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Broadcast Engineering®

the technical journal of the broadcast-communications industry



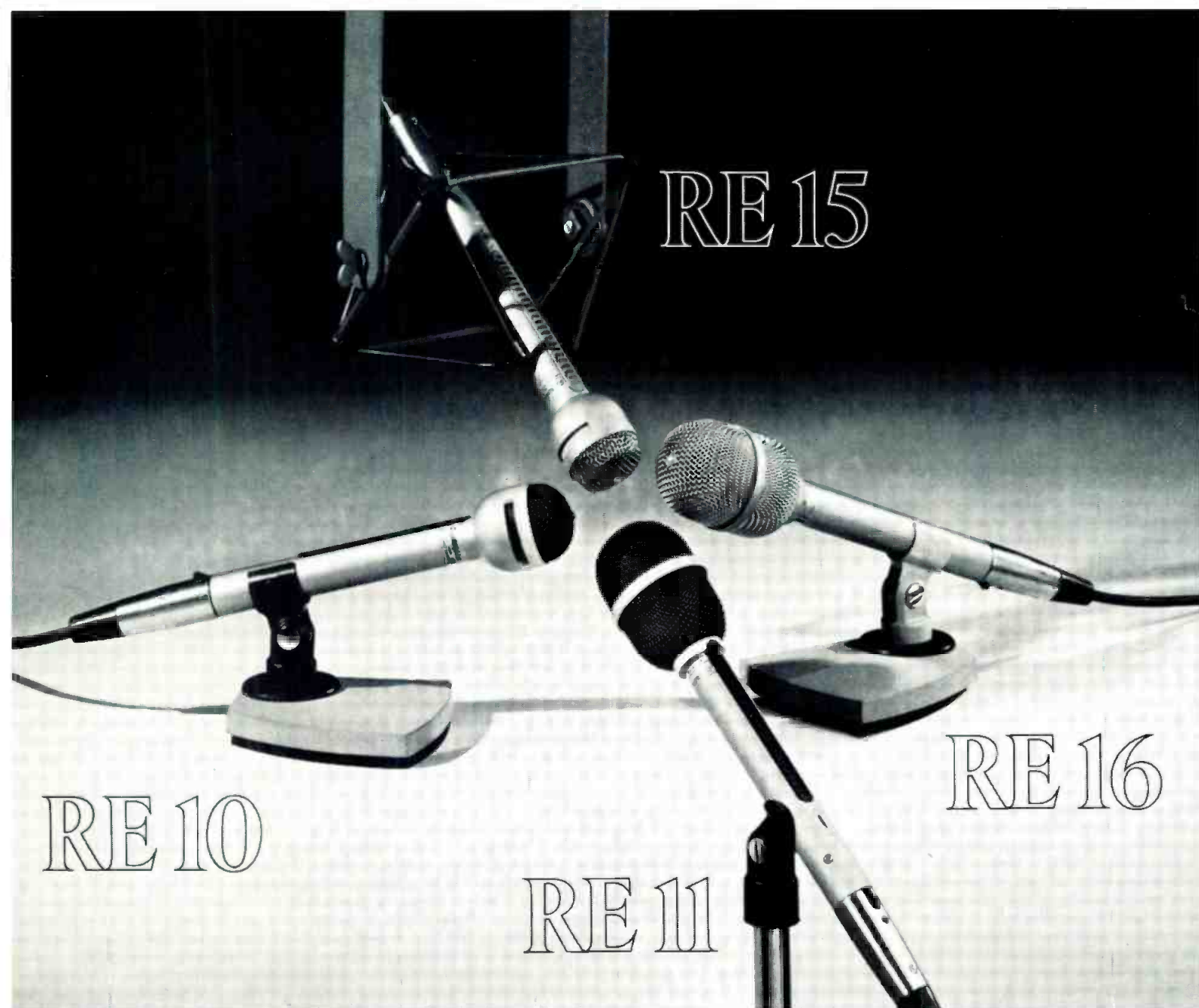
A HOWARD W. SAMS PUBLICATION

Pre-NAB convention issue

page 26



Audio Distortion Review
Super Modulation Docket
Stations In Mobile Homes



NEW Model RE10 \$156.00 shown on Model 421 desk stand \$18.50. Model RE15 \$265.00 shown with Model 307 suspension mount \$34.50. NEW Model RE11 \$166.00, shown with Model 311 snap-out stand adapter \$6.50. NEW Model RE16 \$275.00, shown on Model 421 desk stand \$18.50. List prices shown. Normal trade discounts apply.

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Ey Professional sound has entered a new era. It started with the Electro-Voice Model RE15. And now there are four E-V dynamic cardioid microphones that share its distinctive advantages — with some unique benefits of their own.

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Basic to all of these microphones is Exclusive Electro-Voice Continuously Variable-D* construction. Now it offers something you've never heard before with any microphone: no matter what you do, microphone response never varies!

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Only acoustics and noise can limit you. Yet even here these new E-V microphones gain an advantage from the super-cardioid pattern that provides better sound control than ordinary cardioids. With maximum rejection 150° off axis, it is easier to eliminate unwanted sound while maintaining normal stand or boom microphone positions. There's also an integral bass-tilt circuit to cut rumble below 100 Hz. when needed.

Now Select from Four Models

In addition to the original RE15, we've added the RE16. The same fine microphone with an external "pop" filter to solve the problems of ultra-close miking.

The new RE10 is the economy version of the RE15. The same concept and quality, but for slightly less rigid requirements. And the RE11 is the lower cost twin to the RE16.

These four great cardioid microphones give you new freedom to head off sound problems before they start. Your E-V microphone headquarters has them waiting. Choose today.

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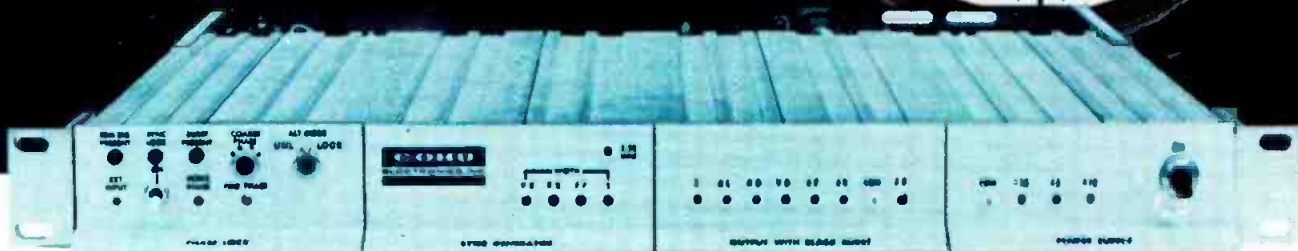
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timing is money



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

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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, a monochrome composite video signal, or an externally generated CW subcarrier 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.

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Broadcast Engineering

The technical journal of the broadcast-communications industry

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ABOUT THE COVER

At the NAB convention this year there will be greater evidence that most manufacturers are making their equipment more compatible with automation. For a roundup of new products to be introduced, see page 30. Photo courtesy of Sarkes Tarzian.

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EDITORIAL

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NAB
BOOTH 115

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DIRECT CURRENT FROM D. C.

March, 1971

By Howard T. Head

In last year's NAB issue of BROADCAST ENGINEERING, we inaugurated our Pompous Predictions feature, in which we endeavored to forecast FCC and other government actions for the year to come. Looking back and scoring last year's predictions, we find a reasonably good rating, with many failing to come true (or false) simply because the Commission did not get around to them.

The Commission is accelerating its pace but is preoccupied with non-technical matters. Hence, we predict that although there will be several important technical accomplishments during the next year, many other items will simply not be acted on for "priority" reasons. And so we bring your our . . .

1971 Pompous Predictions

VHF TV Remote Control: The Commission will act very shortly to authorize the remote control of VHF TV transmitters (we are sure of this one because we have been telling people the same thing for the last five years). The Commission's action will be closely tied to regular inspection and improved monitoring of the transmitting plant. This is sure to be a widely-discussed topic at the NAB sessions.

FM Interference to TV Reception: The Commission will issue a Notice of Inquiry looking into measures to relieve the problem of FM interference to TV reception. Broadcasters and receiver manufacturers will be urged to organize a committee to investigate additional measures, particularly those at the local level involving existing receivers. Meanwhile, the increasing availability of Federal funds for the construction of "public" FM stations will put more pressure on the Commission to authorize additional high-powered stations in the band.

CATV Technical Standards: Final comments in this matter were filed with the Commission just last month with most of the filings, including those from cable interests, generally in agreement with the proposition of establishing CATV Technical Standards. Final action may come during the coming year, but this would be rather close timing. A committee to study future changes in the Standards probably will be formed at the time the Commission acts.

Operator Requirements: The Commission has just received final Industry comments on the NAB proposal to permit use of third-class operators for many phases of broadcast operation for which a first-class ticket is now required. Final action on these proposals during the coming year is unlikely, especially if any substantial opposition develops.

(Continued on page 6)

★ Revolutionary ★



Vidifont

If Ben Franklin had Vidifont, "Poor Richard's Almanac" would have been on television. It took 200 years, however, for graphic arts to produce Vidifont. This new generation television display system, by CBS Laboratories, offers advantages never before available in the broadcast industry.

- ★ A choice of several type fonts and sizes.
- ★ Exclusive proportional letter spacing.
- ★ A unique type font (CBS NEWS 36) that is graphically superior to any being used today.
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- ★ Automatic editing and centering. ★ Word by word color.
- ★ Three speed crawl and character edging. ★ Flashing and blinking.
- ★ And message storing. Vidifont adds a new dimension to television display and opens up a whole new area of programming possibilities for your station.

SEE AND TRY VIDIFONT FOR YOURSELF AT BOOTH 304, NAB, CHICAGO

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AM Freeze: The "freeze" on new AM grants, which has been solid for the past year, will be lifted slightly. New AM stations will be granted only in very special cases, but emphasis will be placed on improvements in existing facilities and service to ethnic minorities.

Coded TV Commercials: Coded TV commercials using the Digisonics process will be supplied to stations in increasing numbers. The Commission will continue to extend its temporary relaxation of the Technical Standards to permit transmission of the Digisonics code (see December, 1970 D.C.). An SMPTE Committee will be formed and will conclude that the Technical Standards must be permanently relaxed if the coded commercials are to meet the requirements.

All-Channel TV Receiver Tuning: By the middle of 1971 at least 10 percent of all new television receiver models will provide comparable ease of UHF-VHF tuning. By the following year, this percentage will be more than doubled.

NBS Time Signal: The National Bureau of Standards will change its schedule of standard time transmission around the middle of July so as to provide a voice announcement each minute rather than each five minutes as is now the practice.

AM Modulation Levels: The Commission will impose an upper limit on positive modulation peaks for AM broadcast transmitters. A wide range of values has been proposed but we will stick our neck out and predict that the NAB request for a 115 percent limit will be the one the Commission adopts.

Part 74 Revisions: The Commission will give careful study to the revision of Part 74 (broadcast auxiliary services) of the Commission's Rules proposed by NAB and will issue a Notice proposing their adoption. However, time will not permit the rules to become final during the coming year.

TV Propagation Curves: Internal disagreement continues at the Commission concerning the adoption of new TV propagation curves first proposed in 1965. The Commission will issue a new Notice of Proposed Rule Making, proposing to lower the signal levels required for Grade A and Grade B coverage at UHF, taking into account improved receiver noise figures.

Color TV Improvement: The Broadcast Transmission System Committee of EIA will continue to test the vertical interval reference (VIR) color signal. The Joint Committee for Intersociety Coordination (JCIC) will report on studies of color TV receiver performance.

Land Mobile Sharing of TV Channels: The Commission will authorize the first actual sharing of land mobile transmitters of UHF Channels 14-20 in the top ten metropolitan areas. There will be no formal proposals for more UHF TV channel diversion to land mobile during the coming year. Proposals for land mobile sharing of VHF TV channels will not be renewed.

Auto Radio Antennas: NAB has been quietly working with the major automobile radio receiver manufacturers to solve the problems created by the trend to "invisible" antennas imbedded in the windshield (see August, 1970 D.C.). The receiver designers will improve the performance of both the antennas and receivers but progress will be slow.

Look at the Difference



Unretouched photographs of 21" studio monitor. Photographic data: Rolleiiflex C-3, CPS color negative film — ASA 100, 1/15 second at f/5.6

...after 3M Color Dropout Compensation

Here's what 3M's Color Dropout Compensator does for your VTR reproduction:

Look at this unretouched composite photograph of a studio monitor. It shows, at the left, a videotape playback with 13 electronically recorded-in dropouts. These dropouts were created by a special test generator which attenuates the RF level to the record driver. On the right, these dropouts have been completely restored by the DOC.

The black dropouts shown on the left are followed by a complete loss of color-lock in the direct color recovery equipment. Since these dropouts include horizontal sync and color burst, they cause transient color flashing not ordinarily attributed to the dropouts themselves. Even shallow dropouts can create a similar problem due to loss of side-band information.

Only the 3M Color DOC corrects all these effects.

After compensation, note the precise color match and complete freedom from switching transients. Also, the dropout disturbance to the time correction unit has been eliminated. Proc amp and

servo stability are improved to such a degree that it is possible to play this tape in full intersync or pixloc mode.

In the compensated half of the photo, compare the replacement material with the original signal two scan lines above the dropout due to a *complete* frame being photographed. Try to find the 13 switching transients.

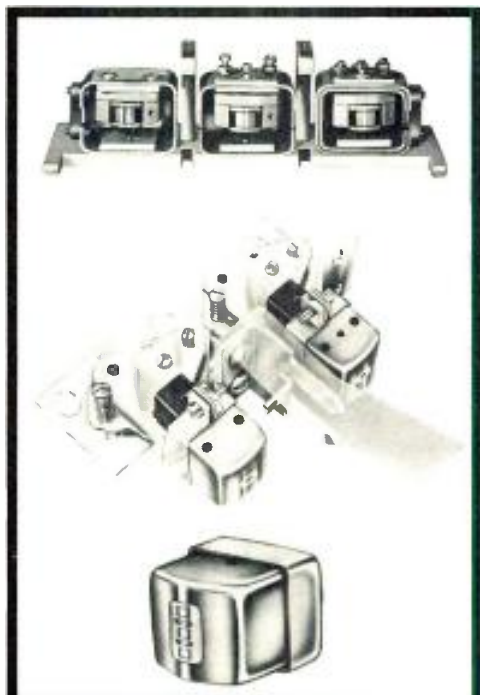


The 3M Color Dropout Compensator is the only system available that can provide proper color and luminance replacement. For details write for the booklet, "Compensating for Dropouts in Color Television Recording."

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LETTERS TO THE EDITOR

Monaural Pickup Tips

Dear Editor:

With reference to Mr. Bubbers' excellent article, "Optimizing Stereo Phonograph Pickup Performance" in the December issue, I wish to offer an easy application of his recommendations for monaural stations. Specifically, this applies to converting the popular Gates tube-type equalized preamplifiers from shunt-resistance loading to Mr. Bubbers' recommendation for equalization, and using a modern stereo pickup:

(1) Remove the compensator leads from the preamp input terminals and substitute a 47,000 ohm resistor. (2) Locate the two series resistors in feedback from the second-stage plate to the first-stage cathode: One has a .003-mfd capacitor in parallel. Add a 510-pf mica in parallel with the other resistor. (3) Using a Stanton 500A stereo pickup with its output channels paralleled at the pickup's terminals, the NAB Test Record (1964) will reproduce 30-15,000 Hz within 1 dB.

At a tracking force of 2 grams, the 500A pickup offers excellent performance consistent with remarkable durability and very low stylus replacement cost. Record wear becomes virtually unknown, and there will never be a back-cue scratch on even the cheapest disc pressings. The shank of the stylus is notably shorter than found on most other brands, and it is much less prone to accidental bending while still offering high compliance. The high recording levels exhibited on new records demands the high compliance of a stereo pickup, especially on 45-rpm singles, even if broadcast in mono. The old mono pickups were not meant for today's records!

The disconnected compensator is a blessing: No more knobs which most disc-jockeys do not understand and which usually bring more grief than benefit. With the modern

standardized recording curve, the variable compensator is an unnecessary "DJ hazard." And we all know about the myriad "hazards" a DJ can find in a control room!

William A. Kingman
Chief Engineer
KTHO-AM-FM
South Lake Tahoe, Calif.

Do License Schools Widen The Gap?

Dear Editor:

I have withheld comment on the Management-Engineering FCC controversy. However, I have enjoyed reading the comments of others in the business. You can be sure that there exists red-hot sentiment in this particular area of broadcasting, even though many of the letters don't show it. There exists a "great gulf" of misunderstanding and a lack of understanding of the problems facing the Engineer/Technician in most operations. Especially the smaller operations. The "90-Day Wonder License Mills" are definitely not helping. In my opinion, the FCC should outlaw these "schools".

Henly McElveen, Jr.
Chief Engineer
Station WJOT
Lake City, S.C.

Dear Editor:

I have been reading with interest the various criticisms of so-called "Cram-Courses, or Six-Week Wonders" that prepare a person to successfully pass the FCC First Phone Exams.

These criticisms are well founded; however, it is obvious the FCC does not care if a person is capable of becoming a good or bad technician as long as he has the correct answers to pass the exam. His test results do not determine his quali-

DITCH WITCH '71...

THE NEW VP12 VIBRATORY PLOW

**Installs service lines,
tubing without trenching**



THE DITCH WITCH VP12, a completely new vibratory plow. It is a self-propelled, four-wheel-drive power-steerable unit that buries service or drop wire and copper, plastic, or steel tubing to diameters of $\frac{3}{8}$ " without trenching! Turf damage is held to absolute minimum. The plow shaker is powered mechanically by a 25-HP air-cooled engine independently of the dual-range hydraulic four-wheel-drive. Stability on hill-sides and rough terrain provides unmatched operator safety. Controls are easy-to-reach for operator convenience. Compactness provides maximum maneuverability in tight places and one man easily can load the VP12 in a small van, the back of a pickup or on a Ditch Witch trailer. It will move through a standard yard gate with room to spare. Available with either feed or pull blade for installation speeds up to 150 FPM.



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music's
"markets of
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Here's how you
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There *ought* to be, and now there *is*—with Permadyne's new solid-state SCA receiver.

Permadyne's receiver makes it easy, economical—and immediately *profitable*—to extend your background music service to the new growth areas your present signal doesn't reach—before your competition does.

No changes in your present transmission equipment are required to achieve this longer reach. And your modest investment of \$120.00 per receiver pays for itself in additional billing within months.

To make this profitable investment simply mail this coupon or your purchase order to Permadyne. Or call Gerry Lundt at (312) 525-5559 for fast answers to any questions you may have. Do it today. Your new markets are waiting, and your competition won't.

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(ADDRESS) _____

CITY _____ STATE _____ ZIP _____

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our consideration.

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fications or performances.

It would be interesting to see the persons who criticize these type of courses go and take the exam. How many of them could actually pass the present ones, even with all their years of experience and knowledge?

Although these quick preparation courses do fail to make an "electronic genius" of a person, they do have their merits, especially when taking the FCC exam.

Eugene Faulkner
Bakersfield, Calif.

No test given by the FCC can assure the hiring licensee that the operator will strive to continue his education, stay up to date on Rule changes, and always act responsibly. Perhaps the question falls more reasonably in the lap of the chief engineer, engineering director, or whoever interviews and hires.

Fact is, the test, if it were perfect in its technical probing, would give no more assurance to the hiring licensee than the auto license tests do for you as a motorist among thousands each morning. If there is a problem with the License schools, it lies in the fact that they are too competitive!

Competition often makes for better business. But when one school promises to get the student through a course faster than another school, the result will be the poliferation of people who know how to pass a test.

The Editor

Shooting The Gap

Dear Editor:

After all of these years it was a pleasure to read Part 1 of your coverage on the "Gap Between Management And Engineering". I look forward to the second part but with very little hope that the "Gap" can be bridged no matter who says what. It is a matter that has concerned me for many years and in spite of all the verbal explosions which must have taken place from coast to coast, few are sufficiently brave to write upon the subject.

As for pay, I can take issue with the article concerning the "Rate" of increase for, as Chief Engineer of an AM, FM, and FM-Stereo station I received no increase at all during the three years I worked in that capacity. During that period of time

I had added Stereo, then SCA facilities, and finally we went to a 24-hour schedule. I didn't just "add" stereo; I bent the conduit, wired the studio, built the audio console, etc. The owner had his office next door to the manager in the same building and I was the first employee he had ever had who didn't work 8 to 5 and he couldn't understand any other arrangement. After a night of maintenance it was standard practice to call me in on some excuse as soon as he arrived and found me missing. The day finally arrived when I could stand the strain and loss of sleep no more, so I flopped in a chair in his office and in no uncertain terms clarified the point that he was more interested in watching me than the station's operation and since that was obviously what he was paying me for I would sit there and let him stare at me while the station fell down around his ears. He was afraid to fire me because he felt certain he couldn't replace me for the same salary. This sort of thing is, I'm afraid, more common-place than many people realize.

William C. Watson
Yorktown, Pa.

FCC File Tips

Dear Editor:

A bit of planning can prevent a few embarrassing moments (and a couple of citations) when the FCC inspector visits with a method that this engineer has found to be extremely successful.

In our control room, we have two Manila envelopes. In one is kept a copy of the most recent common-point, non-directional antenna impedance measurements along with the audio proof-of-performances for the last four years and any other information that would be of concern to the inspector. In the second, is kept information relating to the Emergency Broadcast System instructions, and what the operator on duty would be required to do if an actual emergency condition ever presented itself.

The inspector will usually appreciate your planning ahead and having the material readily available.

David P. Hebert, CE
Radio Station KXRO
Aberdeen, Wash.

ROTEC EXTRA SPECIAL EFFECTS

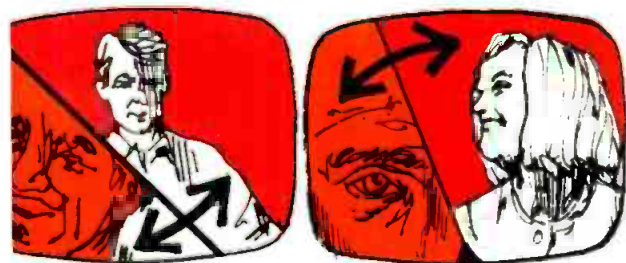
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ROTATING 4-WAY SPLIT



ROTATING 2-WAY SPLIT



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SUPER FEATURES



4-way and 2-way split can be rotated



Center of rotation can be moved off center creating asymmetrical quadrants.



Unusual wipes never seen before—demarcation line pivots from any corner or any midpoint.



1 3/4" rack space



Self-contained power supply



Can be used with your present switcher.

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THE CARTRIDGE KILLER.

This man doesn't have time to baby the tools of his trade. Not with a commercial, a traffic report and time check breathing down his neck. He's got to keep those records spinning fast and furious. And, if he kills a cartridge or two along the way, well—that's how it goes.

Until now.

Meet the Stanton 500AL—the cartridge that's tougher than disc jockeys. Here is the workhorse of the broadcast industry. We designed the entire stylus assembly to withstand the rugged demands of back cueing and the kind of handling that would quickly ruin ordinary pickups. Yet its high restoring force and tracking reliability is accomplished without sacrifice of professional standards for frequency response, output, channel separation, etc.

The Stanton Model 500AL is just one of many cartridges engineered by Stanton for the varied and critical applications in the fields of broadcasting and recording. For nothing less than Stanton performance and reliability would meet the needs of the engineers who have made Stanton—The Professional Standard.

For free literature write to Stanton Magnetics, Inc., Terminal Drive, Plainview, L.I., New York 11803



See us at N. A. B. Convention, Conrad Hilton Hotel, March 28-31, Room 208.

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INDUSTRY NEWS

Random Basis For EBS Tests

Under procedures adopted by the Federal Communications Commission, testing of the Emergency Broadcast System (EBS) will now be carried out on a random basis. Tests had been conducted previously with prior notification to participants.

The EBS is a network of broadcast stations, throughout the fifty States, Puerto Rico, Guam and the Virgin Islands, organized to provide communications in time of emergency.

The new procedures call for unscheduled tests to be conducted at least once every three months, but not more than once a month. Test areas are to be selected by the Military Assistant's Office and the White House Communications Agency. In addition, two broadcast industry representatives will participate in the origination of the tests.

Selected stations participating in the tests will be requested to report to the FCC on the results of the exercise.

