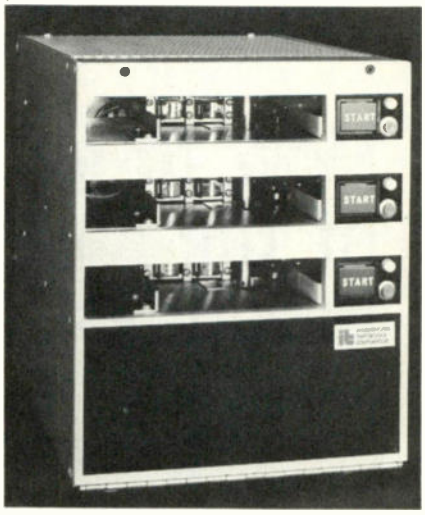
ate on standard compressed air at any pressure up to 80 psi. They contain no moving parts, and with clean, regulated air will provide years of continuous service, according to the manufacturer.

Applications include: Cleaning & Handling of delicate parts. Transfer of material and parts. Scrap removal in Fabricating Dies. De-soldering Equipment. Vacuum Holding in Automatic Machines. Removal of machined chips. Envelope size 2¾" x 2" x 1¾". Weight 2 to 5 oz.

Circle Number 58 on Reader Reply Card

Multi-deck Cart Machine

International Tapetronics Corporation of Bloomington, Illinois, has announced the market introduction of a multi-deck tape cartridge ma-



chine. The unit offers economies in both size and price with its compact construction and common capstan drive. Also available, is a recorder option which converts the bottom deck to record/reproduce.

Circle Number 59 on Reader Reply Card

Cable Laying Machine

Pipe Piper, the one-man machine that lays cable, wire, and flexible pipe underground without removing turf or earth, is proving to be a valuable asset to CATV contractors. Now used all over the United States, and according to the manufacturer, the **Sod-Master** Pipe Piper lays CATV cable faster and more economically than any open trenching method. In addition, the cable can be buried under the finest turf without any damage, and there is no time-consuming job of filling a trench, replacing turf, and contending with dissatisfied customers.

Pipe Piper machines are available in three models to bury cable, wire, or pipe at constant depths of from 5 inches to 16 inches. One man can handle the entire job of cable laying. The Pipe Piper model 180 is the largest of the three models.

Circle Number 60 on Reader Reply Card

UHF Converter

A UHF Converter for antenna site use in cable television systems has been announced by **C-COR Electronics, Inc.** of State College, Pa. This unit has all the state-of-the-art features believed available at this time.

The high performance unit is the only standard product available today with a balanced Schottky barrier diode mixer and crystal controlled local oscillator with the crystal in an oven. The balanced mixer does not generate many of the spurious outputs associated with single-ended type mixers which results in inherently cleaner signals. The oven housed crystal allows the unit to meet frequency stability requirements of the prosed FCC technical regulations and the Canadian Broadcast Procedure 23. A low noise UHF preamplifier is available on one of the models.

The converter was first produced on a military development and production contract for the Israeli Government and has since been adapted to cable television use by the C-COR Engineering Staff.

Circle Number 61 on Reader Reply Card

8 Channel Audio Console

QRK Electronic Products, Inc., Fresno, California, has introduced an 8-channel monaural audio console. QRK is a subsidiary of **CCA**

Electronics Corporation, Gloucester City, New Jersey.

Available through QRK dealers, the console, model QRK-8, contains a built-in 10-watt monitor amplifier and has facilities for handling 22 audio inputs and mixing eight into the single output stage. It weighs 35 pounds, is housed in a metal cabinet, and has dimensions of 26½" x 9" x 12".

The QRK-8 contains two plug-in amplifiers which are identical to the line amplifier. One serves as a cue while the other serves as an independent audition amplifier. The console is 100 percent solid state.

Circle Number 62 on Reader Reply Card

Microwave System

A completely solid-state low cost microwave system has been developed by **Scientific-Atlanta** for operation in the 12.2 to 12.7 GHz General Business Band and in the 12.7 to 12.95 GHz CATV CARS Band. Both color and monochrome television signals may be transmitted with this system in single-or-multiple hops over distances up to 25 miles in full compliance with FCC standards.

The oscillators for both the transmitter and the receiver are housed in weather-proof enclosures behind the antennas so that coaxial cabling may be used rather than waveguide. The system electronics are housed in 5¼" cabinets and system installation and operation is kept simple.

Gunn-effect and Impatt oscillators are utilized to extend operating life and to reduce costs. The transmitter power output is 10MW (+10 dBm). System's reliability is in excess of 99.9 percent, according to the manufacturer.

Circle Number 63 on Reader Reply Card

TECHNICAL DATA

For further information, circle data identification number on reader service card

100. ALLEN AVIONICS, INC.—Custom-built, standard fixed, variable, and laboratory-type delay lines are covered in a new 12-page catalog No. 14. Detailed is the recently expanded Spiradel line, including Mini-Spiradel, the world's smallest delay line having a time delay to rise time ratio greater than 5/1. Descriptions and specifications for various types of custom-built and stocked LC filters are also included.

101. AMPHENOL SALES DIV.—The Bunker-Ramo Corp. A new expanded line of RF coaxial connectors, now available in tranish-free ASTROplate finish is described in a new four-page brochure. The four-color publication includes details on the new N and TNC families and the significantly expanded, already popular BNC and UHF configurations. Between-series adapters are also included. The 31 additional coax connectors bring the total corrosion resistant ASTROplate line to 61 part numbers, although other types are available on special order. The brochure also describes Amphenol's ASTROplate finish process, which produces connectors that withstand corrosive environments, abrasion, constant handling and high temperatures (to 2600° F) without wear-off, discoloration or finish deterioration. Despite their many commercial advantages, ASTROplate RF connectors cost no more than conventional silver plated types.

102. AMPEX CORPORATION—An information sheet describing the Ampex VL-7404 broadcast video logging recorder which provides commercial and educational television stations with a complete audio and video record of up to 38 broadcast hours on a single reel of tape is now available.

103. CEA—a division of Berkleonics, Inc. A new 32-page catalog of Modular DC Power Supplies and Precision Voltage References is now available. In addition to their standard line of high regulation power supplies, CEA introduces the CEA2 Series of DC to DC Converters and the CEA3 Series of High Efficiency power supplies. Also included in this catalog are the Highly Shielded Line Isolators. All CEA Power Supplies include as standard the following features: series starting, no turn on or turn off overshoot, all silicon semi-conductors, and shielded transformers (important to the IC user). A unique ordering system allows selection in almost unlimited cross combination any desired center voltage from 3.5 to 500 volts with voltage adjustment ranges from ± 10% to ± 40%, classes of regulation from 10% to 0.0005%, shielding from 20 dB to 100 dB, output from 50 ma to 60 amp, and additional options covering remote voltage control, input power, protection circuits, and ruggedization. All specifications are guaranteed.

104. C. P. CLARE & CO.—High current switching in corrosive atmospheres, salt spray, dust and lint can be performed by the mercury displacement relays listed in a new two-color, eight-page catalog. Specifications listed include load ratings from 20 to 100 amperes, load voltages as high as 550 VAC or 240 VDC and contact resistances from 2 to 10 milliohms. Detailed data explains the capabilities of the relays to control inrush currents often fifteen times the relay load rating. Cross sectional drawings explain the principle of operation of the self-renewing mercury-to-mercury contacts and the inherent contact seal.

105. COMPUTER MEASUREMENTS CO.—A two-color, two-page data sheet which not only provides complete specifications on CMC's new low-cost high-performance Model 904 Universal Countertimer but also gives information on applications, features, options, and plug-ins is now available.