Broadcast licensees, commercial radio and television networks, and other non-government communications services regulated by the FCC participate in EBS activities on a voluntary basis. All broadcast stations are required to maintain equipment to receive EBS notifications. These are transmitted to more than 6,000 broadcast stations by the Associated Press and the United Press International news services. Follow-up notification is carried out through the radio and television networks and by off-the-air monitoring, by licensees, of specific broadcast stations.

When the EBS is activated by the President all commercial activity must cease and only authorized stations may remain on the air to transmit a common program. The EBS may also be used on a local basis for storms and similar emergencies.

The Federal Communications Commission is responsible for de-

veloping emergency systems in all areas of non-governmental communications. It is assisted in this work by the National Industry Advisory Committee (NIAC) which operates at national, regional, State and local levels to prepare emergency communications plans, systems, and procedures. The new random testing procedures were prepared by NIAC Working Group I, Broadcasting Services Subcommittee.

Documents Filed With FCC Must Be In Before 5 p.m.

Section 1.4(c) of the Commission's Rules requires that all petitions, pleadings, tariffs and other documents filed with the Commission must be tendered for filing in **complete** form before 5:00 p.m. Any such document lodged with the Commission in complete form after 5:00 p.m. shall be deemed to be tendered for filing as of the next succeeding business day.

The volume of filings and the scarcity of space in the Office of the Secretary make it imperative that the filings be in order when delivered to the Office of the Secretary and not readily susceptible to separation. The FCC requests that filings be made early in the day in order to reduce the confusion, congestion and overtime work that result from late afternoon filings.

A request for one stamped copy of a filing will be honored at the time of filing. However, the stamp will be imprinted only on the letter of transmittal, if any, or the top page of any filing, e.g. on renewal filings the letter of transmittal or the top page of the application form only will be stamped. This service will be for one copy to be returned to counsel or party making such filings.

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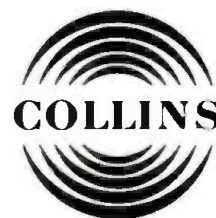
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Radiation Rules Amended

Part 73 of the rules has been amended by the FCC to specify a standard method for calculating radiation for use in evaluating interference, coverage and overlap of mutually prohibited contours in the standard broadcast service (Docket 16222).

The new amendments replace the existing MEOV concept and will govern the design and measurement of directional radiation patterns for standard broadcast stations to make possible the establishment of radiation patterns directly adaptable to computerized interference studies. (MEOV, maximum expected operating values, is approximate, is not computed mathematically, and has no fixed relationship to the basic antenna pattern.)

The proceeding began when the Commission issued a Notice of Proposed Rule Making in October 1965. This notice, which generated great interest and led to detailed studies by various industry organizations and engineering consultants, was followed by a Further Notice adopted on November 19, 1969. Comments were submitted by Columbia Broadcasting System, Inc. (CBS); Robert A. Jones, Consulting Engineer; Association of Federal Communications Consulting Engineers (AFCEE); A. D. Ring and Associates; Clear Channel Broadcasting Service (CCBS); Association on Broadcasting Standards, Inc. (ABS); A Earl Cullum and Associates; and WCAR, Inc.

The new rules would require that interference and service determinations be made through use of a "standard radiation pattern," constructed by adding to the theoretically computed pattern components of specified size, producing an envelope sufficiently large to contain the measured fields of the operating antenna. The detailed procedure for constructing the standard pattern is specified in the new rules, together with procedures which must be followed if the measured fields exceed the standard pattern.

In adopting the new amendments, the Commission said that it will no

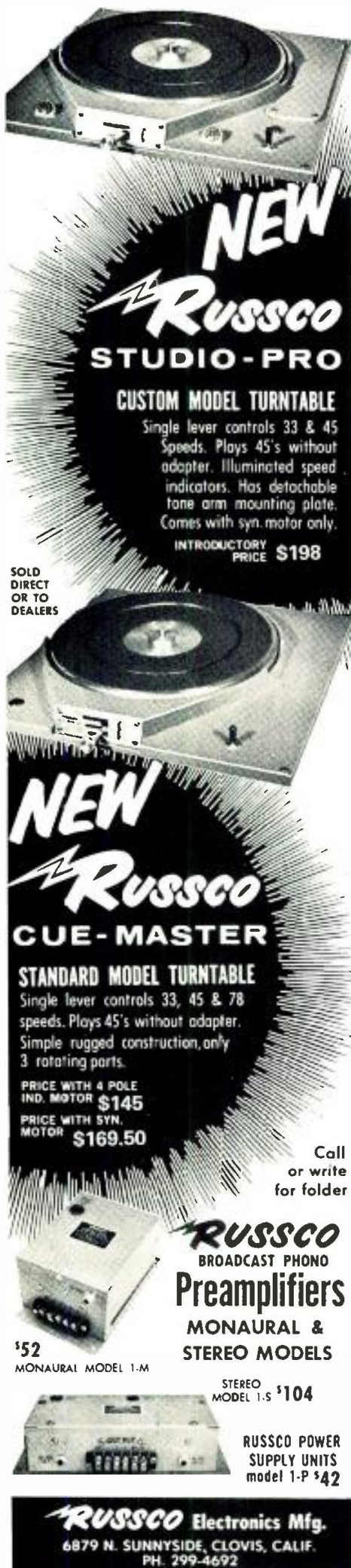
longer require that a measured pattern be furnished in connection with a proof of performance; a tabulation of the measured fields will be sufficient. A statement of the RMS (Root Means Squared—what the size of the antenna pattern would be if the pattern were nondirectional) value of the pattern is to be included in the submission.

While no formal procedure was specified in the rules under which uncorrected reradiation effects at a proposed antenna site would be evaluated and expressed by suitable allowances in the radiation pattern, the Commission pointed out that if an analysis of reradiation conditions in the vicinity of a proposed site is desirable, and if it indicates that there will be difficulty in adjusting an array to the minimums required to protect other stations, then the site might be considered unsuitable for the proposed directional operation.

The Commission said that while it was not establishing rules to govern the acceptability of standard patterns incorporating radiation minimums lower than required by the general rules, it would consider such proposals on an individual basis.

If the applicant makes a suitable showing that the proposed operation is practical, the Commission said, it would act favorably—but only if he could show that the proposed antenna site is suitable in all respects, that the design of the array will insure stable operation, that the current and phase monitoring system is accurate, that departures in relative current amplitudes and phases too small to be accurately measured by the monitoring system will not result in objectionable interference to other stations, and that phase or current deviation will be easily corrected by operators normally manning the directional installation.

The Commission said that it would make "every effort" to persuade Canada and Mexico to adopt the standard pattern for new assignments because in order to con-



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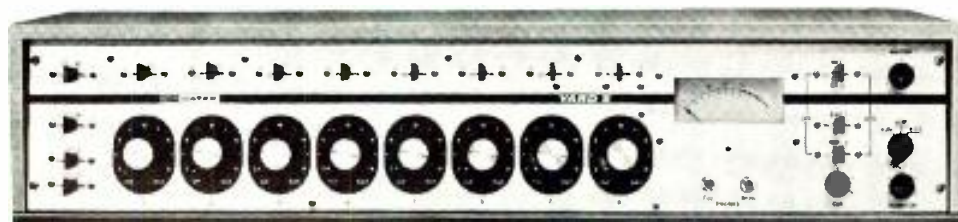


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INDUSTRY NEWS

(Continued from page 14)

vert radiation patterns for existing stations in this country into a standard pattern format, an understanding must be reached with neighboring countries since each standard pattern will be larger than the presently accepted theoretical pattern, and "paper" increases in the level of interference to Canadian and Mexican stations might sometimes occur.

The Commission said that if understandings can be reached, the use

of the same pattern for each station for determining interference to both domestic and foreign stations "— an important objective of this proceeding—" should become feasible.

The NAB has urged the Federal Communication Commission to eliminate the requirement for resistors on transmitters of non-directional stations where the radiated signal must be limited.

In a filing supporting an earlier petition by the Chesapeake Broadcasting Corp., John B. Summers, NAB chief counsel, noted that the

Commission already has recognized that the use of resistors for directional stations is "unnecessary and wasteful." NAB said that where the radiated signal must be adjusted, the FCC has allowed the station simply to reduce the power output of the transmitter to the necessary level.

"It is only fair that this relaxation of the requirements applicable to directional stations should be accorded to non-directional stations as well," NAB said.

Houser Sworn In As New Commissioner

Commissioner Robert Wells has been sworn in to a full term on the Federal Communications Commission. He was appointed by President Nixon on January 5, 1971, for the term ending June 30, 1977.

Commissioner Wells joined the Commission on November 6, 1969, replacing Commissioner James J. Wadsworth for the term ending June 30, 1971. Commissioner Thomas J. Houser was appointed by the President for the remainder of this term.

Commissioner Houser served as an Attorney with the Association of Western Railways, Chicago, Illinois, from 1959-1961, and as Commerce Counsel with the Chicago, Burlington and Quincy Railroad, Chicago, Illinois, from 1961-1966. He was manager for Charles H. Percy's campaign for Senator from Illinois in 1966 and served as Special Counsel for Senator Percy in 1966 and 1967. Before joining the Peace Corps in June 1969, he was associated with the law firm of Leibman, Williams, Bennett, Baird and Minnow, Chicago, Illinois.

A member of the American and Chicago Bar Associations, Commissioner Houser served on the Fair Trial-Free Press Special Committee of the Chicago Bar Association. He was also Secretary of the Executive Committee of the National Railroad Transportation Institute and is a member of the Executive Club of Chicago.

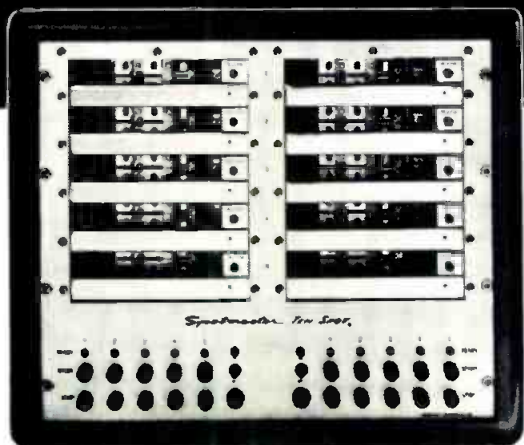
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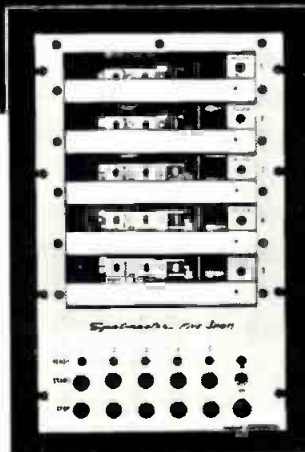
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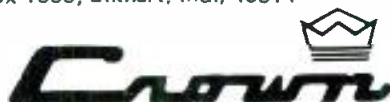
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A Step Forward

NSPE Services For IEEE

In an action that leaders of two major organizations hailed as a most significant step toward cooperation within the engineering profession in decades, members of the 160,000-member Institute of Electrical and Electronics Engineers now will be able to take advantage of certain services and publications offered by the National Society of Professional Engineers.

The new services will be available at varying fees, and will include eligibility to participate in such activities as the NSPE Employment Referral service and retirement program, NSPE legislative programs, receipt of many NSPE publications, as well as some participation in state and local services.

"In our broad discussions with leaders of IEEE during the past weeks, we learned that many of their members have expressed a desire for greater participation in the nontechnical problems facing our profession," said NSPE President Harry C. Simrall, P. E. "These activities parallel very closely the areas in which the NSPE has been involved for many years. The items in which these men are interested include government liaison, both in the legislative process and the administrative decisions, and at the Federal state and local levels. They are concerned with broad employment problems, ranging from the current problems they have as individuals; and collectively in such things as portable pensions, patent right and registration.

"They are anxious for unified action in improving the image and status of the profession through public relations and such professional matters as guidance, ethics and co-operation and liaison with other professional groups. They desire to participate individually in the decision-making process and to be a part of an organizational pattern that is effective at Federal, state and local levels. They do not see the need for another organization."

Commenting on this agreement, Dr. James H. Mulligan, Jr., Presi-

dent of the IEEE, stated; "The leadership is well aware of the increasing interest of many of its members in matters of economic, social and political involvement. IEEE has traditionally limited its activities to the dissemination of technical information concerning electrical and electronic technology. In contrast, the NSPE has limited its activities to the nontechnical area and has developed programs and accumulated expertise in many areas in which IEEE members are presently expressing concern."

POPSI Available Now

A detailed analysis of data from a study of precipitation and off-path scatter interference (POPSI)—conducted by the FCC, the United States Air Force and other Government agencies to evaluate the interference potential of microwave signals scattered from their intended path by rain, hail or other atmospheric conditions—has been released by the Research Division of the FCC Office of Chief Engineer. The analysis, Report No. R-7003, "FCC/USAF POPSI Project—Detailed Analysis of Precipitation Data," is dated December 15, 1970.

The POPSI study was carried out by the FCC and the Air Force from February 15, 1966, until February 16, 1967, with the cooperation of the United States Coast Guard, the Federal Aviation Administration, the United States Weather Bureau and the National Aeronautics and Space Administration. It was "an investigation of the signal power scattered from precipitation and other mechanisms in the common volumes established by the intersections of the beams from transmitting antenna operating in a configuration simulating a satellite earth station and receiving antennas configured in a manner typical of terrestrial microwave radio-relay stations," the FCC Research Division stated in its current analysis. The investigation was conducted in an area near the New Jersey coast.

SMPTE Program Slate Ready

Frank P. Clark of the Research Center of the Association of Motion Picture and Television Producers, Hollywood, has been named program chairman for the 109th Technical Conference of the Society of Motion Picture and Television Engineers. The Conference will be held April 25-30 at the Century Plaza Hotel in Los Angeles.

The program will consist of a wide variety of topics in both motion-pictures and television engineering. As in past SMPTE Conferences a number of papers will be directed toward informing the scientists, engineers, technicians and executives attending the Conference of new developments in the state of the art in motion-pictures and television.

Clark said topics for the Conference have been planned and sessions will include: Laboratory Practices, Studio Practices, Animation, Sound, Projection, High-Speed Photography, Medical Applications, Education, CATV, Television, Color in Film and Tape, Optics, Motion Pictures and Television in Science, and Industry and Control Technology.

So far a number of papers have been scheduled for presentation in each session. However, there is still limited room on the program for exceptional papers that may fit in particular sessions. Inquiries should be addressed to SMPTE Headquarters, 9 E. 41 St., N.Y., N.Y. 10017.

Assisting Clark with the Program is Associate Chairman Douglas H. Fries, Todd-AO, 1021 N. Seward St., Hollywood, Calif. Serving as advisory personnel are William J. Wade, Universal Studios, Universal City, Calif., who is Deputy Program Chairman for Motion Pictures; and S. Bryan Hickox, Ampex Corp., 500 Rodier Dr., Glendale, Calif., Deputy Program Chairman for Television.

In addition to the Conference, an equipment exhibit will run concurrently with the technical sessions from Monday afternoon until Thursday evening. Equipment Exhibit Chairman Warren Strang, Hollywood Film Co., expects this year's

display to be among the biggest of any SMPTE Los Angeles Conference. Over 90 booths will feature the latest in motionpicture and television cameras, recording equipment, laboratory machinery, studio facilities and hardware used in every facet of motion-picture and television research, production and communication.

Cable TV Shackled

"Every movement towards state regulation must be stopped in its tracks and stopped now, if the cable television industry is ever to reach its full potential in serving the communications needs of the American public," said Alfred R. Stern, president of TeleVision Communications Corporation, a CATV systems owner and operator.

"Proposals such as the recent New York Public Service Commission's request to regulate the state's CATV systems must not be allowed to reach fruition," Stern said. "No industry can function under three layers of regulation—local, state, and federal. CATV cannot serve three masters and still adequately serve the public."

Commenting on the move by the New York Public Service Commission to join federal and local authorities in regulating such areas as CATV rates, programming, service and network coordination, Stern said "This proposal is based on the assumption that CATV systems can be considered public utilities and regulated as such by the state. This is an unfounded assumption."

"CATV does not fit any of the classical definitions of a public utility," Stern said. "The CATV industry, in fact, is an example of private enterprise at its best, steeped in healthy competition, out of which have grown the great technological advances which allow CATV systems to deliver their unique services. If shackled by state utility regulations, this business cannot adequately grow to meet the nation's communications needs."





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SCANNING THE CATV SCOPE

Distribution potential in optical links

By Leo G. Sands

The transmission of television signals via cable from a CATV system head end to distribution centers can be expensive and logistically difficult, particularly in large cities. Microwave radio is a good alternative to cable as a transmission medium. When FM microwave is used, the occupied radio bandwidth is greater per channel than the 6 MHz occupied by a television broadcast station.

Less occupied radio bandwidth per channel is required when the microwave system functions as a frequency translator as in the system developed for TelePrompter Corporation by Hughes Aircraft Company.

In this system, as shown in Figure 1, the frequencies of a group of television channels are translated (as two groups) to microwave frequencies at the microwave transmitting terminal, and back to television channel frequencies at the microwave receiving terminal. The television signals do not actually modulate the microwave transmitter and therefore do not widen the band occupancy.

The Laser Link microwave system, discussed in a previous issue of **Broadcast Engineering**, utilizes filtered pulse width modulation which Ira Kamen, the firm's president, claims also offers band occupancy economies.

Looming on the horizon, but not yet ready for commercial use, is pulse code modulation (PCM) transmission of numerous television

channels simultaneously over microwave or through wave guide. Both the British and Canadian Marconi companies are developing PCM systems. The British company is reported to have made considerable progress in the development of a PCM television transmission system. According to an article in *Scientific American*, it is theoretically possible to transmit 200 color television channels simultaneously through a single waveguide. PCM offers great possibilities but, when transmitted over microwave, it requires considerable radio spectrum space.

A new LDS (Local Distribution Service) system, which depends neither on microwave nor coaxial cable or wave guide as a transmission medium, employs an invisible (incoherent) light beam. No, it does not employ a laser which emits coherent

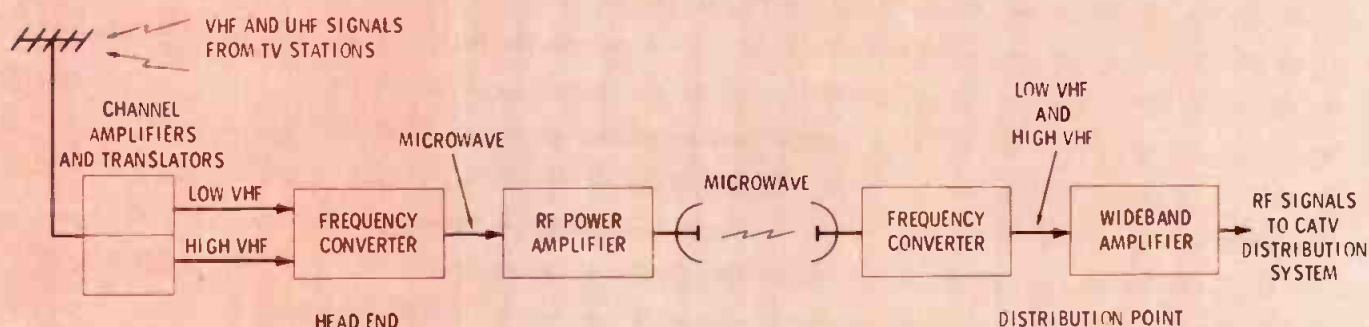


Fig. 1 Frequency conversion type microwave system.

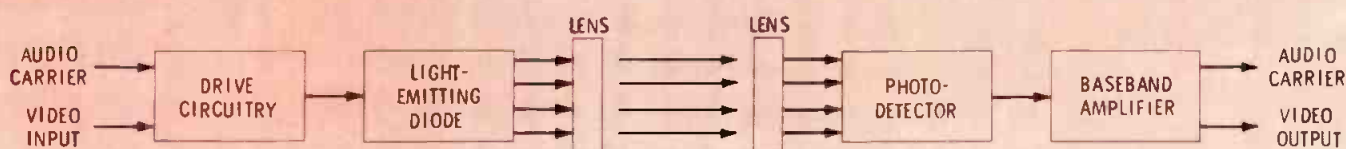


Fig. 2 Optical communications link.

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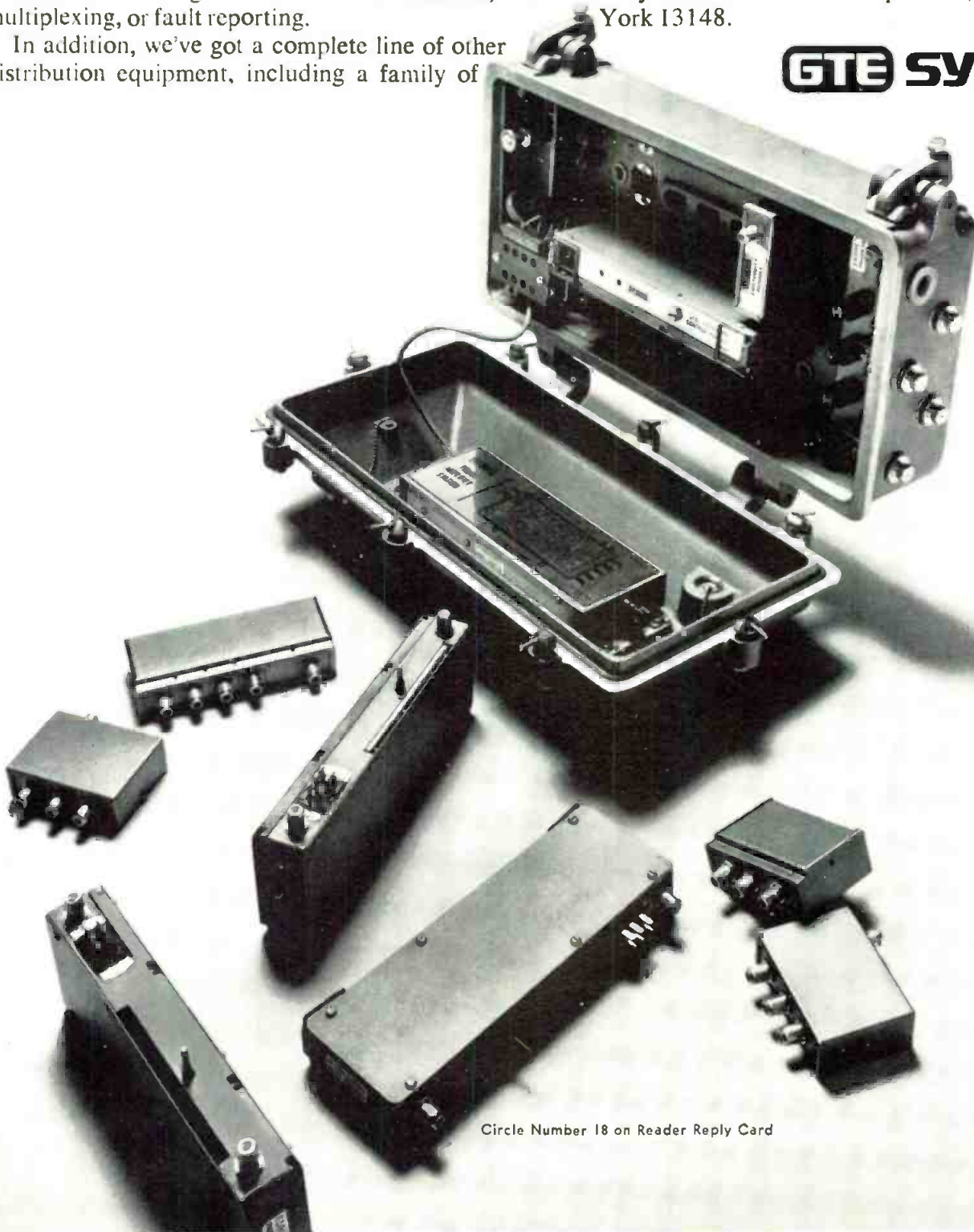
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light. Instead, it employs an infrared light beam.

Known as an "Optical Communications Link" (OCL) the new system developed by University Instruments Corporation of Boulder Colorado, can be used to transmit a single television channel (picture and sound) over a distance of up to five miles. The maximum distance is limited by the brilliance of the beam.

As shown in Figure 2, the transmitter consists of an intensity-modulated light-emitting diode, a lens system and drive circuitry, and the receiver consists of a photodetector, a lens system and electronic circuitry.