106. DIALIGHT CORP.—A new 28-page illustrated catalog describing a full line of illuminated push button switches and matching indicator lights is now available. The catalog (L-210) lists snap-in and panel mounting switches and indicators in round, square, and rectangular configurations. Of particular interest are a variety of transistorized illuminated push button switches and indicator lights designed for compatibility with integrated circuits. Both neon and incandescent lamps are available. These switches and indicators eliminate the need for special power supplies and interface circuitry. Specifications for a variety of push button caps are given to enable the designer to customize legend and color to suit the job. The many design options include: voltage of light source, shape of push button cap, underlying filter color, positive or negative legend on film or engraved in the cap, frame or cap color, and cap face color.

107. ELECTRONIC ENGINEERING CO. OF CALIF.—EP Div. EECO has published a detailed plan for preparing information for EECO's automatic wiring service, using plug-in dual-in-line integrated circuits. The new publication, "A Guide to Processing Logic Diagrams for Computer Aided Design", provides detailed information on the preferred form for the logic diagrams, nomenclature, and the step by step procedures for those engineers who wish to do the spade work needed to put the information in a form ready for card punching and computer entry. For those who do no wish to do this preparatory work, EECO requires only a hand drawn logic diagram. This brochure is a supplement to EECO's 32-page catalog describing the EECO 2-D system for wiring plug-in dual-in-line integrated circuits.

108. GRAYHILL, INC.—A new two-color button has been added to the Grayhill line of alternate action (push-on, push-off) push button switches. The two-color button gives positive indication of the Up or Down position of the button. The disappearing color ring can be black or red, which is opposite of the color on the top of the button. This indicator ring button has been designed into the 46-527 model switch. The 46-527RB part number is a red button with a black color ring. The 46-527BR is a black button with a red color ring. The

switch is rated at ¼ amp, 115 VAC resistive, with a life expectancy of 250,000 operations. More information about this switch is available in Bulletin No. 174.

109. GRAY RESEARCH AND DEVELOPMENT CO. DIV.—A new four-page brochure on Gray Research's Model 2570 Automatic Antenna Heater Control System is now available. The brochure gives system function, system components, system options, system development and theory of operation.

110. HEINEMANN ELECTRIC COMPANY—A new, illustrated Bulletin 3381 describes Heinemann Series JC Rocker Circuit Breakers, now available in one-, two-, and three-pole models. Since the modern white or gray rocker handle constitutes the major difference between this breaker and the familiar Series JA circuit breaker, Bulletin 3381 emphasizes, through illustrations and text, the highly decorative and utilitarian characteristics of the new JC handle. Handles are shown in various panel-mounted configurations, with contrasting color-filled lettering for ON and OFF. Single- and multi-pole JC breakers are shown mounted side-by-side in a rectangular panel cutout, with mounting screws concealed behind a simple escutcheon plate. Frequent reference is made to Heinemann Bulletin 3350 on Series JA breakers for electrical characteristics and applications of JC rocker-handle breakers. Outside dimensions and mounting instructions, which differ from those in Bulletin 3350, are given in detail.

111. INTEGRAL DATA DEVICES, INC.—An engineering bulletin describing their Reed Switching Matrix's is now available. The bulletin lists applications, optional features and characteristics.

112. ITT JENNINGS—European Components Div. An eight-page relay and switch catalog featuring unique printed-circuit relays (JAE) rated for 200 million operations is now available. Also included is a rotary switch (JSR) with printed-circuit mounting, available to 6-pole or 12-position options. It has the lowest profile height known to be available on the U.S. market. Other items are magnetic counter relays (JKAA), standard relays with

(Continued on page 64)

(Continued from page 63)

ratings from dry circuit to 15 amperes and printed circuit track switches (JRTA).

113. JERROLD ELECTRONICS CORP.—A new 56-page, full line general distributor catalog that includes a guide to MATV systems stresses the theme "for the best color TV picture anywhere." Covering several TV distribution product lines, the catalog includes nearly 300 Jerrold products, some of which are recent developments. Complete with product photos, specification tables, diagrams and drawings, the colorful complete product catalog also includes a ten-page section devoted to application and installation of products covered on all of the other pages. Categories of products include system and home antennas, amplifiers, preamplifiers plus a broad array of TV distribution components that covers networks, traps, filters, converters, modulators, demodulators, splitters, tap-offs, outlets, matching transformers, connectors, adapters, cameras and accessories.

114. LIBERTY INDUSTRIES, INC.—A new two-page data sheet tells how to eliminate airborne dust problems on VTR equipment. The Isolair Unit for VTR equipment requires no additional floor space, requires little maintenance, meets Federal Standard 209a, Class 100. The high efficiency of Isolair unit eliminates the need for any other dust control equipment.

115. LORAL DISTRIBUTOR PRODUCTS—A new 24-page electrolytic capacitor replacement guide is now available. The guide lists LDP's Arcolytic capacitor dealer-service replacement products by original manufacturers part number for color and black and white receivers, and includes Aerovox, Sprague and Mallory cross reference guides.

116. LUNDY ELECTRONIC & SYSTEMS, INC.—A 12-page catalog on their new line of miniature RFI/EMI filters is now available. Included are design data, descriptions and illustrations of five separate series: Button, L, Pi, T and Bolt. Full specifications include outline drawings, attenuation curves and rating tables.

117. RAYTHEON CO. — An eight-page brochure describing their QRD dual and twin dual power supplies is now available. The QRD's are highly regulated sources that have all the desirable features of precision laboratory power supplies, plus a high speed remote programming capability. Seven models are listed in the brochure, ranging in maximum output from 15 to 60 volts. Accessories and options are also listed. The high speed programming capability of the supplies makes them particularly suitable for digital and servo system applications. They can be used for power amplification of simple and complex waveforms at frequencies previously unattainable without substantial sacrifice of other performance characteristics.

118. RHG ELECTRONICS LABORATORY, INC. — A new two-page product bulletin describing their Airborne FM-TV Relay Links is now available. The company designs and manufactures a complete line of microwave receivers, transmitter and components. This series of microwave FM-TV links are complete transmitter-receiver combinations for use in high resolution FM-TV transmission and reception. Both receivers and transmitters are available at RF frequencies in L, S, C and X bands and are all solid state with the exception of the output TWT amplifier used with some of the higher power models. These self-contained units only require connection to the antenna and power source for operation. Photos, general information, system and individual specifications for the transmitter and receiver units, mechanical and environmental data, and standard and special options are described and illustrated.

119. SHARPE AUDIO DIV.—Scintrex Inc. A new Audio Visual Catalog is now available from Sharpe Audio. The Catalog lists and describes the Sharpe range of high quality headphones; headset microphones; cordless (induction) headsets; wireless (radio frequency) headsets; audio station and sound centres. There is also an extensive listing of impedances and radio frequencies.

120. SIEMENS CORPORATION—A four-page data sheet describing and illustrating the company's new line of AM/FM IF amplifiers is now available. The integrated circuits designed TAA-981

and TAA-991 are intended for use as combined AM/FM amplifier in high fidelity and communications receivers. The new bulletin includes electrical characteristics, test circuit drawings and specifications drawings.

121. SMITH COMPANY DIV.—Preformed Line Products Co. An illustrated brochure describing the Smith line of Sub-Surface Terminals for telephone cable use is now available. The terminals are the key components in the Preformed "ABC System" (All Buried Construction) for full burial of the outside plant. The brochure describes advantages of all-buried construction and presents a summary of test data on buried performance of the Preformed MONO-SEAL and "SST" terminals.

122. SPRAGUE ELECTRIC CO.—Bulletin 8132 describing their substantially broadened JX2000/3000 Series of subminiature EMI filters for use in high density packaging applications is now available. The bulletin gives complete information on standard designs, including maximum full load insertion loss curves. These miniature filters are available in amperage ratings from 100 mA to 7 amperes. Standard working voltages range from 100 to 250 volts DC at 85C and 125VAC at +125 C.