The new OCL system is avail-

able in two bandwidths, flat within ± 0.5 dB—4.5 MHz for commercial video transmission, and 7.5 MHz for high resolution video transmission and in unidirectional and bidirectional configurations. A two-way OCL terminal is shown in Figure 3. The manufacturer states that the light-emitting diode and the photodetector are capable of greater than 50-MHz bandwidth, and that optical links for multichannel transmission of television are practical.

Infrared rays travel at the speed of light (186,000 miles per second) and are affected by weather as are the shorter microwaves.

In a paper presented in El Paso at a meeting of the Rocky Mountain Cable Television Association,



Fig. 3 A two-way optical link terminal.

Dr. Dean Denison of the company's staff said that OCL propagation reliability of up to 99.5 percent could be anticipated. He pointed out that during the 0.5 percent of the time that excessive attenuation might be experienced, the picture would not necessarily be lost but probably would be snowy.

Instead of referring to frequency in MHz and GHz as with reference to microwave systems, infrared emissions are referred to in terms of wavelength in angstrom units (abbreviated $\text{\AA}$); $1\text{\AA}$ is equal to 1×10^{-10} meter. The visible light spectrum ranges from around $3800\text{\AA}$ to $7700\text{\AA}$. The infrared spectrum begins at the long wave end of the visible light spectrum— $7700\text{\AA}$ and longer.

As in the case of microwave systems, OCL systems can be used in single-hop, multi-hop, wye and other configurations in CATV applications, and as an STL or remote pickup system. Obviously, a line of sight path is required, but at present an FCC license is not required.

The infrared OCL is indeed an interesting new concept whose further development undoubtedly will be watched anxiously by the CATV and broadcast industries. Since University Instruments also produces OCL systems for digital transmission, perhaps the future will see the marriage of PCM and OCL.

Long ago, electric arc lamp beams were modulated and used for voice transmission. Perhaps this too is an area worthy of investigation because of the high intensity capabilities of an arc lamp. ▲

Tavener Answers CPB

A statement by NCTA's president Don Tavener was issued just after our February news deadline. It is presented here in order of fairness and to keep the record straight.

"On December 10, the president of the Corporation for Public Broadcasting, John W. Macy, Jr., called for governmental ownership and public broadcast operation of cable television systems in an address before the 47th Annual Congress of Cities in Atlanta, Georgia.

"That proposal came as a surprise to the cable industry. Its purpose and intent was unclear to many of us who were concerned that the suggestion for municipal ownership and local ETV control of cable systems was a stratagem designed by some educational broadcasters to circumvent the FCC's rules which preclude ETV ownership of CATV systems.

"Because NCTA has a series concern with the question of public vs. private ownership of cable TV systems, I requested a meeting with Mr. Macy. At our meeting last Thursday, December 31, Mr. Macy maintained that his speech had been misconstrued and that his concern as a public official was to secure

access to cable channels for educational and public service use.

Mr. Macy declared that he is "pro-cable," and he indicated that his Atlanta address was intended merely to provoke thorough consideration of all approaches by local franchising authorities before granting cable franchises. He further indicated to me that his statement was not an accepted position of the Corporation for Public Broadcasting.

"Since Mr. Macy's address contained erroneous information on the economics of cable capitalization and operation, I acquainted him with the realistic economics of cable TV, as well as our views on municipal ownership and NCTA's longstanding policy of encouraging systems to provide channels for educational uses. I also suggested that because public broadcasting and cable have a continuing community of interest that a special committee be named by the CPB Board of Directors to meet with an NCTA committee.

"While Mr. Macy was candid, cooperative and receptive, I made it very clear to him that the cable television industry could not be receptive to a concept of public ownership or public television station control of cable television."

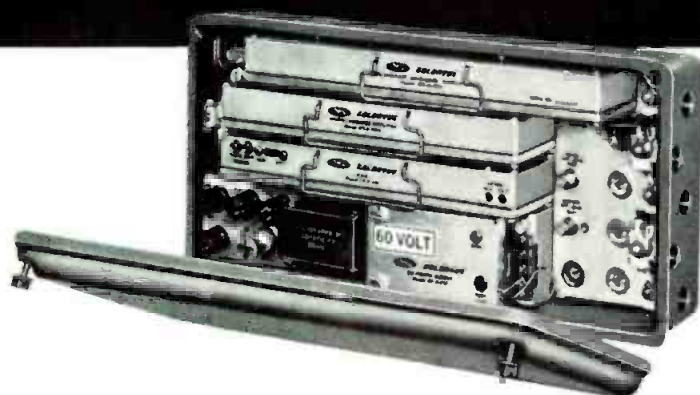
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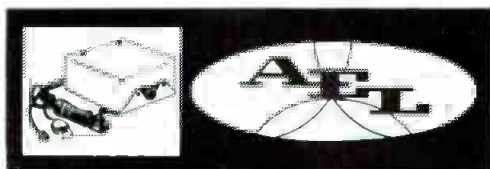
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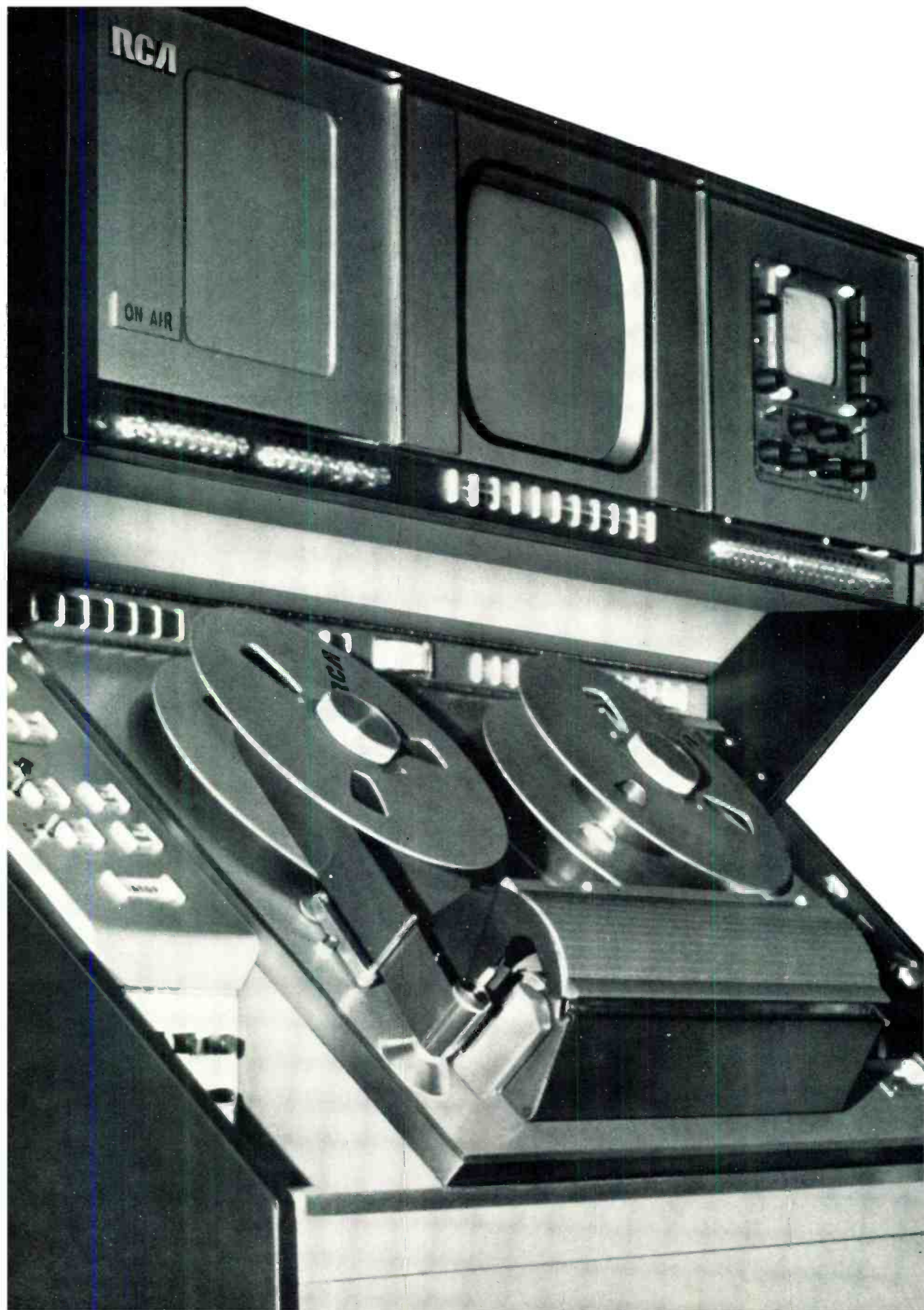


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When it comes right down to it, the two most important factors in selecting a video tape recorder are picture quality and on-air reliability. And these are the two areas where the new RCA TR-70C shines brightest.

It's easy to see why. It's the latest and greatest member of RCA's famed TR-70 family. A tried-and-true series of video recorders that pioneered such advances as automatic FM standards selection; automatic stop cue; one line chroma correction; convenient picture, audio and wave form monitoring, complete fault indicating system and much more.

And to these field-proven features the TR-70C adds two

great new ones. A special-alloy headwheel that provides many extra hours of high-quality performance. And an all-new integrated circuit servo system that provides faster "lock up" and gives greater stability.

What RCA has done is to make a great VTR even greater. But its most important virtues are still its basic ones; the ability to provide picture quality and long-term reliability that can't be matched at any comparable price.

So if beautiful pictures are your ultimate goal, contact your local RCA Representative for full information.

The RCA logo, consisting of the letters "RCA" in a bold, stylized, sans-serif font.

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Circle Number 21 on Reader Reply Card

Pre-Convention

NAB News Roundup

The National Association of Broadcasters has announced that the speakers at its Convention management luncheons will be the Rev. Theodore M. Hesburgh, president of Notre Dame University, cartoonist and lecturer Al Capp, and Chairman Dean Burch of the Federal Communications Commission.

The 49th annual NAB Convention will be held March 28-31 at the Conrad Hilton Hotel in Chicago. There will be separate management and engineering luncheons on Monday and Tuesday, March 29 and 30, and a joint luncheon on Wednesday, March 31. The engineering speakers will be announced later.

Father Hesburgh will address the

Convention management delegates at Monday's luncheon. In addition to his position at Notre Dame, he is chairman of the U.S. Commission on Civil Rights. He has been a member since 1957 and was appointed chairman in 1969.

Capp is well-known for his "Li'l Abner" comic strip and for his outspoken views on students, drugs and other issues affecting youth. He is in great demand on college campuses.

FCC Chairman Dean Burch will follow Convention tradition by addressing a joint management/engineering luncheon on Wednesday, March 31.

Miller Will Receive Service Award

Neville Miller, who served as the organization's first full-time president from 1938 until 1944, will receive the NAB 1971 Distinguished Service Award.

During the World War II years he was NAB president, Miller represented the radio industry on government committees.

He will receive the award—the industry's highest honor—at the opening session of the NAB's 49th annual convention in Chicago on Monday, March 29.

Established in 1953, the award is presented to individuals who make "a significant and lasting contribution to the American system of broadcasting by virtue of singular achievement or continuing service for or in behalf of the industry or in any or all phases."

In addition to industry management leaders, the award has been given to a wide range of individuals including Bob Hope and former president Herbert Hoover.

Walbridge Calls For Action

Willard E. Walbridge, chairman of the board of the National Association of Broadcasters, has urged the NAB to act rather than react

to industry problems and challenges and he set forth three goals broadcasting should seek to achieve.

In opening remarks to the Board of Directors' session, Walbridge said attainment of these goals would permit radio and television to serve the public interest better, which he pointed out is the primary objective of broadcasting.

Walbridge, senior vice president in charge of corporate affairs, Capital Cities Broadcasting Corp., Houston, Tex., called for these actions:

1. Achievement of seven-year licenses to correspond in length with the terms of Federal Communications Commissioners, rather than the current three-year period.

2. Accomplishment of legislative and legal steps to reverse the Red Lion decision of the United States Supreme Court which restricts broadcast freedom as opposed to the freedom of other media protected by the First Amendment.

3. Legal and legislative steps to establish property rights in the broadcast signal.

One-to-a-Market

A petition by the National Association of Broadcasters (NAB) for extension of time for filing comments in the rulemaking proceeding in Docket 18110 (one-to-a-market proceeding) has been granted by the

Commission.

For the NAB and the American Newspaper Publishers Association (ANPA), which supported the NAB request, the new date for filing comments will be April 16, 1971. For all other parties, comments will be due May 17, 1971. The previous filing dates were January 15 and February 15, 1971.

The date for filing reply comments by all parties was extended from March 15 to and including June 18, 1971.

As to the NAB's request for reduction of the number of copies it must file, the Commission ordered that only five copies need be filed by the NAB "of any individual portion of any report, survey or other document which exceeds 100 pages in length."

The Commission pointed out that in earlier actions extending the filing dates, it has indicated concern in prolonging the decision in the proceeding. NAB said, however, that the time extension is necessary because of delays in obtaining material. The Commission said it recognized the advantage of NAB's intention to summarize the considerable volume of data it is accumulating in a more usable form.

Management Workshops

The Radio Board of Directors of the NAB has agreed to investigate the possibility of holding Radio Management Workshops as a new service to radio station members.

The Board asked Clint Formby, KPAN, Hereford, Tex., a Board member and chairman of NAB's Small Market Radio Committee, to have his group undertake such a study.

Its recommendations, to be made to the June Board meeting, will include proposed dates, frequency of meetings, types of material to be presented, and other matters. Formby's committee is not expected to limit subject matter totally to small market stations.

The Board also directed appointment of an ad-hoc committee to study the current districts for district directors and the constituencies of at-large directors to see if these categories should be changed. The committee will report at the June Board meeting.

There are now 17 districts, each

represented by a director, plus four at-large categories broken down by market size with two directors in each. In addition, each of the four radio networks designates a director.

Acting on recommendations of the Radio Code Board, the Radio Board deleted a time standards provision relation to single sponsorship in five, ten and 15-minute programs. Henceforth, both single sponsorship and participating sponsors will be governed by the same time standards which allow a maximum of 18 minutes of commercials in a 60-minute period.

The Board also ratified the appointment of Jack P. Timmons, KWKH, Shreveport, La., to the Radio Code Board for an unexpired term through 1972, succeeding A. Donovan Faust, formerly of WSIX, Knoxville, Tenn., who left radio to enter television and was no longer eligible.

It also ratified the appointment of Jerry Fitch, KGLN, Glenwood Springs, Colo., to succeed Mrs. Jason T. Pate, WASA, Havre de Grace, Md., who has served the maximum number of two-year terms.

The Board ratified the reappointment of the following members. William W. Hansen, WJOL, Joliet, Ill.; J. C. Stallings, KEEE, Nacogdoches, Tex., and Tom Harrell, WSTP, Salisbury, N.C.

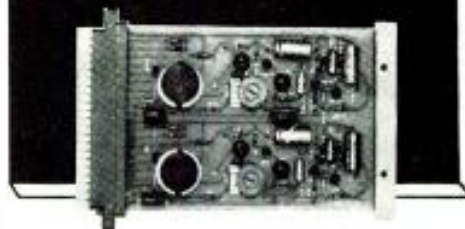
NAB Takes Position On Fair Labor Act

The National Association of Broadcasters has urged the Wage-Hour Division to make no changes in its regulations exempting outside salesmen from provisions of the Fair Labor Standards Act.

The establishment of a Federally-imposed minimum salary test "could create administrative and policing morasses of immense proportions," NAB said.

In a written statement submitted to the Wage-Hour Division, the Association said that the primary concern of the broadcasting industry is the recordkeeping requirements involved with a minimum salary, and the impact such a standard will have on the employment of young, unskilled applicants for broadcast sales jobs.

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**A Brand-New Practical Handbook
for Broadcast Engineers & Technicians**

A GUIDE TO RADIO & TV BROADCAST ENGINEERING PRACTICE

By E. L. Safford, Jr.

A "how-to" handbook on operation, maintenance,
and troubleshooting.

Here's a book long needed by the radio and TV engineering profession—in fact by anyone with an interest in radio and TV broadcasting, since it covers all aspects, from personnel qualifications to proof-of-performance measurements.

The material is divided into two parts—Radio and Television—and begins with a discussion of personnel qualifications. Here you'll find useful suggestions on how to classify various levels of technical competence and how to encourage improvement at each level. Preventive maintenance is given thorough treatment, including how to set up a schedule based on analysis of failure rate and probability, and how to determine tube replacement and spare parts requirements. Also, a number of case histories provide the answer to tough or unusual problems. Extensive attention is given to AM antenna systems: how to measure antenna reactance, impedance, and resistance; the use of shunt-fed towers; the design and operation of directional phasing and matching networks; and multi-station towers.

Part of the material is based on the results of an extensive nationwide survey conducted by the author, giving the content a wide perspective.

The television section includes a complete description of a model station, plus case histories supplied by stations all over the country. You'll find this one of the most interesting and informative books ever printed. 256 pages, over 140 illus. Hardbound.

CONTENTS: RADIO: Operator Qualifications — Broadcast Equipment & Maintenance Philosophy—Case Histories—Antenna System Test & Maintenance Procedures—Shunt-Fed Antennas—Directional Phasing & Matching Networks—Multi-Station Towers & The "Galloping" Guy Wire—Maintenance Procedures—Most Common FCC Violations—Consulting Engineers. **TELEVISION:** Introduction to TV—The Television Station—Special Equipment Needs & Technical Problems—TV Maintenance Procedures—TV Case Histories—What Should Your Salary Be?

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Submitted by Ron W. Irion, NAB's director of broadcast management, the statement said that under the proposal for minimum salary, all outside time salesmen with earnings less than a specified minimum weekly rate would be required to submit weekly time cards. But since salesmen often work irregular hours, away from the studio, NAB said, it would be difficult to verify working hours and overtime hours which would be claimed.

NAB said that the "predictable rise in overtime costs could severely affect the ability of the small market radio stations with low profit margins to remain a going business concern especially where salaries now account for approximately 60-70 percent of the stations' operating expenses."

Furthermore, NAB said, if stations are forced to pay a guaranteed wage to a new employee, the training of young, unskilled applicants would be discouraged. Instead, the broadcast employer will seek the experienced salesman who could show early results, rather than settle for the initially unproductive employment of an untrained salesman.

NAB's statement also urged the Wage-Hour Division to reevaluate the status of broadcast journalist-reporters in order to classify them as professionals and thereby exempt them from minimum wage and overtime provisions of the Fair Labor Standards Act.

NAB Regroups For Challenge Of '70's

Vincent T. Wasilewski, president of the NAB has announced the appointment of three executive vice presidents of the Association.

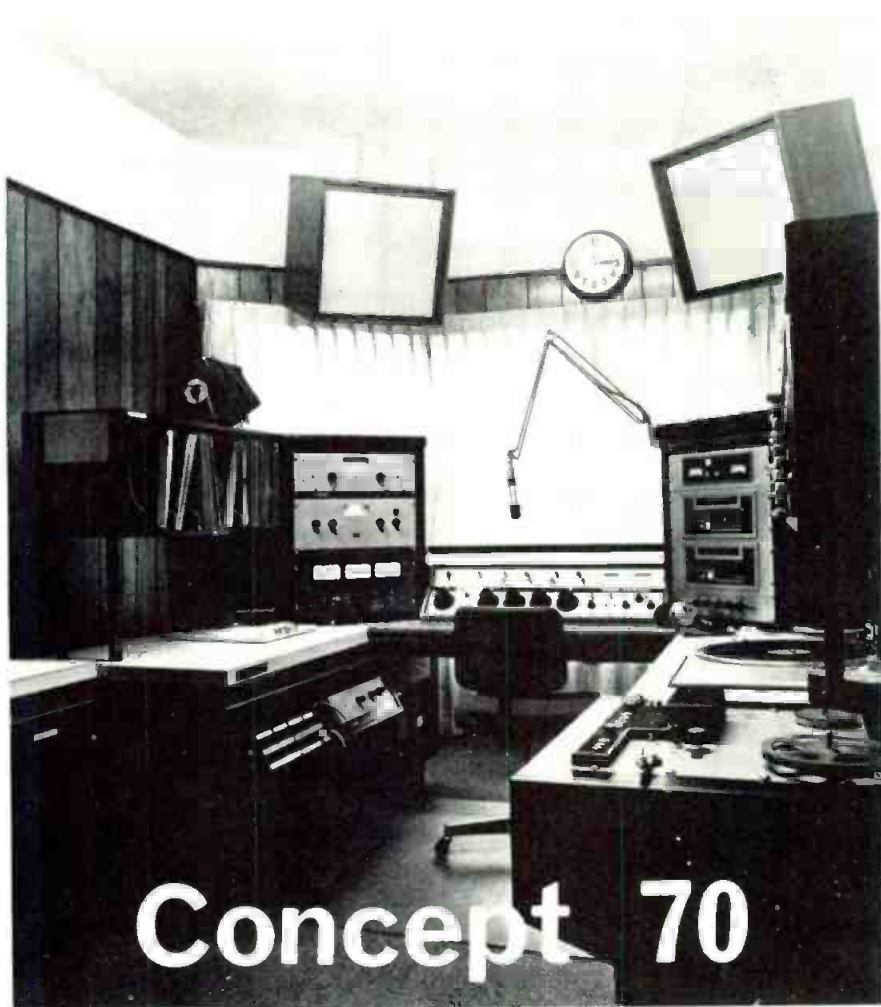
They are Grover C. Cobb, executive vice president for station relations; Paul B. Comstock, executive vice president for government relations, and Paul Haney, executive vice president for public relations.

The three new posts were created under a plan approved by the NAB Board of Directors and designed to free the NAB president for additional planning of long range programs dealing with industry problems.

Cobb now is vice president, broadcasting, Gannett Co., Rochester, N.Y. Comstock currently is NAB vice president and general counsel. Haney is vice president for public affairs for the Houston Astros and Astrodomain.

Haney, long known as "the voice of the Astronauts," joined NASA's public relations arm in 1958. He subsequently became new director for Project mercury and in 1962 was assigned as public affairs officer for the Office of Manned Space Flight.

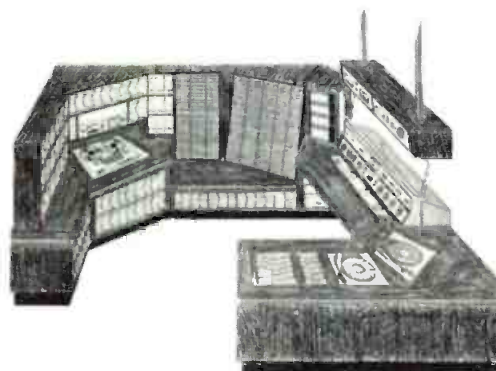
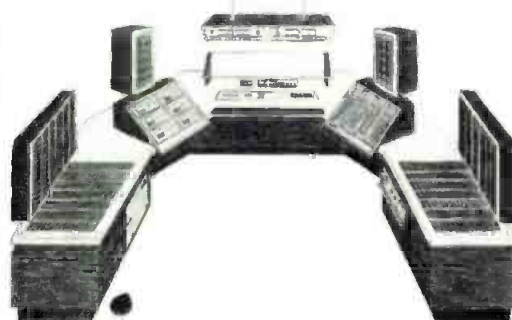
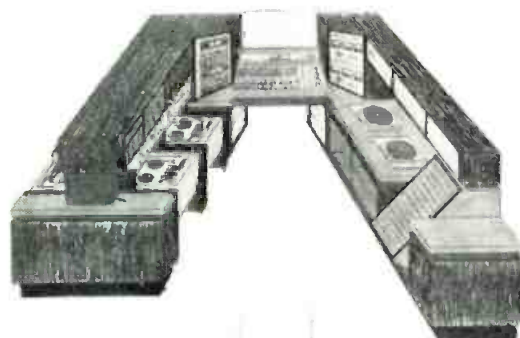
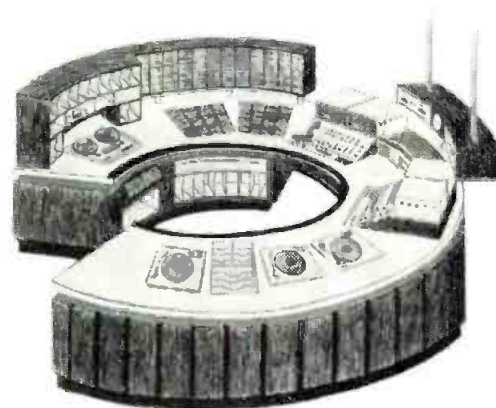
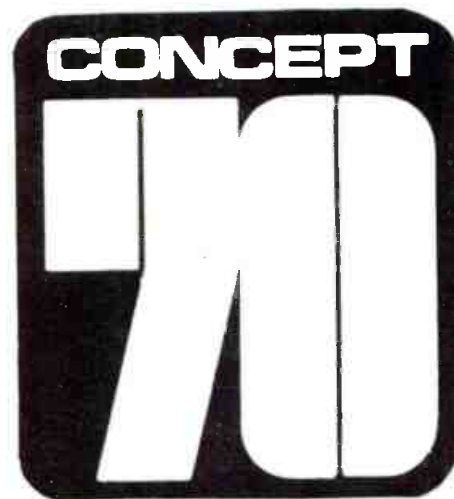




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Circle Number 25 on Reader Reply Card

1971 NAB Product Roundup

If broadcast time sales are off, they will affect a downturn in equipment manufacturer's sales. This domino effect continues to the point where it drastically cuts in equipment research and development. Right? Well, not quite.