123. STANDFORD INTERNATIONAL—A new booklet on the fundamentals of microphones, including characteristics of each type is now available. The test includes much helpful information on microphone placement, feedback, and limiting factors. There is full information on microphone impedances, techniques and applications.

124. TELEX COMMUNICATIONS DIV.—A new catalog for their rapidly expanding Broadcast Industrial line is now available. The catalog covers over 30 general communication and dictation headphones and other private listening devices plus accessories. It highlights the innovative, new 1320 series communication headphones and the Announcers Earset(R). The eight page, two color catalog includes complete product information photographs and price.

125. TEXSCAN CORP.—A new 72-page product catalog outlining complete specification of all their sweep generators, RF attenuators and other related RF components is now available. Also included is an eight-page technical section which explains flatness, linearity, isolation and how these sweep generator specifications can effect measurements. Highlighted in the catalog are many new additions to the Texscan line. Included among these additions is the new SS series of solid state high power sweep generators. This series covers the frequency range of 1 MHz to 1000 MHz in five units with five watts output, variable sweep rates and sweep widths covering the entire frequency range. Also included is a new series of digitally programmable attenuators designed to meet programmable test requirements.

126. TIMES WIRE AND CABLE—Several spec sheets are available on cable featuring the JT-2340, 2412, 2500 and 2750 series that use solid copper clad aluminum wire with polyesterene insulation and seamless aluminum tubing shield.

127. TRIPLETT CORPORATION—A two-page data sheet featuring its new Model 8000 and 8000-A digital volt-ohm-milliammeters with true 0.1 percent DC accuracy, virtually no internal kickback current, high AC accuracy, nearly perfect AC linearity and 10 megohm input resistance plus "instant replay" memory circuit that retains reading indefinitely for later comparison, is now available. The two-color Triplett data sheet #5170 drilled with three holes for easy reference use also provided complete electrical ranges and mechanical specifications for both new digital VOM's as well as suggested user net prices.

128. TROMPETER ELECTRONICS, INC.—A new 44-page, 1970 catalog from Trompeter in full color and illustrating a complete line of COAX, TWINAX, and QUADRAX Connectors, Patch Panels, Plugs, Jacks, Patch Cords and Accessories. Great care went into the preparation of information detailing high and low frequency COAX switches and matrices employed in TV Broadcast, CATV, CCTV, ETV Communications, Telemetry, Telephone, Nuclear Instrumentation and Information Retrieval.

Robertson Is Appointed Director of National Educational Radio

James Robertson, coordinator of radio and television for University Extension and the University of Wisconsin, Madison, has been appointed director of National Educational Radio, a division of the National Association of Educational Broadcasters.

One of public broadcasting's leaders since 1954, he helped put WTTW, Chicago, on the air. He will administer a wide range of professional services to the nation's 400 public radio stations in the NAEB post he assumed November 1.

"Jim Robertson brings to public radio the kind of leadership it must have as it prepares to move into a new era of creative development and expanded service," said NAEB president William G. Harley. "Throughout his productive career, Jim has sustained his interest in public radio and encouraged many public television stations to initiate radio counterparts. He was instrumental in advancing the concept of a national radio program service which is now about to be established by National Public Radio. I am confident that he will enhance an already outstanding record in his new role at NAEB," Harley said.

Richard Estell, chairman of the NER board and general manager of WKAR at Michigan State University in East Lansing, said, "During this decade, two goals must be met if public radio is to survive: a vital, trustworthy and intelligent programming service via interconnected public radio stations and a vigorous trade and professional association dedicated to the task of developing, improving and ennobling public radio stations throughout the United States. I am confident that Jim Robertson will employ all his talents and capabilities in advancing the professional status of noncommercial radio and bring it the visibility and reputation it has so long sought. We are delighted to have such a highly respected broadcaster guiding the future of National Educational Radio."

Robertson has been at the University of Wisconsin since 1967. In addition to his supervision of WHA radio and WHA-TV, he has served for two years as chairman of an all-university committee on instructional media to encourage orderly development of media in improving university instruction.

During his tenure in Madison Robertson also assisted in drafting legislation creating the state Educational Communications Board which now coordinates state educational radio and TV and is developing a statewide public television network, and served as head of the state FM radio network.

From 1963 to 1967 he was executive vice president of Community Television of Southern California, a nonprofit corporation which operates KCET, Los Angeles. He was the corporation's chief executive officer and general manager of the station.

The importance of the Instructional Television Fixed Service band for both space and terrestrial communications for education has been underscored by the National Association of Educational Broadcasters.

The NAEB has strongly endorsed a recent filing by the Joint Council on Educational Telecommunications with the Federal Communications Commission, in which JCET argues for preferably exclusive use of the 2500-2690 MHz band for "the full range of spaceborne educational TV, public TV services, and other educational and non-commercial communications." JCET also asked for the allocation of an FM channel for space transmission.

In cooperation with other national educational groups, NAEB is leading an extensive effort to find positive data concerning terrestrial use of ITFS. The FCC has proposed the reservation of 28 of the 31 channels available in the ITFS band for educational use but NAEB wants the educational community to demonstrate as carefully as possible the extent to which it hopes to use ITFS.

In a letter to the FCC, NAEB president William G. Harley stressed that "the NAEB has repeatedly urged that effective provision should be made to accommodate the pressing needs of education in space." In regard to the JCET filing, Harley recommended that the FCC "take affirmative action along the lines indicated in these comments in order to assure that education's needs for frequency space in space are fully considered and satisfied."

FCC Grants Extension For Special Code Tests To Metromedia, Inc.

In response to a request by Metromedia, Inc., the Commission has granted special temporary authority for the period June 8 through September 8, 1970, for transmission of special coded signals in the visual transmissions of television stations WTTG (Channel 5), Washington, D. C., and KTTV (Channel 11), Los Angeles.

The transmissions are to assist the United States Naval Observatory (USNO) and the National Bureau of Standards (NBS) in conducting precise time dissemination experiments in the Washington and Los Angeles areas. It is believed that television can be used to disseminate time information more accurately than is now possible through the widely-used domestic radio time service and the experiments will aid in evaluation of the usefulness of television facilities for this purpose.

The test involves time-interval measurements between two local clock pulses and the arrival time of a horizontal synchronizing pulse from a local TV station. For the experiments, the Commission authorized use of line 16 of each field or such lines within the vertical blanking interval for the purpose of transmitting the coded time information. There would be no interference with the television picture or sound. The experiment, the Commission said, must comply with the transmission standards of Section 73.682(a)(21) of the rules.

Microwave Applications

Time for filing responses to 15 groups of specialized common carrier microwave applications has been extended by the Chief of the Common Carrier Bureau. The extensions were ordered to permit petitions to deny, oppositions, replies and other responses to be filed.

Oppositions and other responses to petitions to deny are to be filed within 30 days of the applicable periods of time and replies within 21 days of the applicable periods of time.

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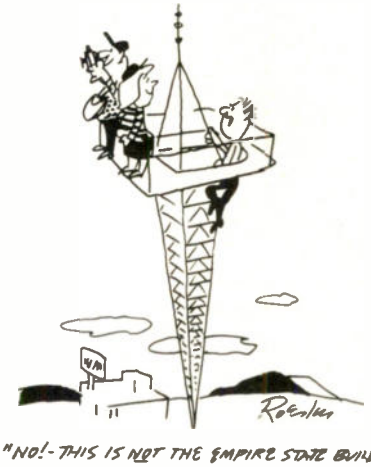