Let's take a wider view. Is smart money pulling out of TV? I suppose that depends upon your point of interest. Fact is though, some very large, stable companies are the buyers. This leaves you wondering where the smart money really is, and, if in fact there aren't other factors involved.

Equipment manufacturers did pull in their horns during the 1970 season. They hitched up their belts, cut into their overhead and continued to change what we so often refer to as the state-of-the-art.

Admittedly, some manufacturers will bring in pinch-hitting units that do not represent the meat of what they had hoped to develop in 1970 and market in 1971. But you will see for yourselves in the product report that follows that many companies continued their original research and development programs.

Perhaps we'll be able to say next year that smart money was optimistic money.

What follows here is a deluge of new products, most of which will be on display for the first time at the NAB convention. This presentation is not complete, because some manufacturers wait until convention time to say what they will show. Then too, not everyone answered our call for new product reports.

Vidifont TV Display System

A television display system that makes it possible for the first time to produce on command and in real-time word messages from several desired type fonts and sizes will be unveiled to the nation's broadcasters by **CBS Laboratories** at the National Association of Broadcasters Convention in Chicago.

The new generation Vidifont

heads a wide range of advanced electronic audio and video products being produced and marketed by the **CBS Laboratories Professional Products Department**.

Vidifont enables the user to produce more creative and informative video displays for television broadcasting, advertising and film production, and a wide variety of application areas for dynamic infor-

mation display. Its unique type font (CBS News 36) has resulted in characters with high resolution, attractive design and maximal viewer readability. Language symbols such as Japanese, Hebrew, Greek or Russian, can also be used with the new Vidifont.

Proportional character spacing is a key feature of the system, and character display color control is provided on a word-by-word basis.

Also featured at the CBS Laboratories NAB exhibit will be:

A new solid-state device that enables broadcasters to automatically correct color variations in a television program after it has been encoded and at any point during its transmission to the home.

Circle Number 131 on Reader Reply Card

Effects Module

Systems Resources Corporation has announced the introduction of the Model 600 Effects Module. The module is a specially designed printed circuit device which may be added to any A. B. Dick Videograph Model 9901 Character Generator to achieve: Word-by-word color; all-around edging for clear tilting; roll/crawl pause; and visible record mark. The Model 600 Effects Module provides a total electronic tilting capability when used in conjunction with the Chiron Vidiloop Title Storage System.

Circle Number 130 on Reader Reply Card



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The bigger and bolder they are
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ROHN'S concept of communication
and microwave towers is based on the
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Achieving this has always been one of the
bigger, bolder ideas motivating the ROHN
organization . . . an idea that makes ROHN
the only totally integrated tower source in
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ROHN guyed 450 ft. tower UHF Pylon Antenna Top-mounted, located in Noblesville, Indiana, gives WURD-TV viewers the best "Tower Power" that can be provided!

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Check these advanced features:

- ALL SOLID STATE • COMPATIBLE WITH YOUR EXISTING AMPEX 350 SERIES HEADS • LOW NOISE • HIGH RELIABILITY • FRONT PANEL SWITCHING OF MICROPHONE AND LINE INPUTS • RECORD ALIGNMENT CONTROLS ON FRONT PANEL • PLUG-IN PRINTED CIRCUIT CARD CONSTRUCTION • HIGH OUTPUT RECORD ELECTRONICS • LOW DISTORTION LINE AMPLIFIER • SAFE/RECORD SWITCH • MONITOR JACKS ON FRONT AND REAR PANELS • COMPACT SIZE — 3½" x 19" • OPTIONAL PLUG-IN MICROPHONE PREAMPLIFIER AND SYNC PREAMPLIFIER CARDS

*Based on trade-in of Ampex 351 series electronics. Trade-ins also available for Ampex 300 series electronics.

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Circle Number 29 on Reader Reply Card

Compact Tape Cart Machine

Gates' Criterion Compact tape cartridge playback unit will be introduced at the 1971 NAB Show. This is a space-saving version of Gates' Criterion system, and is designed to conserve valuable space in today's crowded studios.

The Criterion Compact retains all those features which were part of the standard Criterion. Compact features include: rugged machined aluminum deck; massive 450 rpm direct drive capstan motor; and exclusive, improved Micro-Set precision head assembly. Also, single-

card electronics for mono or stereo units; air-damped solenoid for quiet control room operation; and optional high-speed cueing.

The Criterion Compact is designed for desk or rack mounting, and two Compact playbacks can be mounted side by side in a standard 19-inch equipment rack in the space normally required for a single machine.

Dimensions of the Criterion Compact (desk mount) are: 5 9/16 inches high, 8 9/16 inches wide and 12 1/2 inches deep.

Circle Number 132 on Reader Reply Card



Criterion Compact

New NTSC Signal Generator

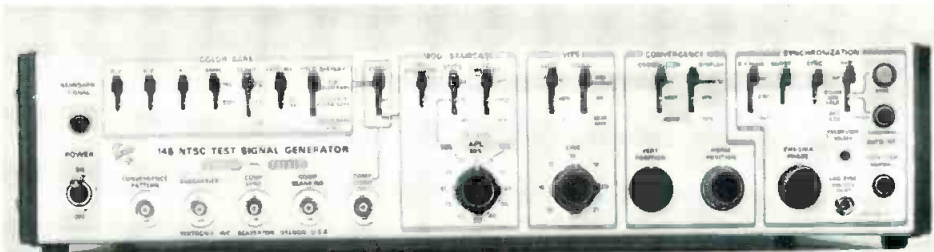
Tektronix, Inc., announces the 146 NTSC Signal Generator, a signal source for 525 line, 60-Hertz field video systems. The 146 provides signals to measure all non-linear, amplitude-related forms of distortion in a video system and is an excellent EIA color standard. The sync generator, with color GEN-LOCK, features temperature-controlled frequency stability.

A new split-field signal for detecting and measuring chrominance-luminance delay is an additional feature of the 146. This signal con-

sists of ¾ of a field of standard color bars and ¼ field of only the luminance component of standard color bars. This new split-field signal clearly reveals luminance cross-modulation and luminance/chrominance delay effects when a color picture monitor or waveform monitor is used.

Tektronix announces the 147 NTSC Test Generator, a source of all the signals necessary for VITS and full-field testing. A first in a commercially available generator is the new Vertical Interval Reference Signal.

Circle Number 133 on Reader Reply Card



146 Test Generator

Digital AM Frequency Monitor

The new FCC type-approved **McMartin TBM-8000** digital AM frequency monitor is designed to provide a visual, digital readout of the frequency deviation of the operating carrier of standard AM broadcast transmitters in the range of 540 to 1600 kiloHertz.

Three operating modes are provided. The normal mode employs a 10-second gate time and displays deviations from 0 to ± 39 Hz in the presence of modulation. A second mode, with 1-second gating permits readjustment of the transmitter frequency in the absence of modulation. A wide-band mode, for correction of wide transmitter frequency deviation, uses 0.1-second switching and increases the range to ± 390 Hz.

Indicator lamps operate for deviations in excess of 10 and 20 Hertz with relay contact closures available in the latter case for connection of an external alarm or transmitter disabling circuitry.

Plug-in cards, containing critical components, are accessible from the front of the unit. Optional plug-in cards are available for analog remote metering or with parallel BCD output for driving automatic logging equipment.

Circle Number 134 on Reader Reply Card

Helical Recorder

Ampex Corporation is exhibiting its entirely new line of one-inch helical recorders, as well as its recently announced Instavision system for video record and playback, at the National Association of Broadcasters Show.

The one-inch Video Production Recorder (VPR) Series provides new performance closed circuit teleproduction capability and playback, with all models being compatible with previously introduced Ampex one-inch helical scan equipment.

The series comprises three recorders, VPR-7900, VPR-5800 and VPR-5200, plus a player only, VPR-4500. All models feature exclusive split capstans which permit higher tape tension control; minutes/seconds timers for simplified search and editing; simplified, locking, reel hold-down knobs; and improved tape handling characteristics and generally improved electronics.

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can the same lens :

zoom from 18 to 270mm ? *

angēnieux 15 to 1 can

change extenders by
pushing a button ?

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have adjustable back focus ?

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fill a full screen with an
object less than 1/2" high ?

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**Cancer
is
sneaky.**

It doesn't announce itself loud and clear until it's often too late. Beat it at its own game. Yearly visits to your doctor are cancer's worst enemy. Help yourself with a checkup. And others with a check.

American Cancer Society

Solid State TV Monitors

Two new product series of all-solid-state, monochrome, professional television monitors for broadcast studio general purpose and signal analysis applications will be introduced by **Conrac Corporation** in Booth 107.

Solid-state professional color television monitors will also be featured in the Conrac exhibit, along with a modernization program which permits the economical updating of a studio's existing tube-type color monitors.

Conrac's SNA series of monitors being introduced at the show are all-solid-state, of modular design which allows interchangeability of circuit boards, and are designed for general purpose applications in the professional broadcast studio. The new DZA series are performance-stabilized monitors with test instrument features for use in broadcasting's most stringent signal analysis applications. Both new series are designed to meet UL approval.

The SNA series comes five kinescope sizes, and in chassis, cabinet,

or rack mount versions, including dual-mounted models. Three sizes, 9-, 12- and 14-inch kinescopes, will be shown at the NAB.

Circle Number 136 on Reader Reply Card

Tape Cartridge Equipment

International Tapetronics Corporation will introduce its **Encore** series of tape cartridge equipment at the 1971 NAB Convention. The **Encore** series reproducers and recorder/reproducers, designed to compete with the lowest priced equipment, are the first economy priced units to include features previously available only in the highest priced equipment.



A 450 RPM hysteresis-synchronous direct capstan motor, a full-swing pressure roller (no cocking or releasing), and an air damped solenoid are standard features in the **Encore** series.

Circle Number 137 on Reader Reply Card

Audio Connector Adaptors

A new line of "Q-G" ("Quick-Ground") Audio Connector Adaptors, Series S(*)FM, designed for use in situations requiring a transformer, attenuator, or other electronic circuitry in line with a microphone input, has been introduced by **Switchcraft, Inc.**

The new adapter is 4 inches long with 1½ inches of usable space for extra circuitry between the unwired terminals of the male and female inserts at either end of the adapter.

S(*) FM connector inserts are available in 3, 4, and 5 pin/contact configurations to accommodate a variety of standard microphones. The specific connector adapter is designated by inserting the number of contacts in place of the asterisk in the part number.

Circle Number 138 on Reader Reply Card

(Continued on page 84)

2 NEW Low Cost AM FREQUENCY MONITORS



MODEL 510
ANALOG

MODEL 520
DIGITAL

- Solid state design.
- Proportional oven control for excellent stability.
- Fits standard relay rack.
- Remote metering available — Model 510

FCC TYPE APPROVED



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You can choose characteristics like "flat" frequency response. Tapered low-frequency response. Switchable Bass Roll Off. A host of others. To make "today's" sound come alive—close up or far out.

That's the way it goes up and down the Sarmaker

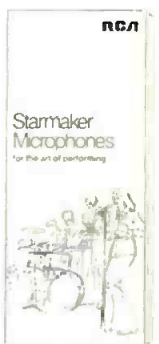
line (at optional list prices from \$12 to \$93). For pop, rock, and classical performers. At concerts, theatres, night clubs. In reel-to-reel and cassette home recordings. For discussion/panel, paging, P.A., CB, and ham applications...you name it.

To get specific, ask for the new Sarmaker brochure 1S1056 at your RCA microphone distributor or, write: RCA Electronic Components, Commercial Engineering, Section 20CJ10, Harrison, New Jersey 07029.

And, remember, for further professional needs, RCA also produces the renowned BK and SK microphone lines.

Circle Number 32 on Reader Reply Card

RCA



Another step forward

moving the videotape machine into automation

By Charles W. Crum*

The words "automation" or "computer control" evoke images of extremely complex systems, that are highly vulnerable to error or breakdown. But broadcasters, contemplating the adoption of automated equipment, should be aware that the goals of properly planned automation are simplicity of operation, greater reliability, and improved system flexibility and performance.

Automation generally involves the programming of equipment functions at least partially by computer. It is implicit in the automation con-

cept that each piece of equipment should contribute to the overall goals of automatic operation, ease of operation, reliability, and broad performance capabilities.

These four factors provided the design objectives in planning and building the AVR-1, the first high-band quadruplex videotape recorder capable of being interfaced into a computer-operated production or broadcast facility.

Because the AVR-1 is designed for station or teleproduction automation, it represents improvements in video tape recorder technology. It is, in fact, the first of the "third generation" of broadcast-standard videotape recorders.

An important previous improvement in videotape recorder technology was the high-band broadcast standard, introduced in 1964 and now used in stations and production installations throughout the world. High-band machines belong in the "second generation" category.

The "first generation" broadcast videotape recorders are, of course, the earliest models which introduced the principle of video magnetic tape recording in 1956.

The following discussion explains some of the steps taken in designing the AVR-1 to achieve the four objectives already mentioned.

Adapting to Automation

Adapting a system for automated use involves several system modifications, some of which will be discussed here. Major design factors which were implemented in the AVR-1 to allow its use as an automatic recorder include automatic tracking. In addition to the conventional tracking system which uses the normal control-track signal to position the tape longitudinally (with respect to the headwheel scan in the reproduce mode), the AVR-1 uses additional information off the recorded video tracks. As the tape is reproduced, the capstan drive signal is modulated a minute amount at a low frequency rate. As a result, the head scans are deliberately caused to vary from their nominal position.

The recovered RF envelope contains positional information which centers the head scan automatically. The automatic tracking system can operate in the complete absence of a control-track signal.

In the reproduce mode, an auto-

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Fig. 1 The AVR-1 in operation. Note that operator makes operating adjustments near eye level. After the adjustments are made, the control panel cover can be pulled out and then down to cover the panel. Also, transport has a similar pull down cover.



matic standards selection system senses the deviation standard (high band, low band, etc.) and reproduce electronics are automatically switched to the proper standard.

In color reproduction the individual channel chroma equalization is normalized by measuring the color burst amplitude and applying appropriate correction on an individual channel basis. The correction is applied on a band-by-band as well as a line-by-line basis. The band-by-band equalization has a fast response to quickly correct the overall response of a channel, while the line-by-line equalization removes variations within a channel at a slower rate.

Operation of many controls may be accomplished by means of a DC voltage applied from a remote point. The control may be applied from a panel on the recorder or from a distant location. The controls may be switched to an external connector panel. With suitable interface equipment, the DC control voltage may be applied by means of digital-to-analog encoding techniques over virtually unlimited distances. The control may be transmitted in digital form over conventional communication links or from a computer.

Operation and Service

Properly planned automation implies improved operating and servicing simplicity as well as stable performance. Therefore, design features implemented to improved operating simplicity (discussed under this heading) also contribute to the objectives of automatic operation and equipment stability.

To achieve simplicity of setup, four major steps have been taken:

(1) Circuit design is aimed at stable operation over wide variations of component value variations and extremes of environment. The object is to eliminate periodic adjustments caused by drift in circuitry.

(2) Automatic circuitry is provided where possible to eliminate manual controls and operations.

(3) Circuitry is designed so that zero volts at a given circuit-control point cause unity gain or some maximized setting. If variable control is desired, DC voltage may be applied

from a remote point.

(4) Extensive monitoring facilities are provided for quick checks should an adjustment be required.

Tape threading has been simplified by a tape transport design which uses vacuum columns. The operator depresses a toe-bar which sets up the transport for threading while leaving his hands free for loading the tape. Once the tape is placed in the tape path and the toe-bar released, the AVR-1 is immediately ready to be switched to play or record.

Light sensing elements within the tape columns automatically adjust the servo controlled reels to maintain uniform tape feed to the video heads for optimum head-to-tape contact and gentle tape handling.

Tape reels are located at waist-level, eliminating the need to lift the reels to an uncomfortable height when loading.

Head replacement is normally a delicate, time consuming task. The new Mark XX record/playback video head assembly on the AVR-1, however, can be installed or removed at the touch of a button within seconds.

Serviceability

The introduction of new equipment with new devices historically has presented new challenges to those who must service it. It should be the goal of the manufacturer to simplify the task of equipment servicing. In the AVR-1, strict attention has been given to simplifying service both mechanically and electronically.

Mechanical assemblies are accessible for removal for service. The goal was to provide access to components from the front of the machine. Slide-out drawers have been provided, and removable overlays allow mechanical assemblies to be removed for servicing.

In the area of electronic servicing, built-in aids help analyze and isolate potential problems. An integral monitoring system permits examination of key waveforms and signals at strategic circuit points. An illuminated warning display panel provides a visual indication of non-standard or faulty operation, indicating the area affected. Built-in test generators permit pinpointing faults to a particular module or circuit. Circuit modules, in many

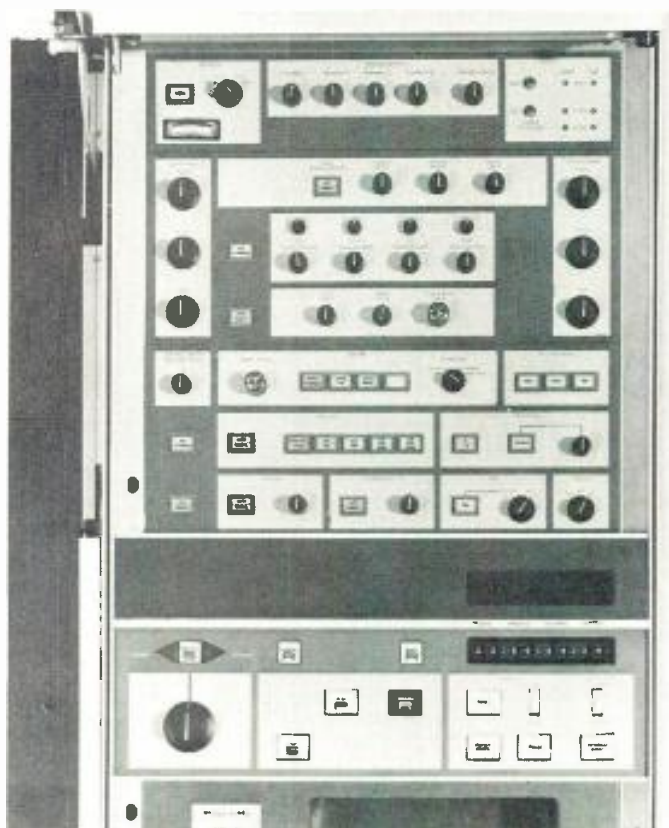
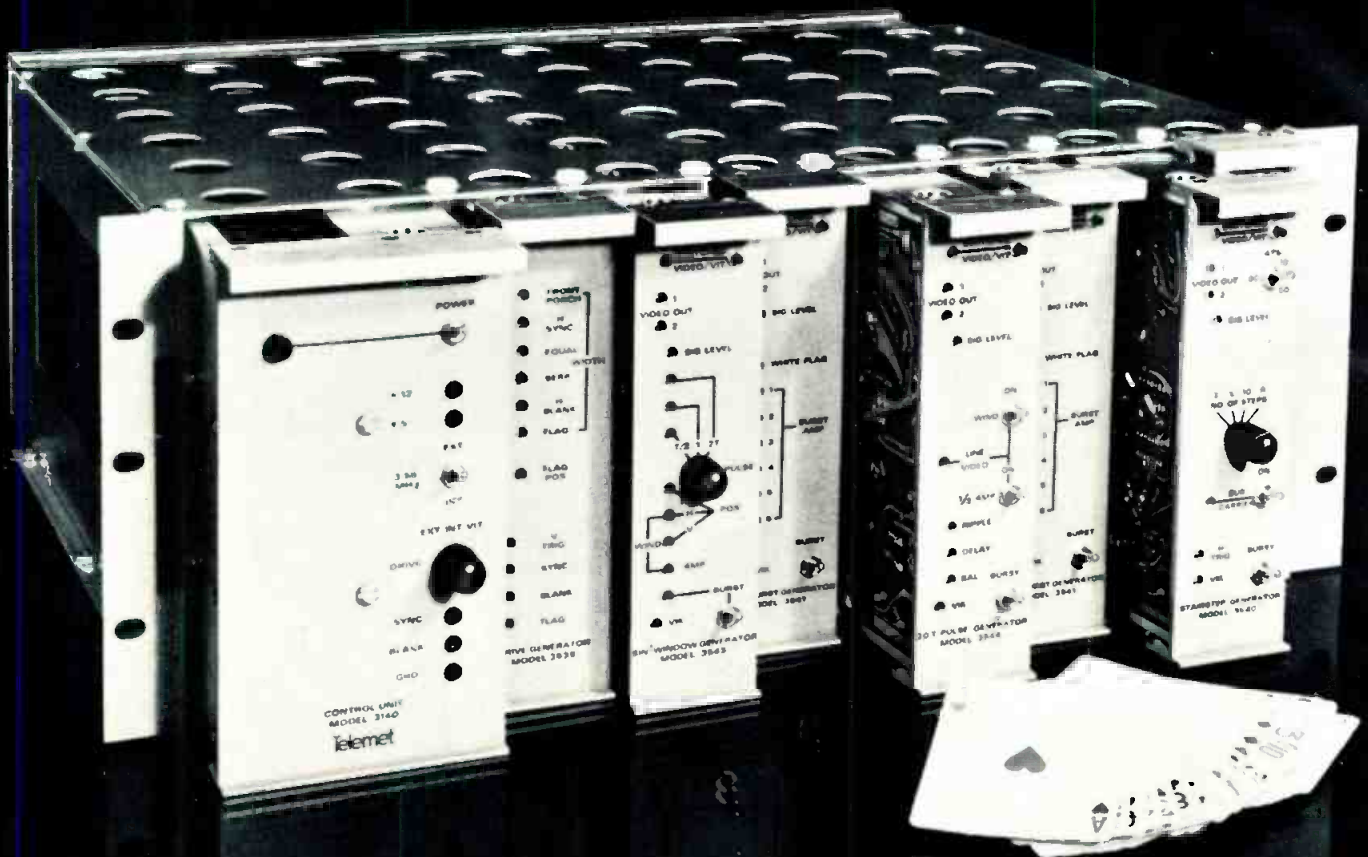


Fig. 2 Operating controls are readily accessible, simplifying the set-up and control procedures. After adjustments, the cover is pulled down.