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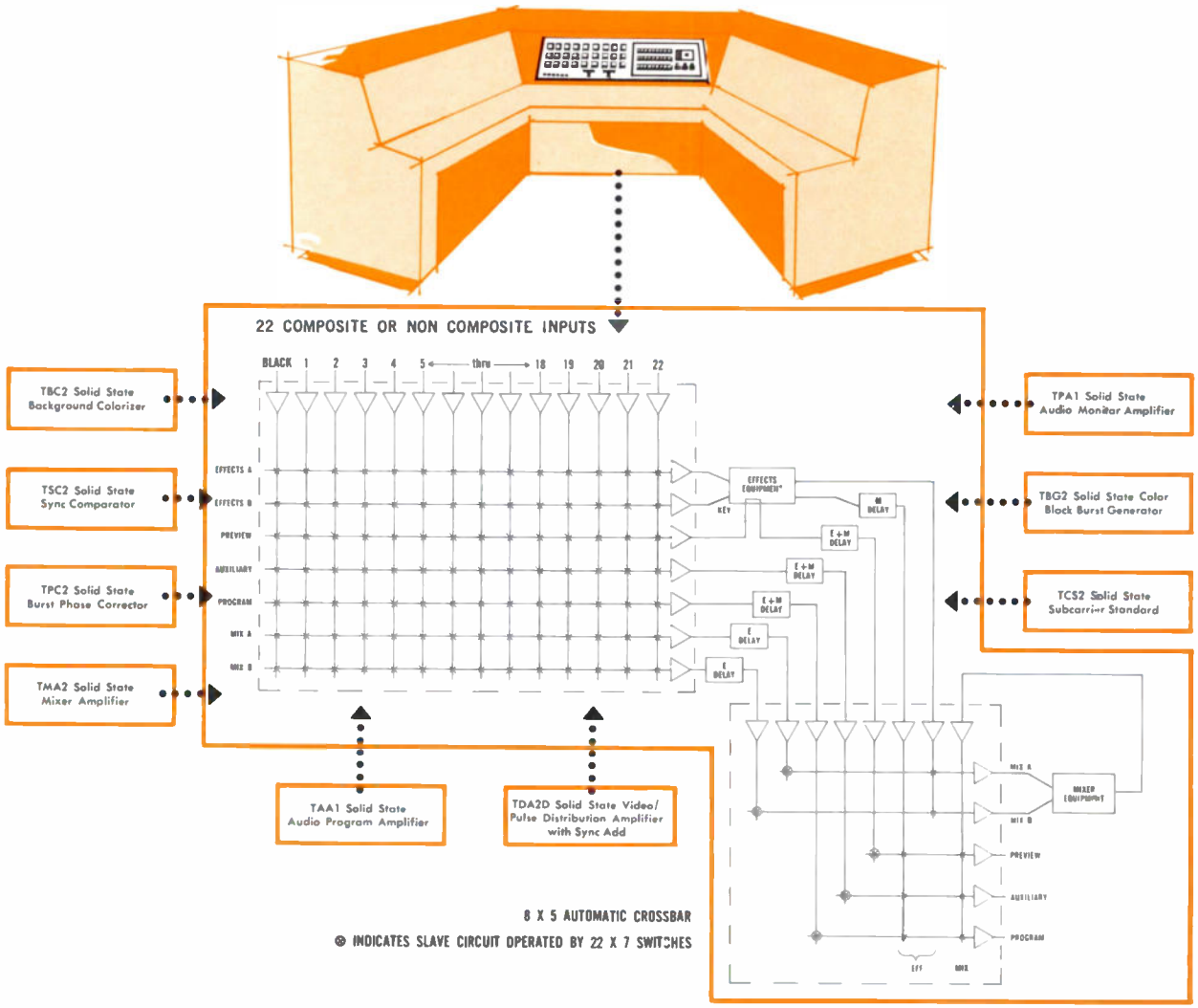