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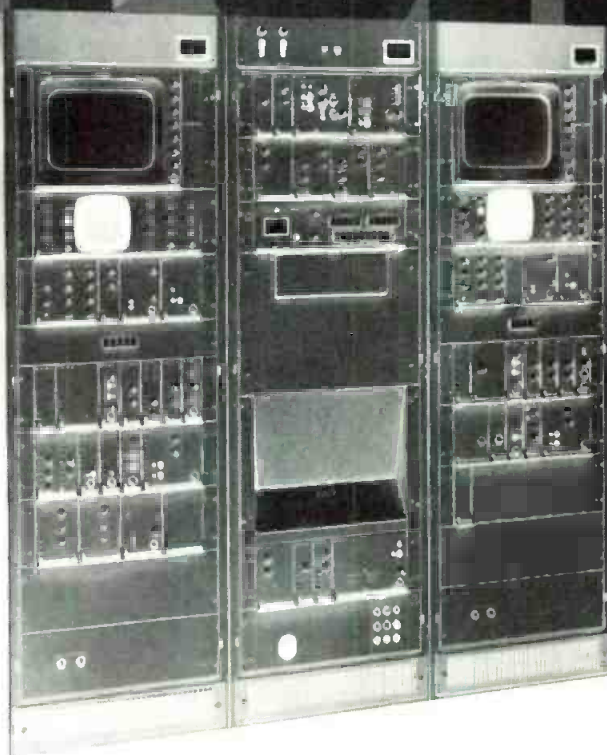


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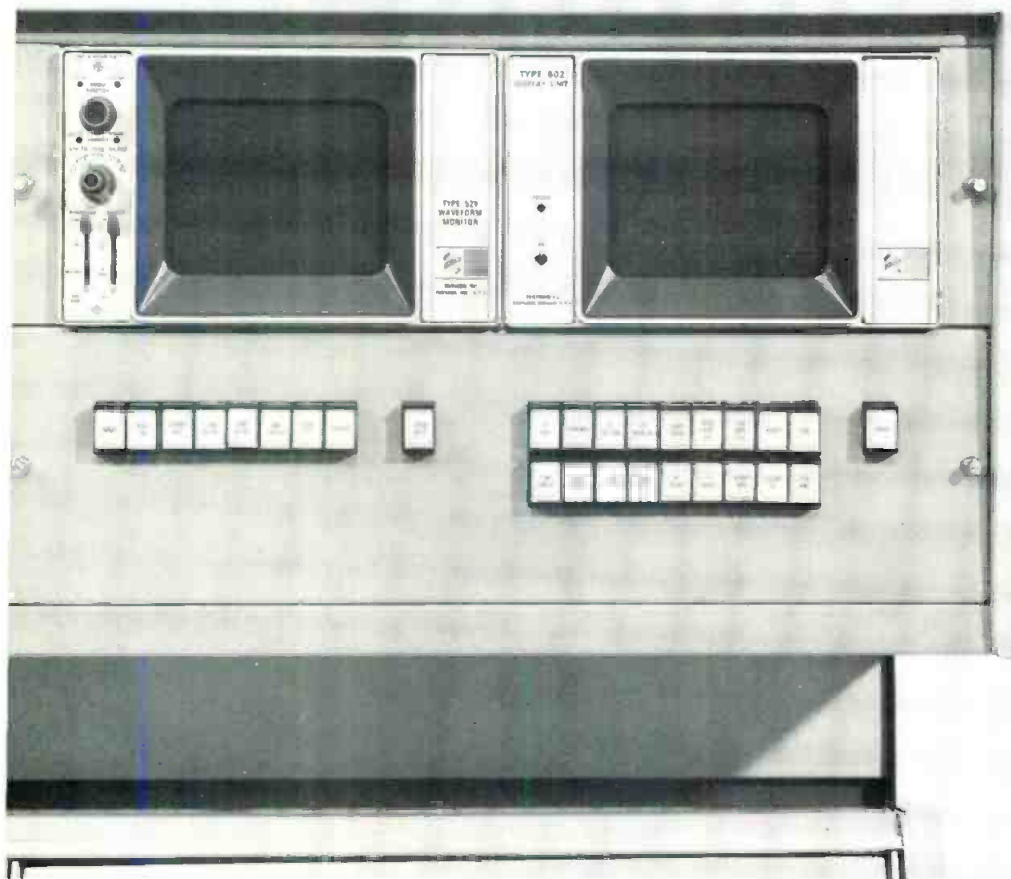


Fig. 3 In the event of a non-standard or faulty operation in the AVR-1, waveform monitors permit examination of key waveforms and signals at strategic circuit points. An illuminated warning display panel provides a visual indication of machine problems and pinpoints the area affected.

cases, have plug-in links which may be removed to isolate faults to a particular stage, or to a particular loop in a servo system.

Range of Stable Operation

In addition to the design of drift-free circuitry, improvements were made in the time-base correction system. Previous time-base correction systems employed an electronic system with a dynamic range of the order of one microsecond. To meet the stringent requirements reproducing color signals, the electronic time-base correction system worked in conjunction with an electromechanical servo system. The servo system was required to reduce and maintain the time-base error to the electronic system centered within the one-microsecond correction range.

The new electronic time-base correction system in the AVR-1 has a dynamic correction range of 64 microseconds. The system uses a binary arrangement of delay lines which can be switched in or out of the signal path. It is operated in the center of its nominal range allowing a correction of ± 32 microseconds.

Performance Capabilities

The videotape recorder is a production tool. Its purpose is to record and reproduce signals. It is frequently used by skilled artists in a creative atmosphere. The operator often has little time for anything more than choosing tapes for record or reproduction, or editing or assembling a program. It is highly desirable to relieve the operator of tasks not directly related to the primary operation of the recorder.

An analogy can be drawn between a television camera chain and a videotape recorder. In the case of a live studio camera, the system controls and adjustments are logically separated by function. The camera is placed in the studio and equipped with a minimum number of adjustments. Generally speaking, only those controls required by the operator are provided at the camera. The camera control unit is placed

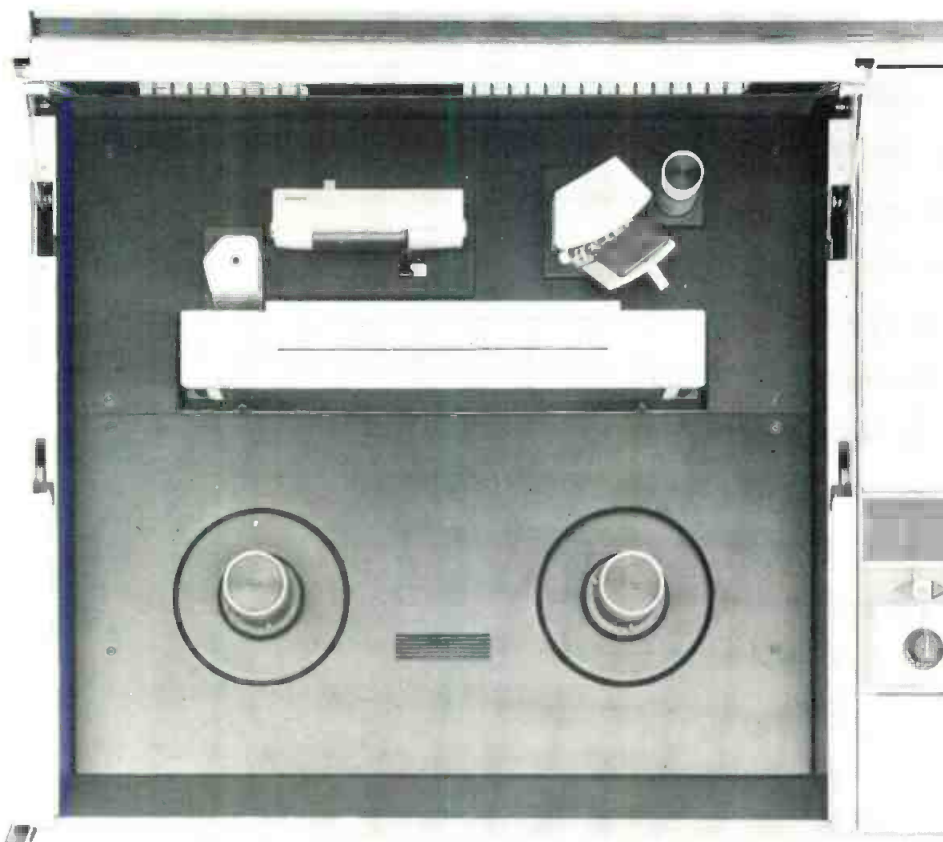


Fig. 4 Reel hubs, located below the head assembly permit convenient tape loading. The vacuum column (center) permits constant and uniform tape tension for gentle tape handling and increased shuttling speed. The operator does not thread the machine. The vacuum system automatically threads tape in the transport.

in a control room. The camera control unit is equipped with those controls necessary for operational and setup adjustments not directly related to the primary operation of the camera.

The same functional separation for controls and adjustments can be incorporated in a videotape recorder system. Provisions have been made in the AVR-1 to permit remote control of secondary operating controls and adjustments. Necessary monitoring required for these controls and adjustments may also be remotely located.

Synchronous Operation

The videotape recorder has been treated in the past in somewhat the same manner as a remote or network program source. That is, even in a synchronous mode of operation it was, in a sense, genlocked. The output of the recorder was phased to the local studio sync generator and local sync was sometimes added. This arrangement allowed the recorder output to be synchronously mixed with local signal sources, but not in the same manner as live cameras, film chains, etc. Live and film camera chains are driven from the local sync generator and the signal output is mixed with local sync, blanking and color burst, thus fully synchronous operation is assured at all times. The different method of operation with the videotape recorder was dictated, in part, by its limited range of electro-mechanical servo system and electronic time-base correction system could be exceeded under certain conditions, with recovery time extending to several seconds.

Typical causes were switching between non-synchronous signals in the record mode, or mechanical disturbances, such as mechanical splices in the reproduce mode.

Lock-up time of the video tape recorder has typically been of the order of seconds. A pre-roll time

must be anticipated and integrated into programming. It would be desirable to reduce the lock-up time to a minimum.

The fast start and response time of the new AVR-1 transport, together with the wide correction range of the new time-base correction system, have made it practical to permit fully synchronous operation with the videotape recorder. The output signal of the recorder is now treated as a camera signal. Local sync, blanking and color burst are added at all times.

Computer and instrumentation recorders have much to offer in well tested, improved techniques in tape handling. A new transport has been designed utilizing higher torque reel motors, vacuum columns and fast response capstan. Together with their associated servo electronics,

this new transport design has resulted in vastly improved tape handling. Shuttling time has been approximately halved, constant tension is provided in all modes of tape motion, and start time has been reduced from several seconds to 200 milliseconds. ▲

What a manufacturer claims for his equipment may not always be evident in operation. Certainly, without having operated the AVR-1, it is not possible for this magazine to make any statements as to its operational features. However, it is evident to even the casual observer that Ampex has taken several steps forward in designing this machine. In the bump-and-run state of the art, the AVR-1 may provide a stationary target.

The Editor



Fig. 5 Access to the electronics is facilitated by the roll out sections.

An introduction to the cassette loading projector

By Jack Litter*

The following article should serve to keep us all aware that nothing these days can escape change. And it is because this machine has such radical changes that we bring it to your attention now.

At press time, the unit described here was scheduled to be demonstrated in an exhibit at the March NAB convention in Chicago. You can see it in operation there and draw your own conclusions.

The Editor

*Listec Equipment Corp.

Despite the fact that the major portion of promotional material aired by television stations starts out on film, until recently scant attention has been paid towards improving conventional methods of film handling for today's needs. In contrast, magnetic recording and playback machines are constantly in the news and hardly a week goes by without some startling new technique being developed to make tape handling more acceptable.

It is the author's view that whereas the ability to tape-record program material is an undeniable advantage, many of the new developments in the tape field are concerned mainly in getting over the disadvantages of magnetic tape. In contrast, many of these disadvantages do not appear in the case of film which, in itself, has several unique advantages.

Partly through history, partly due to the mystique of creativity, program material will continue to be shot on motion picture cameras. In the case of promotional material, and commercials in particular, the advertising agency will pursue a given slant in the production of a typical one minute commercial. The production is carefully scripted and gone over with the client in advance and is then rehearsed and shot using a single motion picture camera. Editing is easy and the careful selection of individual shots and the precise point at which cuts will be made can be agreed upon by all parties concerned.

The putting together of the final product is accomplished by cementing together individual strips of film, each of which can be readily seen on its own and without any problems of selection. This is not to say

that editing cannot be carried out with the magnetic process but not even the most enthusiastic tape user would claim the editing of tape is an easy or as consistent as film editing.

The use of film for news presentations is also self-evident. The roll of the newsreel cameraman in reporting events has been well established. He often operates under conditions where his equipment must be small, lightweight and in some cases, totally independent of any source of external power. It is not foreseen from developments so far in miniature television cameras and magnetic recorders with full color capability that they will supplant a 16mm hand held motion picture camera for ease of use plus the attendant advantages in the editing process, all in living color.

While developments in the magnetic recording field had been arriving thick and fast, it appeared that the Motion Picture Industry, and in particular projector manufacturers, were not developing professional equipment which could be thought of as truly modern and which could take advantage of some of the trends to cartridge or cassette operation as is now commonly found in home audio equipment.

The Japanese manufacturer, HOKUSHIN, with the active participation of NHK (Japanese Broadcasting Corporation) over a considerable number of years, has evolved a cassette loading, random selecting, automatic threading, 16mm projector—the TC-701.

This new 16mm cassette loading projector incorporates several features which are unique. The projector, in the form shown in Figure 1, has the capacity to accept eight



Fig. 1 The TC-701 cassette projector. Main projector controls are on the panel at the left. Cassettes are selected manually at the control panel or by an external computer programmer.

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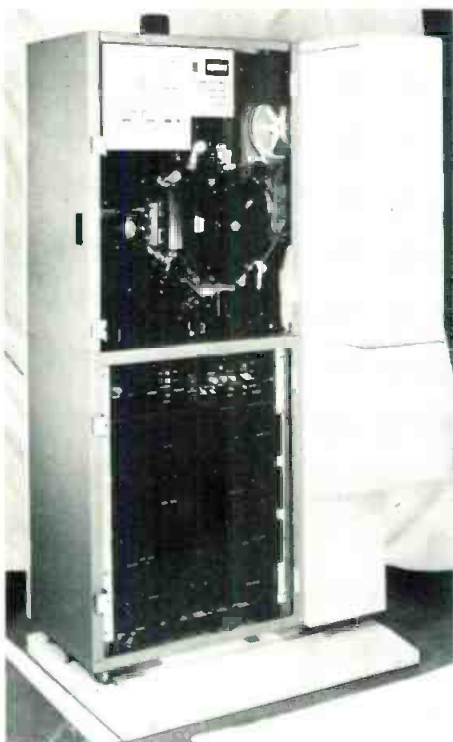


Fig. 2 Side view of the TC-701 with the door removed.

cassettes, each containing up to 400 feet of film on a standard reel and a separate special take-up reel. Film lengths as short would be required for a 10 second promotional spot plus leader can be handled using conventional smaller feed reels.

Program Sequence

Preparation of the film for cassette loading is very simple and consists of punching a hole at the end of the film. Arming the cassette ready for insertion into the projector takes the operator approximately three seconds, and a visual indication of the status of the loaded cassette is given on the projector and at the remote panel. Individual cassettes are selected by number either manually at the control panel or by an external computer programmer.

The selected cassette is drawn into position in less than three seconds from commencement of operation. A rotary arm grasps the exposed film in the cassette and proceeds through approximately 360° arc of movement in less than nine seconds. During this motion, all idlers are removed from the film path, the projection lens is retracted

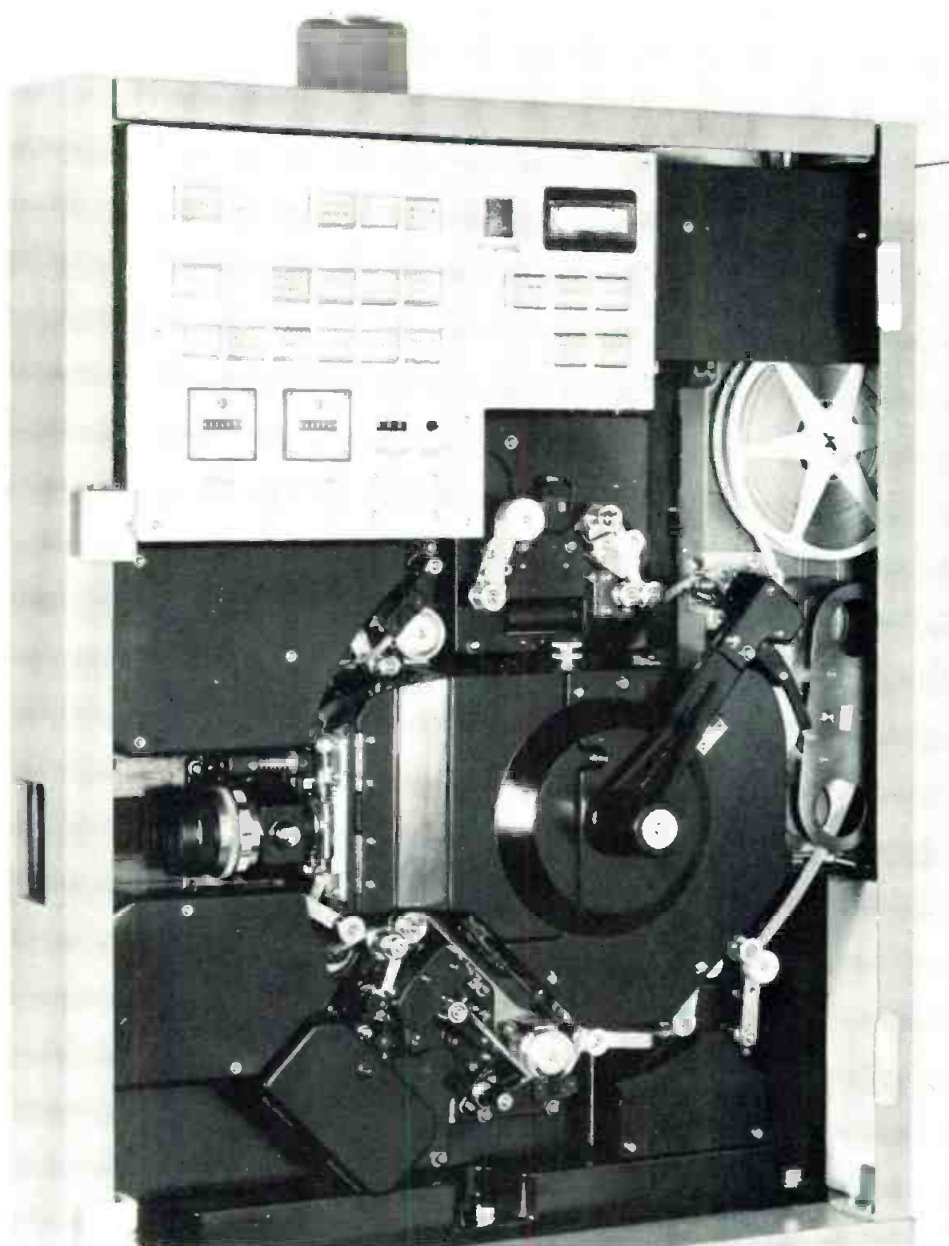


Fig. 3 View of the upper part of the projector showing the control panel and rotary arm assembly with a cassette loaded.

and since the speed of rotation is somewhat less than the actual running speed of the film, the differential allows the various loops to be automatically set. Upon completion of the automatic threading sequence, by inserting the end of the film in the take-up reel, the projector is now ready for running and, at the appropriate signal from an operator or programmer, will begin to project film.

Upon completion of the program sequence, the cassette is automatically ejected. Total access time for the machine, including these operations but excluding running time,

is less than 17 seconds. The projector will indicate that the ejected cassette has been used and a red warning light at the projector and on the remote panel will signal any attempt to reuse the cassette without rearming. In addition to these features of cassette selection and automatic threading, the projector possesses the ability to stop or start instantaneously in both picture and sound. The transition is not distinguishable to the eye under any conditions and a change of pitch in sound can only be detected on sustained low notes as found in piano music. Speech is clipped in

mid sentence without any discernible change in pitch.

In conjunction with the fast stop and start operation, the projector can be operated analytically—that is to say, frame by frame or repetitively at the rate of three frames per second. In this way, visual cue marks can be easily determined.

Automatic Mechanics

In addition to the operational features, the TC-701 projector also has the following automatic mechanisms:

1. Automatic stop at completion of projection.
2. Automatic stop at any predetermined frame.
3. Automatic replacement of main projection lamp.
4. Automatic replacement of optical sound exciter lamp.
5. Automatic control of external equipment (cue signal.)
6. Automatic restoration of lower film loop.
7. Automatic indication of broken film within the projector.
8. In the event of complete power failure, a built-in battery operated power supply will prevent the driving sprockets from tearing up film.

The following are optional accessories:

1. Automatic selection between magnetic and optical sound track and subsequent automatic switch between preamps.
2. Automatic selection between color and monochrome films providing a signal at the vidicon camera.
3. Automatic light control by means of a 100:1 neutral density wedge.

In addition to normal reverse, both fast forward and fast reverse are available as standard. This considerably increases the flexibility of the projector and allows for changes in programming sequences that might occur, such as during a news broadcast as late stories break.

It is important to realize that the machine can be thought of as either a sophisticated manually operated projector which could be run in conjunction with a library of short messages to be reloaded at will by the operator or as part of a computer controlled system as originally intended by the manufacturer in its NHK application. The quick start feature is particularly useful in the latter type operation and has not been possible before in projection equipment of this type.

Film Automated

It is hoped the brief outline of the Model TC-701 projector detailed here will indicate the uniqueness of this machine and its appropriate use in a total automation concept.

For the first time, film can be handled in an automated way by a machine without the need for excessive human attention. For example, splicing may be a thing of the past as far as short commercial messages are concerned.

While it is not envisaged that this machine will replace standard reel to reel machines when long programming sequences are required as is the case in feature film presentation, it will, however, when used in conjunction with such a machine, handle station breaks with admirable ease.

The HOKUSHIN TC-701 projector should help to raise the stature of film from the relatively unglamorous position it has assumed to a position of respect more befitting the workhorse of the Industry.

Projector Specs

The film transport uses a 2-3 pull-down intermittent system with a shutter disc. And light application time is greater than 30 percent. Film speed in this machine is 24 frames per second in both forward and reverse.

Picture size is 86mm x 115mm (3 $\frac{3}{8}$ x 4 $\frac{1}{2}$) with the 65mm projection lens. Also, picture stability has been designed to achieve a vertical jump and horizontal weave of less than 0.12 percent of picture width.



Fig. 4 Each cassette, as shown here, includes a 400 foot feed reel and a special take-up reel.

Uniformity of illumination is not less than 90 percent at the corners of the aperture in relation to the center. The projection lamp is a 24 Volt 250 Watt Tungsten-halogen type.

Film loading capacity is eight cassettes with a running time of 15 minutes for each cassette. The loading system includes random selection and automatic threading. Stabilization is achieved in less than two frames. Also, stop time is less than two frames.

Sound Systems

The over all frequency characteristics of the optical sound system include plus 1 dB, minus 2 dB, reference 1000 Hz from 50 to 7000 Hz. Signal to noise ratio is more than 50 dB at rated output. Overall distortion is less than 5 percent at rated output plus 5 dB, utilizing SMPTE test film.

Wow and flutter is less than 0.3 percent.

The magnetic sound system signal to noise ratio is greater than 50 dB. Output distortion is less than 3 percent at rated output plus 5 dB. Wow and flutter here also is less than 0.3 percent.

The TC-701 could go far in once more placing film in the mind's eye of all station personnel. ▲

Audio distortion in review

By Pat Finnegan*

The broadcast system is a connecting link between program sound origination and the ultimate goal—the receiver. The system must pass the signals it receives faithfully.

Basic distortions can make a station's signal sound muddy, dull, or simply unintelligible. Often, these distortions must be observed with a critical ear, and in other cases, measuring equipment. In this day and age, with so many choices available, the listener quite freely exercises his option of selecting another signal.

Distortion falls into three primary categories: amplitude, frequency, and phase distortion. When one of the primary distortions occurs, often there are secondary effects of harmonic and intermodulation distortions unleashed to further deteriorate the signal.

While the possible causes are many, most fall within three broad categories: production techniques, systems operation, and equipment malfunction or failure.

Amplitude Distortion

Amplitude distortion occurs when the output signal is not a faithful reproduction of the input signal. Clipping of either or both signal peaks is a distortion form that will generate harmonics and intermodulation problems in addition to the original distortion (see Figure 1). Peak clipping can be minor or severe, or on a selective basis. Most often the cause of peak clipping is stage overload, initiated by improper operation. When the input signal to a stage is greater than the parameters permit, the collector (plate), base (grid) is driven into saturation or cutoff. When these conditions occur, the collector current ceases

to rise and follow the input peak, or on the other side, is cut off.

The improper operation is often caused by inattention to program levels. Riding gain is a lost art today among many combo men and control operators. There is too much attention to the mechanics of the operation and too much dependency upon AGC amplifiers to correct all level excursions.

System maladjustment can come about during emergency situations when an amplifier or other unit must be bypassed because of failure. The system gains must be adjusted to compensate for this change.

It may be days before the unit is repaired and replaced. Then the gain adjustment is forgotten. Stages following the replaced amplifier will most likely be overloaded. One might argue that such a situation would be obvious immediately. This is true if the overload were severe. The changes may not have been so great that distortion is obvious.

This system may have been checking out under test at 1 percent overall; but after the amplifier has been replaced, it now checks out at 4 percent. The quality of the system has obviously deteriorated by the slight overload. Even setting the controls to the original setting may not do the job, because the amplifier gain may have been slowly failing and the gains may have been periodically adjusted to compensate the gain loss. Thus, it is a good practice to test out the system as early as possible after such replacements have been made and make any adjustments necessary.

Signal clipping is often caused by a tube, transistor, supporting components or power supplies. Total failure of a tube, transistor or power supply doesn't cause distortion, it usually causes the signal to cease to exist. Distortion in most cases is caused by a deterioration of the components in a specific area, caus-

ing a stage to operate short of its design parameters.

Heat can start many distortion problems in transistor stages by causing them to shift operating points or simply run away. It is most important when working around these stages to replace heat sinks or make sure they are in place. Air circulation around the units is important and the air must be free to circulate. The silicons are less sensitive than the germaniums, but both should be cooled properly.

For all their glory, solid state components often are critically affected by heat. Since this is true, it is a point to remember when rack-ing units. If older tube type units are in the same rack and below, the smokestack effect may bring quite a log of heat into the unit's underside vent holes.

The DC voltages applied to a stage set its operating parameters. These voltages are usually supplied from a common power supply through resistors that regulate the levels to each element. Generally, when the power supply is delivering less voltage than normal, the only effect on the stage will be lower gain, since all the voltages will have decreased in the same ratio. However, the input signal is most likely too high because it is still at the normal input level, and this will overload the "weakened" stage.

Vacuum tubes rely upon the filament and cathode for electron emission. As a tube ages, the emission drops off. (Low emission can also be due to low filament voltages.) Poor emission will have an effect similar to plate saturation. That is, all the electrons are in motion, and there is an insufficient amount to follow the peak input grid swings. Thus, the signal peak flattens out during that time interval.

Transistor stages are generally designed with a large amount of both AC and DC feedback. This

*BE Maintenance Editor

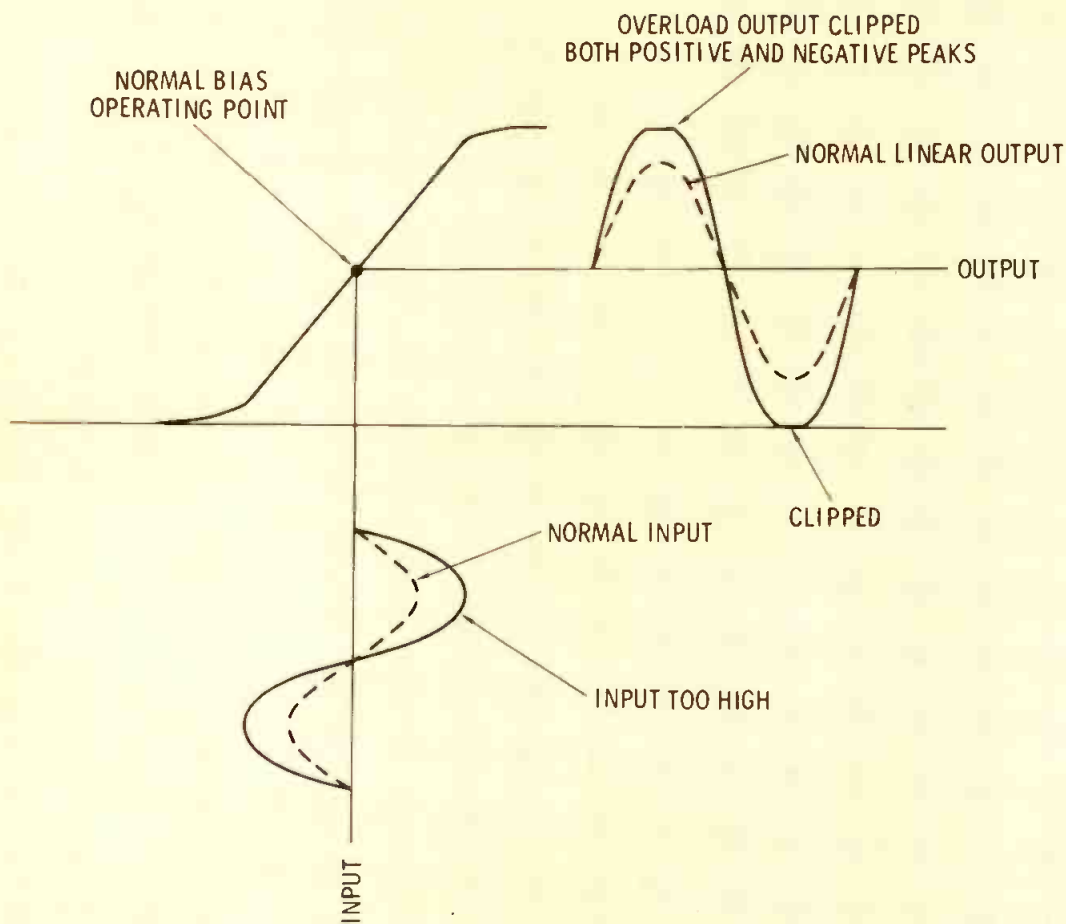


Fig. 1 Stage designed to operate on linear portion of input-output curve. Overload caused by excessive signal input can cause clipping of either or both signal peaks.

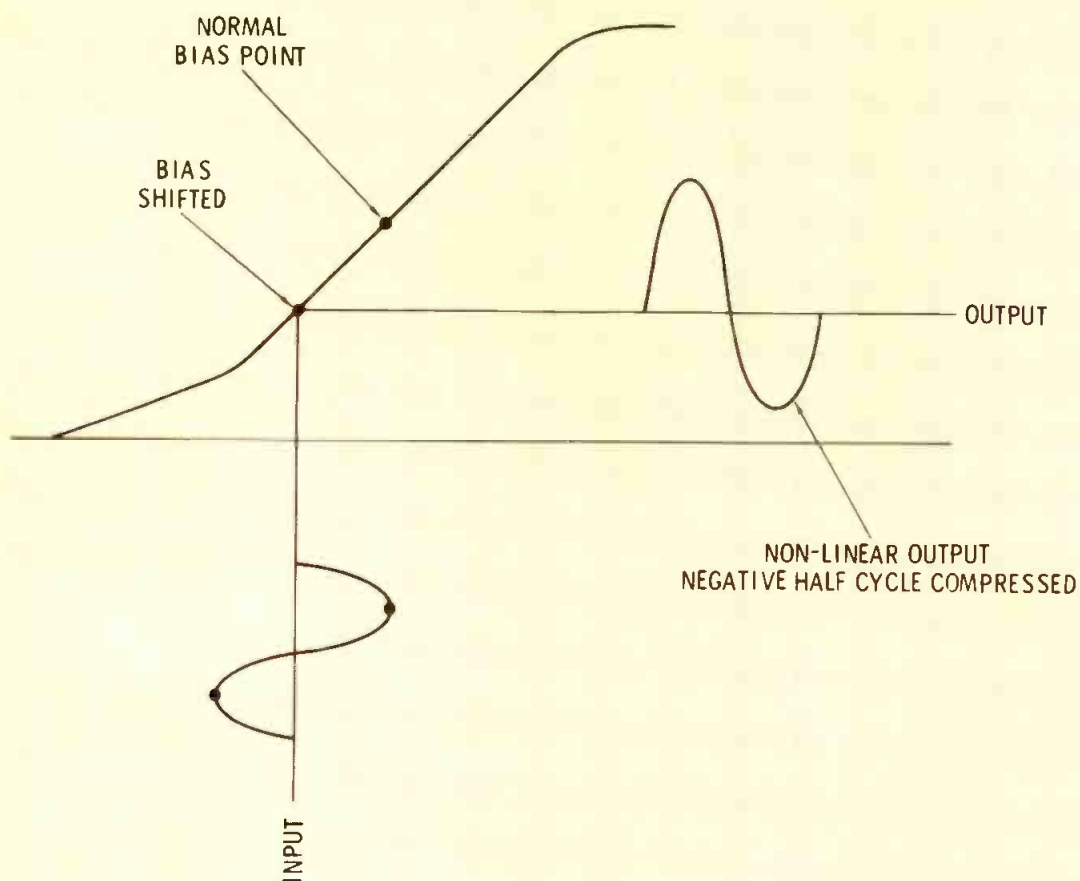
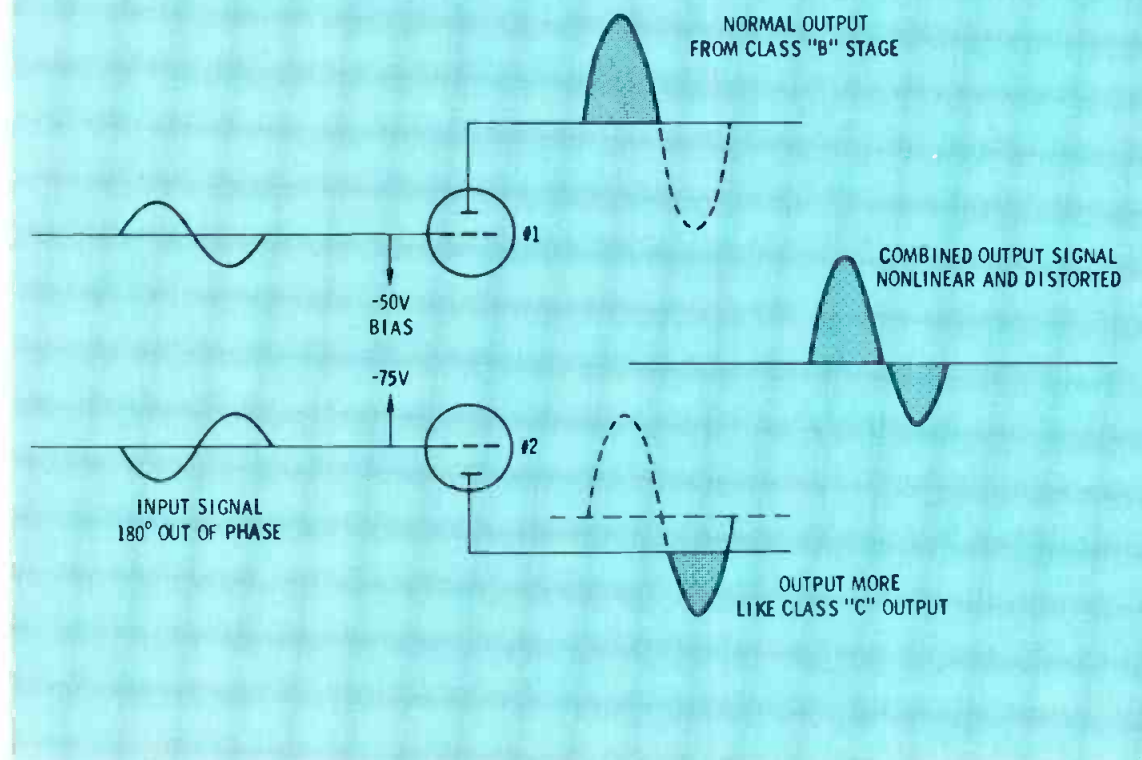


Fig. 2 Stage designed to operate on the linear portion of input-output curve. Input signal is normal, but the output signal will be compressed (non-linear) on the negative half cycle because the tube is operating off the linear slope.

Fig. 3 A Class B push-pull stage normally is fed out of phase inputs and each tube only amplifies half of the input signal, adding the two in the output for a linear output. Here, the bias on one stage has been misadjusted so that tube #2 is operating more like a Class C stage, amplifying only a part of the input cycle (less than half). When these two are added, output is nonlinear and distorted.



large feedback reduces the gain per stage, but allows for a higher degree of stability and tolerance for transistor change without adjustment. Defects or deteriorations of any of these components can cause the stage operating parameters to change to a point of causing distortion. For example, a feedback resistor may open, thus removing the feedback. In this case the gain of the stage or stages included in the loop will increase dramatically.

Signal clipping is not the only form of amplitude distortion. A shift in stage parameters can be only to a degree that it operates in a nonlinear region, yet not enough to cause clipping (see Figure 2). For example, a stage is adjusted for class A operation. The bias may shift so as to make it nearer a class B operation. If the input signal is large enough, the signal peak will be clipped, but if it is not, the output signal will be nonlinear. Now there are some designs that use nonlinear sections to create a linear result. Take a class B push pull circuit, for example. If the bias on one side moved in the direction of a class C, that half of the cycle would not be as large as the other side, and the result would be a nonlinear output. (In a class B, push-pull circuit, each side amplifies one half the cycle.)

Frequency Distortion

This type distortion is basically an amplitude problem, although on a selective basis. When the system frequency response is poor, distortion can sometimes be caused by operation. When a system with a badly "tilted" response curve across the bandpass is carrying program material, the operator may be setting the VU meter to the average program material that is in the low response area. The high response area may be of enough amplitude to cause peak clipping during the intervals those peaks are present. Such can occur during times when there is an intentional misadjustment of the bandpass through the use of equalizers.

Circuit components around a stage also can cause frequency distortion. For example, the AC feedback capacitor may change value. Since capacitive reactance varies with frequency, the AC signal at some frequencies may now be overloading the stage. The stage gain during those frequencies is increased, so if the immediate stage is not overloaded, the following stage may be.

Resonant circuits are a source of overload distortion and they can cause extraneous signals to be created. Resonant circuits are used for various purposes, such as equalizers. The high Q of the resonant

circuit can increase the signal at the resonant frequency and cause overload. A strong signal of another frequency can cause a resonant circuit to "ring". That is, it can cause shock oscillation of the resonant circuit, creating unwanted spurious frequencies or harmonics, resulting in signal deterioration.

Harmonic Distortion

As was pointed out earlier, most distorted problems are inter-related. When one type is present others also may exist. Harmonic distortion falls into this mold.

Clippings of the signal will always cause harmonics to be introduced, both the odd and even variety. Carefully balanced push-pull stages will reduce many of the even order harmonics.

There is also another side effect when clipping occurs. In addition to the odd and even harmonics of the fundamental signal frequencies, there are also sums and differences of the frequencies. These are called intermodulation distortion. Instruments are available to check intermodulation distortion, but too often are not used in the field. Avoid harmonic distortion and there will be no intermodulation distortion.

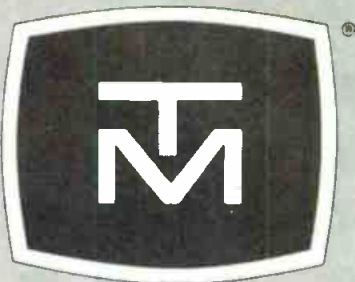
The basic method used to check intermodulation distortion uses two input signals simultaneously to the amplifier or system under test. One

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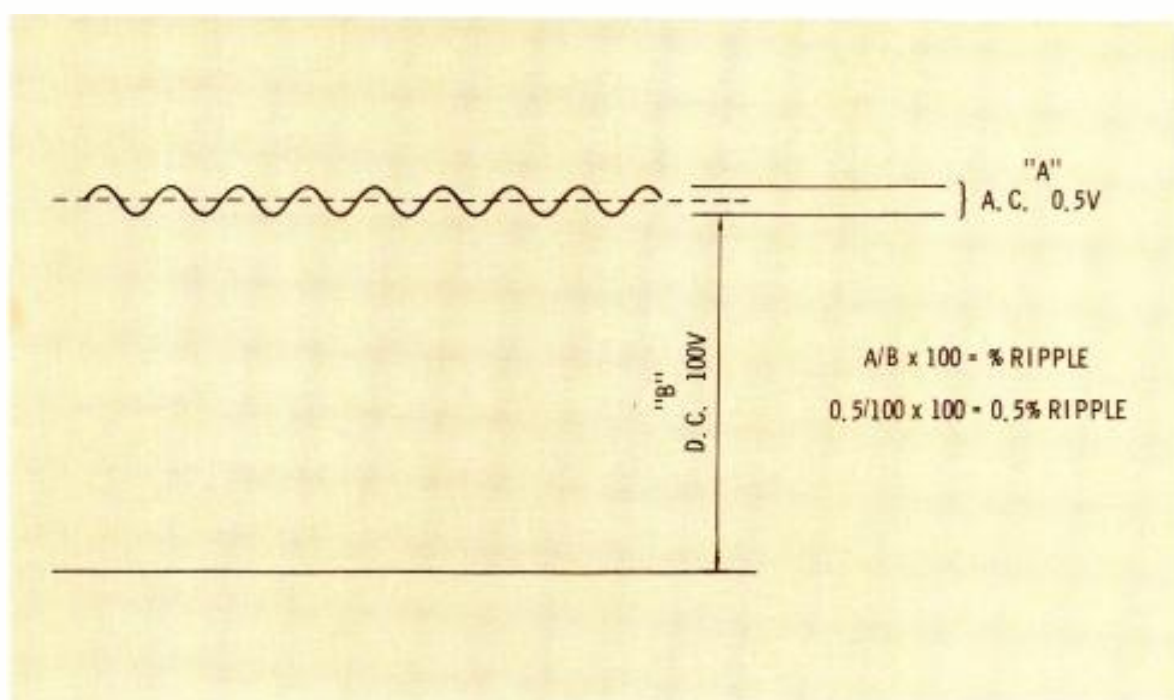


Fig. 4 The tracing of AC ripple on the DC voltage from a power supply. Measure and compute the percentage of ripple. A very low percentage ripple should be obtained.

is a high audio frequency and the other is a low audio frequency. The low frequency is about four times the amplitude of the high. The output is filtered, rectified and measured. If there is intermodulation distortion, the low frequency will be riding on the high frequency as modulation.

Phase Distortion

This type of distortion is based on the time element. The system should pass all frequencies on a same time basis. If some are delayed there is a phase problem. In an ordinary monaural system, phase does not cause too much of a problem, even when some is present. If the delayed signals are somehow added to the non-delayed signal, however, problems will arise.

Feedback or crosstalk can be areas where phase delays can cause a problem. The delayed signal will trail the original signal and produce an echo effect in the final signal. This is similar to the controlled echoes that are used for specific effects. Print-through on an audio tape will produce this in an undesirable manner. Print-through occurs, sometimes, when one layer of tape on the roll magnetizes the adjacent layer beneath it. When the tape is played back, there is a faint echo on the reproduced signal.

Another operational area where echo can occur is during recording.

The program may be on the air live and being recorded at the same time. If the tape machine has separate record and playback heads and the tape recorder output is being fed into the console, the delayed program through the tape machine will produce an echo effect on the total program.

Stereo systems are critical of phase problems. Any phase problems will show up generally as poor separation of the channels. There are many areas of the stereo system where phase delays can occur, since the entire route from input to output is a dual channel. The matrix in the stereo generator adds and subtracts the left and right channels to produce the transmitter signals. If complete cancellation or addition cannot take place because of phase delays, what is left over will appear in the opposite channel . . . and that is reduced separation.

Other Signals

Spurious signals, hum and noise are other problems that bedevil the electronic audio system. It is best that these be called by their specific designations, which aids in communicating problems and troubleshooting. Too often, non technical people will lump everything they hear into one term, distortion.

Power supplies can cause distortion by low output voltages. Defective components are often the prob-

lem. The output capacitor does many things, but one main purpose is filtering of the AC ripple on the rectified DC.

Excessive ripple can introduce hum into the system. The ripple can be measured easily with an oscilloscope. First, measure the DC voltage. This may be done with the oscilloscope or with a meter. Measure the AC ripple with the oscilloscope. The ratio of the AC ripple to the DC voltage is the percentage of ripple. This ripple should be less than one-half percent for a good audio system. When one is accustomed to using an oscilloscope regularly, computation will not be necessary.

Filament DC supplies are sometimes used for tubes in low level circuits to reduce hum to a minimum. When signal clipping appears to be happening, it may be poor filament emission. The filament voltage should be measured, if the other voltages appear normal. When simple tube substitution is made, the new tube may appear to cure the problem, but if it is low voltage, the cure will be short lived. The new tube will present a greater supply of electrons and will be more efficient.

Dirty jacks can cause distortion that appears or sounds like peak clipping. There also can be a loss of low frequencies due to the capacity contact.

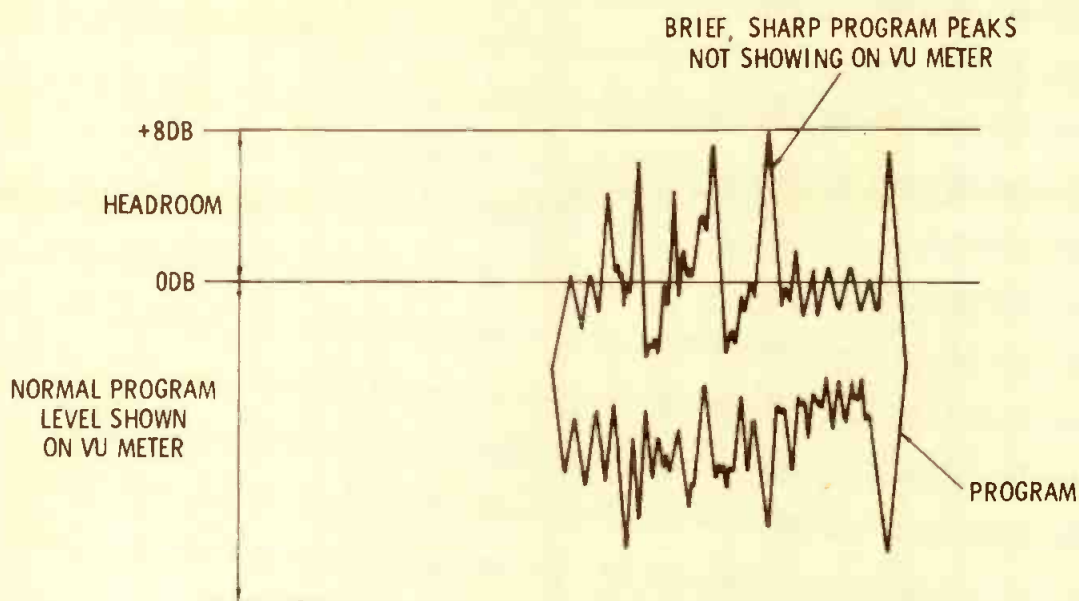


Fig. 5 System levels should allow "head-room" for signal peaks to clear without being clipped with resulting distortion. These brief, sharp peaks will not show up on the VU meter. System should be able to handle at least 8 dB above normal program levels without distortion.

Usually the fault will be in the "normal" connections inside the jack. A quick remedy is a patch cord to bypass the normals. Should the problem disappear, the jacks need to be cleaned. If a regular jack cleaning tool is not available, a narrow bladed relay burnishing tool can do the trick. It will take a bit of trial and error to find the right spot inside the jack to insert the tool. The tool is inserted from the front of the jack and into the normal contacts.

Signal Tracing

Signal tracing methods can be used to quickly isolate the offending unit when distortion is occurring. A headset and a proper cord is used to go from unit to unit in the system. As soon as the output of the offending unit is passed, the sound will be distorted in the headset. Two cords should be available, each with a female cable receptacle for the regular headphone plug. The other end of one cable, attach alligator clips. The other cable, a regular double patchcord plug. The alligator clips will prove handy when checking on audio blocks.

Proofs of overall station distortion measurements should naturally be within the FCC limits. One should also check to see that each segment of the system is contributing an equal part of the total distortion. There may be one section

contributing most of the total distortion. For example, an AM station is permitted 7.5 percent distortion above 85 percent modulation. An engineer making measurements may read 5 percent and since this is within limits, he may be satisfied. The audio system by itself may be only 0.8 percent distortion, while the transmitter is contributing 4.2 percent. Yet the transmitter (if a modern one) is capable of at least 1.5 percent distortion. If the transmitter is corrected to this value, his overall distortion would be 2.3 percent and a much cleaner signal than 5 percent.

Modulators on present day transmitters are capable of good distortion figures. Most of these use class B, AB or A'B' push-pull modulators. Unbalanced or poor tubes can deteriorate the distortion figures. And even balance of the modulators does not guarantee good dynamic balance and low distortion.

The best technique for dynamic balance is to tone modulate the transmitter as close to 100 percent as possible. An oscilloscope should be used to check the envelope to insure that the monitor is reading 100 percent correctly. Monitors do get off calibration and 100 percent indication on the meter could actually be over 100 percent modulation. Overmodulation can cause high distortion figures.