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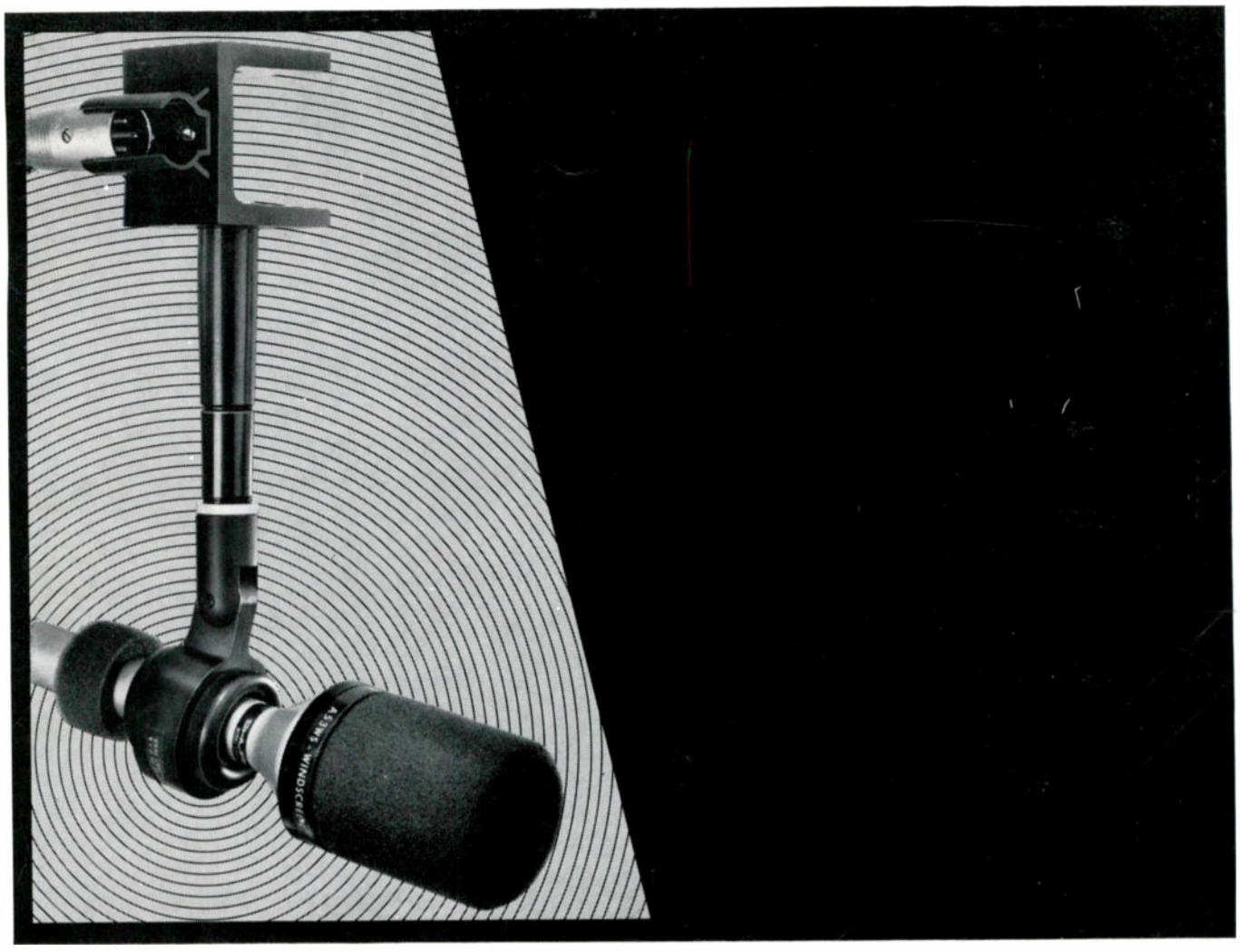

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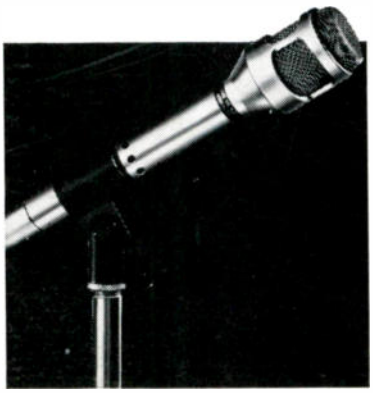

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