Now move the scope to the out-

put of the distortion analyzer. Adjust the analyzer to read the distortion figure. Balance the modulators by adjusting the individual bias controls for the lowest distortion figure. As most analyzers read all that is left after the fundamental has been nulled out, part of the reading can be hum. Adjust the hum balance control for a still lower distortion reading on the meter and analyzer. The scope will show what is being read by the meter.

Tape Head Wear

Head wear on audio tape machines can be a cause of poor frequency response as well as distortion. Many FM stations use tape machines as the main program

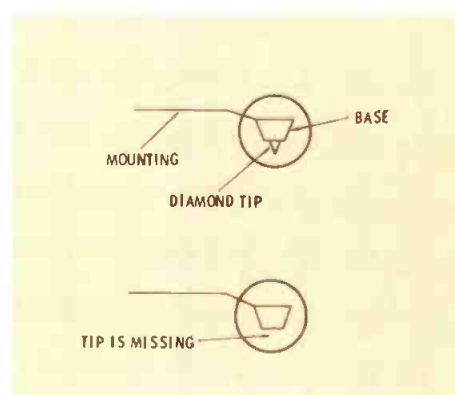


Fig. 6 The diamond tip is mounted on base of stylus. Even though tip is gone, the base may still be present. A small microscope will quickly reveal the condition of the tip.

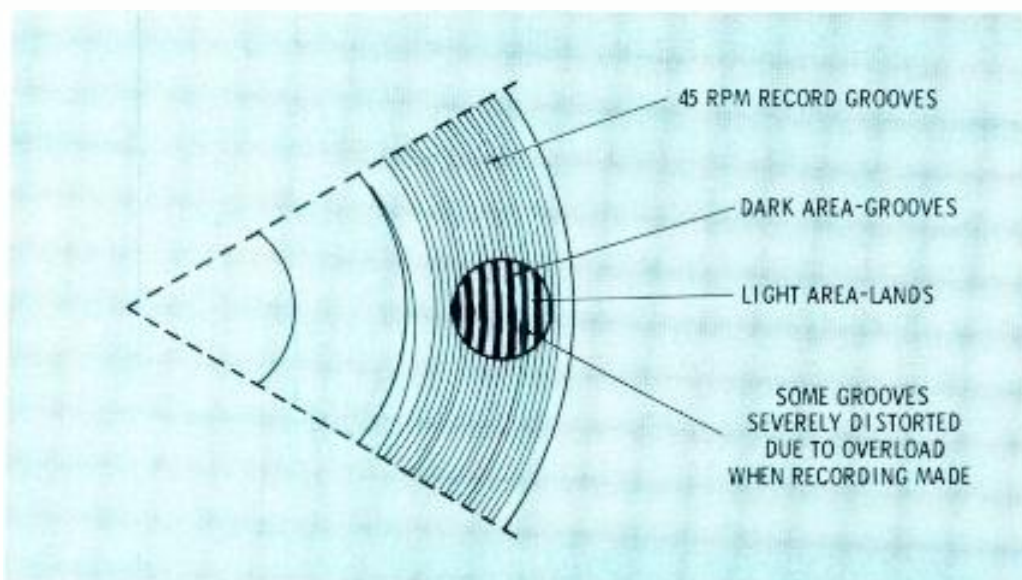


Fig. 7 The grooves of a 45 rpm record can be badly distorted physically when they are severely overloaded during the recording process. As seen through a microscope, the grooves waver, occasionally leaving almost no wall between grooves.

source. If the heads become worn, oxide can build up in the gap, and ridges can keep the tape from making good contact with the head.

Loose oxide is intermittent as the tape motion moves it from place to place across the gap. It can be shorting out the gap intermittently, particularly during high frequency segments. This will cause the signal to sound distorted.

These heads can be cleaned sometimes even with the machine in use and the program on the air. Dip a cotton swab which is attached to a stick in head cleaner or solvent. Have it saturated. Hold this saturated swab against the tape on the oxide side, just before the tape enters the heads. Often, this will remove most of the loose oxide that is present on the head.

Peak clipping and resulting distortion is sometimes caused by poor design of the system levels. When selecting equipment and designing the signal paths, one should allow "head room" for signal peaks above the average program material. This headroom should be approximately 8 dB higher than average program level. Run distortion tests by sending tone signals through the system 8 dB above the normal program

level settings. Good distortion figures will indicate the system can handle program peaks easily without overload.

Transcription Equipment

Transcription equipment is often a source of distortion, and there are several areas which can cause distortion.

Many of the modern tone arms are designed for stereo operation and are very light, exerting 1 to 3 grams of pressure on the record. Unfortunately the pressure adjustments are too readily accessible and often get adjusted for all but the correct reasons. For example, warped records, bad stylus. The tone arm pressure should be checked often, especially in areas where they are in constant use by nontechnical people.

Excessive pressure and rough treatment can easily damage the stylus. An investment in one of the small inexpensive pocket microscopes is recommended. The microscope can be used to inspect the stylus tip. A stylus that appears to the naked eye to be alright or to feel sharp to the finger can still have the tip gone. The base may track in the groove, but the sound

will be distorted and a fine groove record may be ruined.

Light pressures require delicate handling of the tone arm. Dropping the tone arm down hard on the record or allowing it to scoot across the record will most often knock the diamond tip off the stylus.

LP records with fine grooves are easily damaged. The trend today is to make all records stereo. A stereo record can be damaged if it is played with a monaural pickup. For those stations who intermix stereo and mono records, the tone arm should be equipped with a stereo cartridge and the output of the cartridge strapped to provide a mono output. The stereo cartridge will play either mono or stereo records without damage to either.

Some 45 rpm records are very poor quality, especially those carrying top 40 tunes. If one of the small pocket microscopes is available, inspect the grooves of some 45 rpm records. Some of these are so overmodulated that the walls between the grooves are almost non-existent.

Playing these records with a good stereo tone arm and fine stylus can cause problems. This is especially true if the stylus is 0.5 mil. A fine point like this will drop all the way down into these overmodulated grooves and the cartridge itself may ride on top of the record. There will be noise, distortion or both present. If the turntable has only a single tone arm, a compromise can be made by using a 0.7 mil stylus. If a second arm can be placed on the table, equip it with a 1 mil stylus for the 45 records.

Transistor Circuits

Transistor circuit design problems are not ordinarily a concern for the man in the field. A little knowledge will help in trouble shooting problems. The resistor values around the stage set the operating values. These values are, in a sense, non-critical. They are for setting the stage operation within limits. What is most important is the ratio of the resistor values. All of these can be changed in value a long way so long as the ratios remain intact. The change must be within the limits of the

transistor. There will be a change in impedance and gain values. What is important from a distortion and trouble shooting viewpoint is that one of the resistor values may have changed radically. This would upset the stage parameters, perhaps upsetting the stage bias. Thus, when checking values around a stage, do not be concerned if resistor values are off 10 to 20 percent, so long as they are all off in the same direction. If one has changed 50 to 75 percent of its stated value, it should be changed. The replacement should be as near as the stated value as possible, assuming the others are close to stated value. Thus, if the circuit calls for 1,000 ohm resistor and the one in the spare parts only reads 950 ohms on an ohmmeter, add a 50 ohm resistor in series with it. It may not look nice, but will make the stage work as it should.

A transistor stage had two operating modes, AC and DC. The DC is the static while the AC is the dynamic mode. Control of the AC characteristics is just as important as the DC characteristics.

The capacitor values are important because if they change value, the AC characteristics will change and on a frequency selective basis. Impedances and gains will also change and often distortion will result. When a capacitor is replaced, it should be with one as near the stated value as possible. One should not just use whatever value is handy so as to have some capacity in the circuit. If need be, stack them in parallel to get more capacity or in series to get a higher voltage rating.

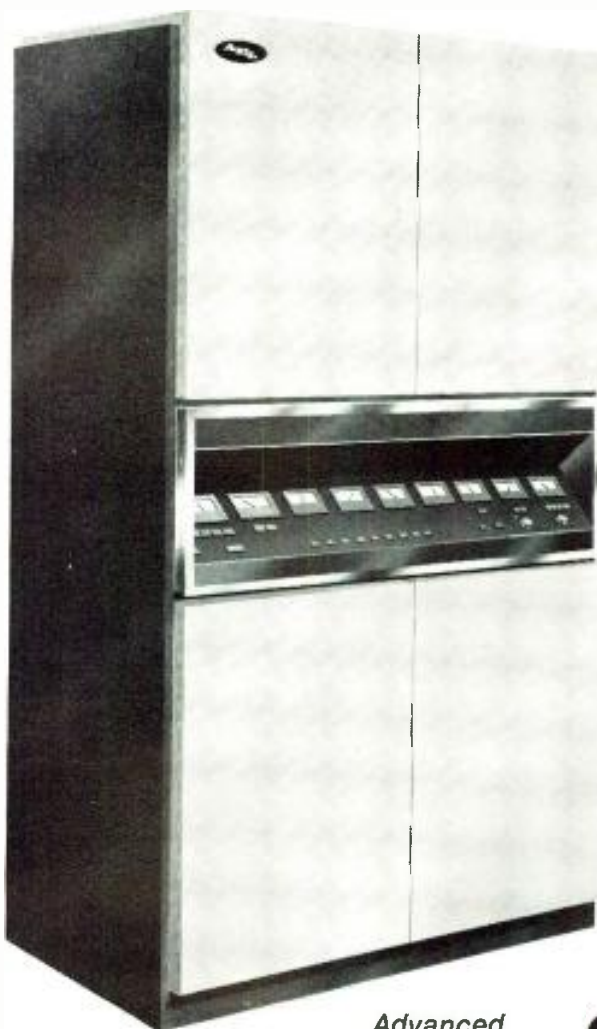
In summary, distortion can originate in many places and have many causes. It can start small and grow gradually. Regular checkouts of the system under test conditions will show up many of these problems before they can be heard. But always, the signal should be listened to with a critical ear. Often, distortion is masked under program material. The overall effect is a muddy signal and can invite the listening audience to switch to another station—a no-no in this highly competitive era. ▲

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Can we bridge the gap between management and engineering?

Part 3 of a 3-part series

There can be no substitute for the person-to-person relationship of mutual confidence and respect that will go far to weld management and engineering into the complementary team that it should be. There's no point to merely throwing stones across the gap. By R. H. Coddington

There's much the engineer can do to make himself more valuable to his operation and thereby close the "gap" to some extent, but there also are steps that management needs to consider. Some of them are implied in the parts of this series addressed to the engineer.

The manager, too, needs to step beyond his frame of reference so that he can view his operation from an engineer's viewpoint. He may need to spend some time with an engineer if he is to appreciate the more subtle facets of a good technical operation, and the "invisible" engineering effort that goes into it.

With a little effort, the manager can come to a better appreciation of technical professionalism and the industry-wide need for tighter quality standards. Radio's ultimate product is sound, and the audible difference between nominal and optimum equipment performance can be demonstrated with even a pocket-sized transistorized receiver.

Meeting The Competition

The evidence of the difference from station to station can be spotted as one dials across the signals with a high-quality receiver such as those associated with the increasing number of stereo consoles to be found in modern homes.

The broadcaster today competes not only the other stations, but with the sophisticated home entertainment center. If his signal is inferior in its sound, he's handicapped from the outset. (Professional broadcasting

standards used to be the criteria by which home equipment performance was judged. This is no longer true; many home systems far surpass in capability the technical limitations of some signals on the air. This seems inexcusable on the part of broadcasters. Even AM, contrary to common misconception, can rival mono FM in the fidelity of the transmitted signal.)

If the manager is a genuinely dedicated broadcaster, he will come to appreciate the long-term desirability of consistent technical excellence, and he will clear the way and the time for his engineer(s) to deliver it. He will understand, for instance, why proof measurements should be made at frequent intervals. He will approve the businesslike nature of complete and ready engineering files. He will appreciate the time an engineer may spend in evaluating available new equipment that may improve the station's sound, flexibility, or ease of operation.

That manager will back the technical department in demanding proper equipment supervision by non-technical licensed operators, and he'll make every effort to keep within FCC requirements at all times. He'll do this not merely to avoid the financial losses of fines, but to deliver the performance that those rules are intended to assure.

Update On Education

Management also may choose to underwrite a continuing education for the technical staff. Many indus-

tries send key men to training sessions for updating from time to time, and there's no obvious reason why radio should be an exception. And management really serves itself in the long run by supporting the local broadcast engineers' association, where the experiences of other engineers are shared by station personnel, who may profitably adapt some of them to their own operation.

Given a better understanding of the specialized needs and the "hidden" productivity of technical employees, station management needs to review its economic philosophy. Are current pay scales commensurate with the education, experience and responsibility required of the technical personnel? How do they compare with those paid for similar requirements on the "outside"? Do they represent a share of the station's prosperity that is proportional to an engineer's real contribution to it? Or has an industry-wide de-meaning of the engineer's true value been instrumental in creating today's engineer "shortage"?

If management will answer these questions objectively and honestly, and act accordingly, the engineer will see a brighter horizon. This, too, will enhance the operation. Engineers, like anyone else, work toward a company's best interest when it is to their **own** personal best interest to do so.

Above all, management will encourage communication with the engineer. Regular reports, recommendations on equipment and operating procedures, and complaints should all be invited and considered upon their merits. Finally, there can be no substitute for the person-to-person relationship of mutual confidence and respect that will go far to weld management and engineering into the complementary team that it should be. Given this in both directions, the inherent philosophy gap between the "typical" manager and the "typical" engineer can be bridged.

Closing The Gap

This discussion of the traditional management-engineering rift has suggested that there is a basic personality divergence between the groups in general. More than an

actual cause of friction, however, this divergence is seen to be principally nothing more than a surmountable barrier to communication between them. A better understanding by each side of the other's motivations can lead in turn to an appreciation of the fundamental problem, which—in radio, at least—is an economic one of skilled pay versus productivity.

For his part, the manager should investigate the nature of the engineer's job to determine whether there's more to it than meets the casual eye. He also might revise upward his conception of the technical standards desirable in modern radio broadcasting. He should encourage the engineer's comments and suggestions, and re-examine pay scales in the light of engineering's total contribution. He needs to see the engineer as a vital ingredient of the station's prosperity.

The engineer, in turn, must see to it that he **is** that vital ingredient. This he can do by working toward productivity goals that genuinely enhance the operation, and by making management aware of than en-

hancement. He must recognize that his license is not an automatic ticket to security, and charity is not a fringe benefit of the industry.

The engineer should actively seek ways to increase his real contribution through upgraded professionalism and genuine operational economies, and he needs to examine the merits of budding innovations.

He also needs to join his fellow engineers in upgrading technical performance industry-wide, both collectively and individually; and he should join them in raising the stature and image of the profession as well.

Finally, he will strive for better communication with his management. He will subtly educate the front office in the nuances of technical excellence, always framing his remarks with reference to potential economic benefit accruing from the highest professionalism.

The problem of the broadcast engineer's plight is not a simple one. Only through mutual understanding and cooperative action by management **and** engineering can the gap ultimately be bridged. There's no

point to merely throwing stones across it.

Editor's Note: We are reminded, as we read through the three parts of this series, that there are many exceptions to what has been said here. We know, for instance, that there are many managers who have technical knowledge. We know there are managers and owners who have been stung by FCC fines and lost equipment due to an engineer's lack of knowledge or honesty.

On the other hand, we also know that there are managers who drive engineers straight up the wall because they will not allow the required updating of equipment, managers who will not pay the price for engineering talent, managers who seek the easiest way out of any situation.

So we see the extremes. The manager wrestles with profit and image. The engineer drives for signal quality. So long as there is a gap, it makes little difference that both put the better part of their lives into the same station, for the gap will leave its telltale marks and both will suffer from that. ▲

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Small market stations in mobile homes

By Robert A. Jones*

Many stations have found the advantages and economy of using mobile homes as a natural for housing the small market radio station. Possibly you have overlooked the practical approach?

The mobile home industry has made rapid advances the past few years. It is no longer looked upon as the "House Trailer" industry. Units can be purchased in eight foot widths, in 10-foot widths, and even in 12-foot widths. Many companies provide two units that can be coupled together to complete a finished unit 20 to 24 feet wide. This is accomplished by mounting two individual units side by side.

The most obvious advantage to the use of mobile homes is one of cost. A typical 10 by 50-foot unit can be purchased new for under \$4,000. This works out to a cost of about \$8.00 per foot. This is about one-half the going rate for hand constructed buildings, since most commercially constructed studios and transmitter buildings run between \$18 and \$25 per square foot.

Another advantage of this type of facility is that mobile homes can readily be financed by local lending institutions. In fact, they often can lend you a higher percentage of the mortgage on a mobile home than on a commercial building. This is, of course, a blessing to those just beginning in the business. The reason savings and loans and banks are more willing to loan money is that mobile homes have a higher resale value (as homes) than do single purpose commercial buildings.

KCLN, in Clinton, Iowa had their mobile home specially constructed, and designed for their needs. Sometimes it is easier to



Fig. 1 KCLN's mobile home station setup as it appears now. With minimal landscape treatment, it would present a pleasing, efficient, and attractive facility.

have a new unit built to your requirements and specifications. At KCLN we contacted one of the better known manufacturer's. We gave them an outline of our needs, setting forth the location of each wall and outlet and specifying those walls that need sound treatment, along with other special requirements. Obviously, we did not want the built-in cabinets, refrigerators, gas stoves and fancy bathrooms that come with a new mobile home. As you can appreciate, a saving is realized when buying a new unit without all the extras.

Mobile homes like KCLN's can be purchased in any color scheme desired. In our case we chose bright red. Also the choice of wall material is up to your individual preferences. In our case we selected wood paneling. A simple color scheme, without a lot of frills and trim can also reduce the costs. Maintenance costs can be reduced by using simple paneling of a Marlite type of material.

KCLN Floor Plan

In designing the KCLN studios we chose to locate the control room at one end of the trailer. This is for a fairly obvious reason. In doing so we needed to sound proof just one wall. In all but one of the

mobile home studios I've seen the control room was so located. If one located the control room in the center, it would be necessary to sound proof three walls.

In the KCLN control room, the desk and console are located so that the operator faces toward the opposite end of the trailer. As the reader can see, this permits the operator on duty to view anything going on in the rest of the mobile home. By selecting a 10-foot wide unit, there is ample space for the desk and console and still enough for a walkway along side the desk.

The next part of the trailer serves as a large studio. It is big enough for interview programs, for panel discussions, and for any other sort of limited audience participation program. With the landslide away from large audience programs, this has been no hardship to KCLN's programs.

The next part of the mobile home is the production studio. In our case we used a room about six by six feet. Because of the limited space, the desk and console in this studio face toward the wall, away from the door. As can be seen in the floor plan, this allows the operator to make a one-half turn and view sideways through the window anything going on in the live studio

*BE Facilities Editor and Consulting Engineer, La-Grange, Ill.

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Fig. 2 Mike Mathews in position in the KCLN main control room. As you can see in the KCLN floor plan in Fig. 5, his window looks down the hall and into the news room. Also, note the meters to Mike's left.

area, or main control room. The production studio is wired so that it can be used to record from any of the mike positions in the live studio.

The news room is located at the rear end of the mobile home. This room includes built-in desks for two news men and storage space for news files, and copy. The teletype machine is located at the entrance to the news room facing the hallway. By locating the news wire machine this way, it is easier for late night operators or weekend men to quickly select and edit news directly from the machine.

Between the news room and production studio are the rest room facilities, including a hot water tank. No space is required for heating, since it was decided to heat by electricity. Any moves like this which result in more usable floor space are of great help.

You may have noticed that no room was provided for the transmitter at KCLN. This is because KCLN already had a transmitter building, and the mobile home was located adjacent to it. Thus the mobile home is really an addition to the existing building. Before going into more detail as to wiring and other considerations, let me briefly describe two other floor plans.

The WNRR Plan

The first of these is that employed by FM station WNRR in Neenah-Menasha, Wisconsin. At WNRR the mobile home selected had been a used one, so we were somewhat limited in placement of walls. As with KCLN, the main control room was located at one end. WNRR's trailer was only eight feet wide. Because of the reduced width, we found it better to turn

the operating position so that it faced one side wall. Also different at WNRR was the fact that the monitoring equipment and limiters were installed in relay racks in the control room. These are mounted to the right of the operator's normal position. To the operators left is the sound proof wall separating the control room from the rest of the mobile home.

At WNRR the FM transmitter was located in the same unit. We installed it directly in line with the window from the control room, thus complying with FCC Rules. It was not necessary to have any racks next to it, since all monitors were in the control room. As you will see from the floor plan, no production studio was installed at WNRR. However, future plans call for modifying one of the offices for this use. At WNRR the control room and transmitter area consume

less than one-third of the total floor space. In designing equipment layout, as well as walls, desks, and usable space, you must keep in mind that compactness is the prime virtue. If care is taken, things will fit together efficiently, yet not appear overcrowded. Also, you will find that junk and unneeded items do not accumulate, because there is no extra places to store them.

The balance of the mobile home setup at WNRR is used as office areas, rest room facilities and for a heating plant. WNRR is an all-in-one radio station facility. It is the best example I know of an efficient, inexpensive, low budget station.

The KFIL Plan

The second example is that used as KFIL. As noted already, KFIL has selected their control room to be in the middle of their mobile home. As the floor plan shows, this was done for a good reason. Like WNRR, KFIL has their transmitter and studio combined. In fact, they have two, since they operate both AM and FM and have two control rooms.

The mobile home used at KFIL is a used one, so that as in the case of WNRR we were somewhat limited in location of walls. However, KFIL's home was of the type with an expandable room attached to one side. This worked well since it allowed office space adjacent to the control room.

The FM transmitter was located at one end of the mobile home, with the AM transmitter near the middle. This was necessary for two reasons. First, it distributes the weight of these units better; and second, it allows for separate cooling of each. The FM transmitter is a 5 kW unit that requires a log of air exchange. In fact, it was found necessary to pull outside air in directly, then to exhaust directly to the outside. The AM transmitter draws the air from the inside of the trailer, but then exhausts through the side wall. At KFIL and WNRR some of the heat generated by the transmitters is used in the cool months to help heat the mobile home.

There can be many alterations to these basic floor plans and uses for mobile homes, but KCLN, WNRR, and KFIL represent the three basic plans.

Special Precautions

When using any mobile home there are several special precautions to be employed. The first of these is with mounting, or, with anchoring the mobile home. If possible, unless you plan to beat a hasty exit from town some dark night, it is best to remove the wheels and mount the unit directly on a secure concrete pad. Unless this is done, you may find your mobile home rocking like a boat in a strong wind. In some cases where this is no prob-

lem, as would be the case in an unattended operation, the mobile home can be mounted on cement blocks.

At WVFV in DunDec, Illinois we employed a mobile home as the transmitter building. WVFV has its studios located in the downtown area and operates by remote control. All that is mounted in the trailer is the transmitter, some rack mounted equipment and a work shop area. In the case of WVFV it makes no difference if there is a



Fig. 3 Is this as cramped as you thought it would be? Here news director Rod Church and "girl friday" Donna Galusha have quick access to the wire machine.



Fig. 4 Operations Manager Robb Strack appears to have more than enough room. The reception area would be in the foreground.

little rocking in strong winds, or if things jiggle when somebody walks around. However, in a trailer with studios, it will just not do to have the tone arms jump when the wind blows. So precaution number one, be sure the whole thing is securely anchored.

The second precaution pertains mostly to radio stations located in the northern, colder areas. To avoid

ice cold floors, be sure to insulate around the bottom of the mobile home. All units are constructed so that they are about 24 inches above the ground. For permanent installation, I recommend that these areas between the floor of the home and the ground be "boxed" in and insulated. This prevents the wind from howling underneath, and also provides a dead air space to assist in

keeping the floors warm. Some stations find that this underneath area is also useful for additional storage.

The third precaution is be sure to provide for a place to run your cables and wires. In ordinary type construction there is always room between the wall joists to fish wires or to install conduit. This is not so with mobile homes. The walls are very compact and completely filled with insulation.

We have found that there are generally two good ways to provide for routing of cables. One method calls for running all cables down through the floor and then underneath the unit to the point where you wish to bring them back up. This is probably the easiest method, but it does require somebody (probably the engineer with least seniority) to crawl under the unit every time a new wire is added or has to be changed.

Our experience has been that the use of baseboard cable ducts is the most practical, although slightly more expensive. You will note that in each of the examples given here, we have so installed the various rooms that all had a common outside wall. This is for the use of a common cable duct. Isolation of high and low level audio, AC, and proper grounding are just as important here as with any regular studio installation, but no special practices are needed.

An excellent finishing touch by KFIL and by WWDA was the installation of some outside wood siding to give the mobile home an appearance of a wooden building. In each case the wooden planks were installed vertically and lapped. This also serves the purpose of boxing in the area below the house floor. Thus, by clever designing, you can actually end up with a mobile home that looks like a commercially built building, but has all the cost and maintenance savings of the mobile home.

Conclusion

The use of mobile homes has "grown up". They no longer should be looked upon as a trailer business, and or for tiny remote units for the county fair. To the small market radio station operator and those on limited budgets, I do believe this is a practical solution to the studio-transmitter building requirements.

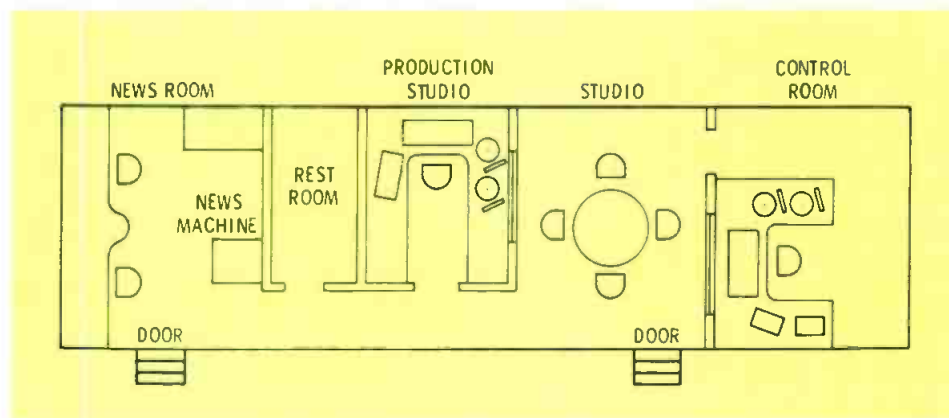


Fig. 5 KCLN's mobile home station layout.

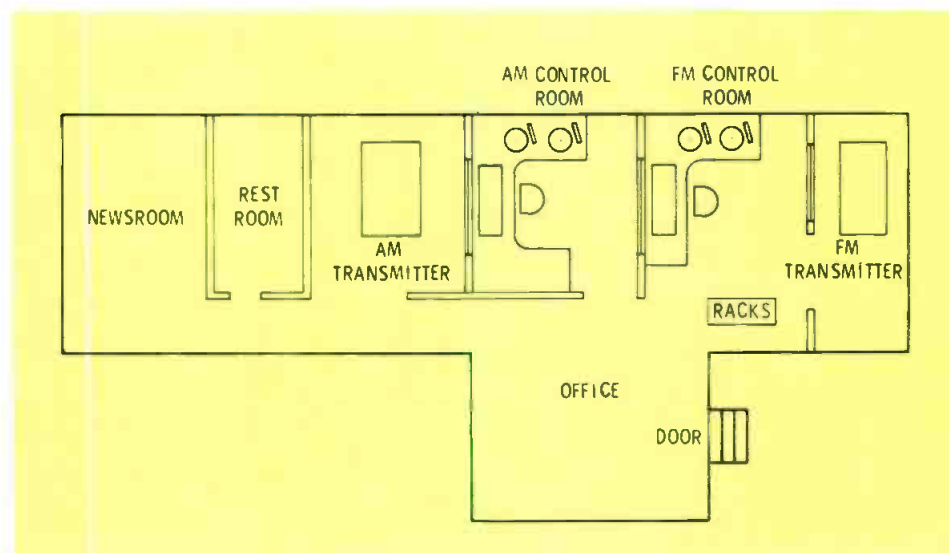


Fig. 6 The KFIL floor plan. This is an AM-FM station.

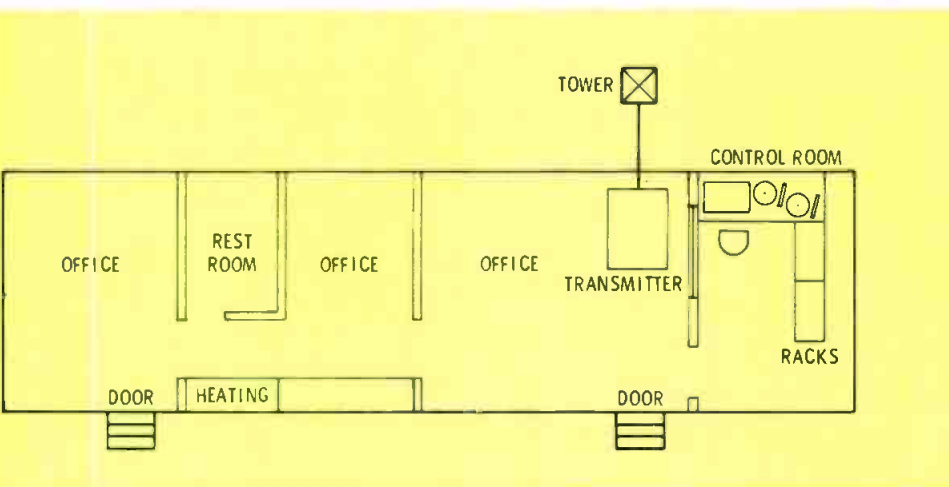
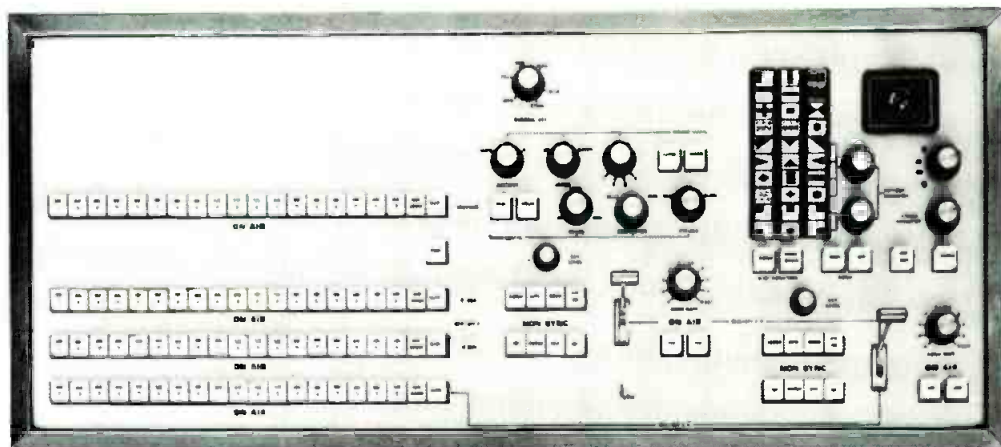


Fig. 7 The WNRR station floor plan.

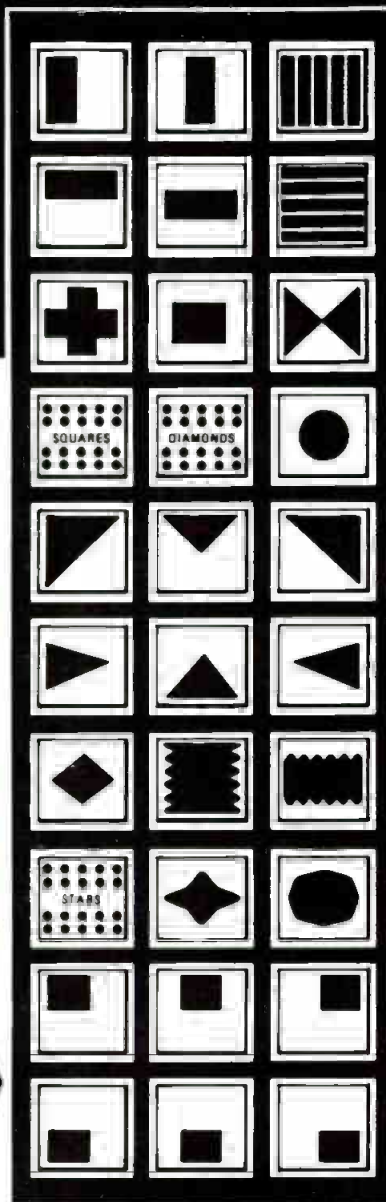
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Docket No. 18867 ...

An update on super modulation

By Ron Merrell

What ever happened to Docket No.18867?

On May 20th of last year, the FCC brought forward a Notice of Proposed Rule Making with the intent of amending Section 73.55 of the Rules. This one deals with setting a limit on positive modulation at 100 percent.

Currently, the Rule is set at 100 percent on negative modulation peaks, with no limit set on positive peaks.

Comments were due at the Commission offices in November, and reply comments were set for December, 1970. As our March edition of **Broadcast Engineering** went into production, the only change in the picture was the acceptance of Gates Radio's late comments.

In order to see what is at stake and what some of the important comments filed contended, we will review three positions taken. First, the NAB comments. The following is taken from the NAB comments filed with the Commission.

"The National Association of Broadcasters (NAB) is fully aware of the Commission's concern with unlimited modulation peaks in the positive direction and their subsequent effect upon distortion, carrier-shift and co-channel interference.

"However, it is our contention that to limit the positive modulation to 100 percent is overly restrictive and may not be in the public interest. Standard broadcast transmitter operation should be capable of providing maximum service to the listening public consistent with good engineering standards and practices. NAB, therefore, believes that a positive modulation limit somewhat above the 100 percent proposed by the Commission would satisfy this criteria.

"A series of mathematical calculations which have been conducted by the Association indicate that a value of 115 percent positive modulation can be established without degrading either the station coverage or the technical performance of the transmitting equipment. It is NAB's contention that at the 115 percent limitation in the positive direction, the carrier shift, harmonic distortion and spurious radiation are within the limits

now specified in Part 73 of the Commission's rules.

"The above-referenced calculations were compared with those submitted by the Broadcast Equipment Section, Industrial Electronics Division, Electronic Industries Association, and the results of this comparison clearly substantiate the conclusion that 115 percent level of positive peak modulation is a realistic limit.

"We, therefore, recommend that Section 73.55 of the Commission's rules and regulations be amended to read as follows: 73.55 Modulation. The percentage of modulation shall be maintained as high as possible consistent with good quality of transmission and good broadcast practice. In no case shall it exceed 115 percent on positive or 100 percent on negative peaks of frequent recurrence. Generally, it should not be less than 85 percent on peaks of frequent recurrence; however, where necessary to avoid objectionable loudness, modulation may be reduced to whatever level is necessary, even if the resulting modulation is substantially less than 85 percent on peaks of frequent recurrence."

The CCA Position

In a letter to the editor printed in the December, 1970 issue of **Broadcast Engineering**, Alan Roycraft (Broadcast Services, Inc., Honolulu) made the following pointed comment.

"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 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 there is no discernable additional interference caused by increasing positive modulation peaks from 100 percent to 125 percent."

During this same general time period, Bernie Wise, president of CCA, was finishing his study of the problem.

Juan C. Chiabrando, CCA's director of engineering, prepared a technical analysis paper on the CCA tests,

and we give you now the summary of that paper.

Chiabrando began by citing the three major complaints about over-modulation. They are (1) that distortion is excessive, (2) sidebands created cause adjacent channel interference, (3) that increased modulation causes co-channel interference.

"The Engineering Department of CCA Electronics," he said, "recognizes that distortion can be created before the transmitter (in the studio and audio processing equipment) as well as in the transmitter itself. Thus we are presenting in this report a technical analysis of the audio as the result of processing as well as an analysis of the transmitter itself."

The following is taken directly from that paper:

Distortion In The Studio

The average professional broadcast studio equipment

has adequate dynamic range ("head room") to accommodate all but the "loudest" of audio programs. However in some studios, where "head room" is not sufficient, loud passages will cause "clipping". This can occur in overloaded preamplifiers, consoles or line amplifiers.

In addition to the unintentional clipping described in the preceding paragraph, there exists intentional clipping in some limiting amplifiers. The net result of this clipping is the creation of harmonic distortion products.

Audio Frequency Response

In the previous section, it has been demonstrated that "clipped" or processed audio contains substantial harmonic content. If this spectrum of audio energy could be reproduced by a transmitter, substantial sideband energy would result in adjacent channels.

The CCA AM-1000D is typical of the high quality AM broadcast transmitters available. Figure 4 (not

TABLE 1—NEGATIVE PEAKS OVER-MODULATION

Relative Input Level (dB)	Positive Peak Modulation (Mod. Meter)	Negative Peak Modulation (Mod. Meter)	Total Harmonic Distortion (Percent)	Relative Level of Harmonics (- dB)							
				Fund	2nd	3rd	4th	5th	6th	7th	8th
0	100	100	1.1%	0	45	41	—	58	—	—	—
0.5	105	101	1.6%	0	44	40	46	45	48	48	52
1.0	110	101	2.7%	0	35	38	40	38	41	44	49
1.4	115	102	4.2%	0	32	35	35	36	40	45	44
2.3	122	105	7.0%	0	28	31	36	36	40	40	45

TABLE 2—BANDWIDTH OF "BAD" TRANSMITTER

Trans- mitter Condition	Positive Peak Modulation (Mod. Meter)	Negative Peak Modulation (Mod. Meter)	Harmonic Distortion (Percent)	Relative Level of Harmonics (- dB)						
				Fund	2nd	3rd	4th	5th	6th	7th
Normal	100	100	1.1%	0	45	41	—	58	—	—
25% Low Fil.	92	98	2.5%	0	35	43	58	58	—	—
34% Low Fil.	84	98	7.2%	0	40	38	36	35	43	56
50% Low Drive	94	100	3.0%	0	36	38	60	47	60	—

included with this article) describes the frequency response of this transmitter. Here it can be seen that the transmitter has a roll-off that starts at about 12 KHz and continues until the modulating frequency is completely attenuated at about 60 KHz.

Obviously, with this kind of response the transmitter will reproduce the sideband distortion products generated in the audio.

If a lowpass filter is connected at the audio input terminals of the transmitter, then the frequency response will be modified and the attenuation will be the sum of the filter and the roll-off of the transmitter itself.

Over-Modulation

The previous paragraph presented data relating to the reproduction of spurious by an AM transmitter of frequencies generated in the studio. This section relates to the extraneous frequencies generated by the phenomena of overmodulation.

A standard CCA Model AM-1000D, 1 kW AM Transmitter (Serial #202) was modulated with a 4 KHz sinewave. No compression or limiting device was used and thus, when overmodulated on the negative peaks, a very serious degree of clipping occurs at the zero axis. Please also note that the CCA transmitter modulated the positive peaks substantially in excess of 100 percent under negative clipping condition.

The RF output was detected with a modulation monitor, CCA AMM-1D.

The demodulated audio signal was analyzed by two different means. A Hewlett Packard type 330B, harmonic distortion analyzer was used to measure the "total" harmonic distortion while a Nelson Ross Type 102, spectrum analyzer was used to determine the relative level of each harmonic.

Table 1 describes the results of this analysis.

If the audio input signal is compressed, or even clipped, before it reaches the transmitter, the degree of spurious sideband created by the harmonic will be different than that of plain over-modulation.

A sharp cut-off low pass filter, UTC type LML-8000 was placed between the CBS Volumax and the transmitter input.

The reduction of high order harmonic was so dramatic that it did not seem worthwhile to make readings for low compression levels, but only at the maximum of 5 dB.

Poor Quality

Many times "poor quality" and adjacent channel interferences has been blamed on "Over-Modulation" where an inadequate transmitter might be the reason. In order to simulate a marginal transmitter, CCA Engineering ran an analysis of the CCA AM-1000D under the following conditions:

- (a) Normal transmitter, modulated 100 percent.
- (b) The filament voltage of the PA and Modulator tubes was reduced by 25 percent in order to simulate "aging" tubes.

- (c) The filament voltage was reduced by 34 percent.
- (d) The RF drive to the PA was reduced by 50 percent in order to make a "poor" Class C amplifier (filament voltage was normal).

Table 2 describes these results.

The Commercial Receiver Test

In order to complete this investigation, we felt it was logical to investigate the selectivity of an average commercial receiver.

Analyzing the performance of the CCA AM-1000D modulating 132 percent position and with the negative peaks controlled by a CBS Volumax (98 percent modulation); plus the use of a UTC LML-8000 filter in the input to the transmitter, it was noted that:

- (a) The high degree of compression afforded by the CBS Volumax was still retained.
- (b) The loss of modulating frequencies above 7.5 Kc was barely noticeable, due to the selectivity of the receiver.
- (c) The overall effect was that of a "loud signal that tunes quite sharp".

Technical Conclusions

The radio station studio facility which experiences any overloading of their audio equipment will produce "clipped" audio signals. This audio occupies a substantial bandwidth which can be transmitted by the average professional AM broadcast transmitter.

The introduction of a low pass filter will substantially reduce the ill effects of studio imperfections.

Over-modulation in the negative direction generates spurious signals of substantial magnitude even under the conditions of "slight" over-modulation in the negative direction.

The use of a CBS Volumax or equivalent with a "good" transmitter and low pass filter can adequately protect against over-modulation in the negative direction.

Negative peak over-modulation and an unfiltered Volumax with 2 dB compression produce the same levels of spurious content up to the 4th harmonic due to the transmitter audio response roll-off. For higher harmonics, negative peak modulation creates much more disturbance. Thus, a negative peak limiter is very desirable.

A mediocre transmitter that is never over-modulated is more likely to produce adjacent channel interference than a good transmitter with audio compression followed by a low pass filter.

A "good" broadcast transmitter with reasonable peak power output capability, when used with a CBS Volumax equivalent and a low pass filter can produce 120- to 135 percent positive modulation with distortion products less than FCC maximum value—and with negligible sideband interference.

CCA Recommendations

Investigation should be conducted into determining

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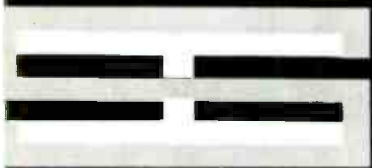
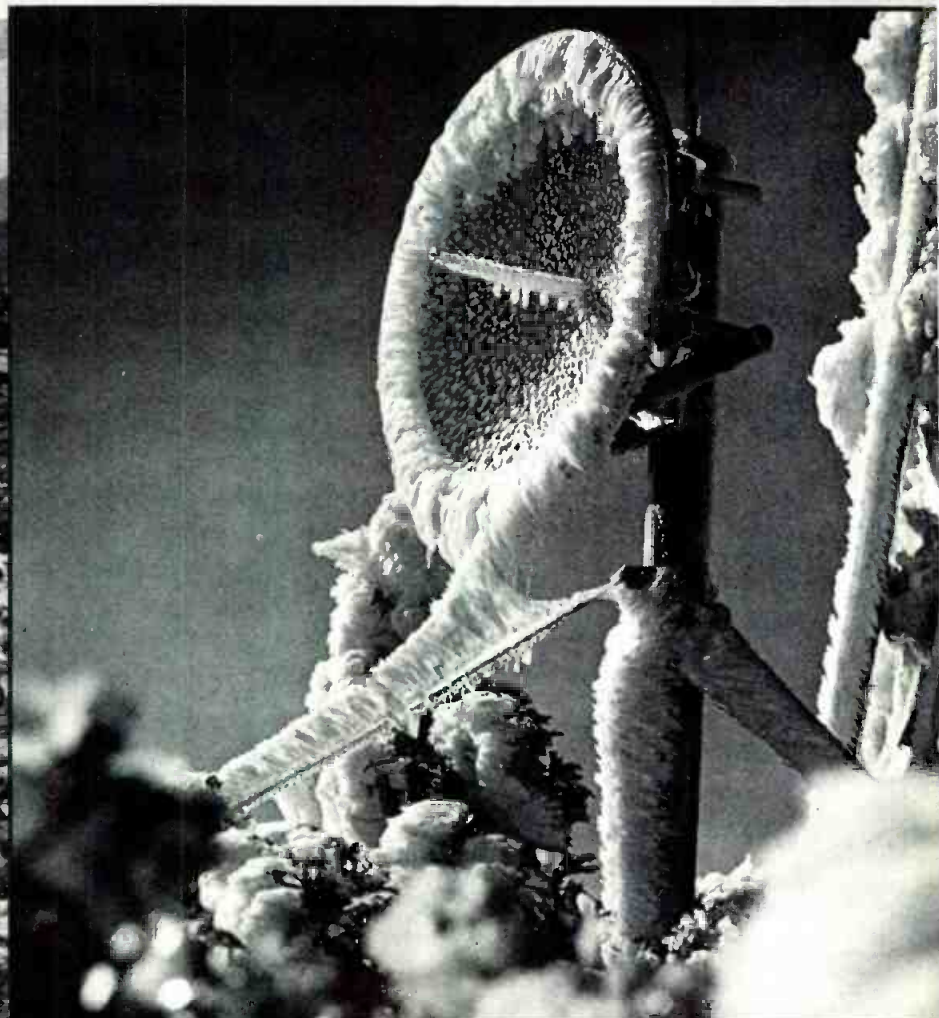
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the characteristics of a low pass filter that could be placed before the transmitter to protect against the sidebands created by studio equipment.

Limiting of negative modulation levels is essential for conservation of bandwidth.

The use of older, non-linear AM transmitter contribute to "dirty" transmission. These units must be updated to maintain high broadcast standards.

Over-modulation in the positive direction does not introduce adjacent channel interference. From the practical view, it would appear that 125-135 percent positive modulation can be attained in a modern AM broadcast transmitter. Higher modulation percentages could not be read by present monitors and CCA seriously questions the ability of any transmitter to produce these higher levels without substantial distortion.

Some thought should be given to the formulation of new monitoring techniques for evaluating the energy radiated in the sidebands. This could serve the broadcaster in determining his quality visually.

A CCA Station Survey

And as a further inquiry into the problem, Wise sent out a survey that went to all AM stations. Here are the results of that survey.

- (a) Number of Stations solicited for replies—4200.
- (b) Number of Stations that replied—864.
- (c) Of the Stations that replied, the number of Stations that were using Asymmetrical Compression Equipment—743.
- (d) The number of Stations that do not use any limiting equipment—91.
- (e) The number of Stations using Asymmetrical Modulation equipment who had introduced to their knowledge, interference on their co-channel or adjacent channel stations—0.
- (f) The number of Stations replying who had experienced themselves, interference as the result of over-modulation of other stations—12.

In addition to receiving the completed cards, CCA also received correspondence from 18 Stations. These letters all seemed to emphasize in one way or another, the fact that, according to the writers, interference created by over-modulation was not the result of the over-modulation process itself, but rather the equipment utilized by individuals in creating over-modulation.

In other words, the utilization of transmitters with insufficient modulation capability, the utilization of poor audio equipment, and the mis-handling of other accessory equipments were the major reasons for the degradation in the signal and not the over-modulation process itself. On the otherhand, these letters indicated the success and the increase in performance in their service area as the result of utilizing the over-modulation techniques.

Recommendations From Survey

Over-modulation in the positive direction has been

an approach by which the AM broadcaster has been able to provide coverage in his assigned area despite the high noise level present in most urban locations. The basis upon which the present FCC AM allocations have been made are subject to question from the view of being consistent with existing propagation characteristics.

Until the Commission is allocated sufficient funds to update the technical basis for its regulatory actions, it is recommended that positive modulation limits of 135 percent be permitted. Broadcasters who have been using this technique unanimously agree that it has increased their effectiveness without causing interference to their co-channel or adjacent channel broadcasters.

This concludes the CCA position. What we have seen to this point is the NAB recommendation for 115 percent, Roycroft's 125 percent, and CCA's 135 percent.

Gates Radio ran tests of their own, and while it may cause many a raised eyebrow, there is ample reason to give them the floor before closing out this report.

The Gates Position

The following is taken directly from Reply Comments filed with the Commission by Gates Radio Company.

The Gates Radio Company, as stated before, is in agreement with the need to provide adequate safeguards for high quality broadcast service. At the same time, however, Gates feels obligated to improve the state-of-the-art within the framework of the present Rules and Regulations, and to seek methods which will assure more efficient use of the available spectrum. It is with this in mind that Gates undertook a series of measurements to determine whether or not over-modulation on positive peaks was, in actual fact, an advancement in the state-of-the-art and did remain within the present rules and regulations. The tests are described as follows:

A 100 kilowatt transmitter was used for the modulation tests. This transmitter was ideally suited for these tests because its power output can be controlled without reducing its full power output capability. It produces an amplitude modulated signal that completely conforms to all requirements of the FCC Rules and Regulations, and at the power output of 33 kilowatts to which it was adjusted, it placed no limitation on positive peak modulation capability.

Power output measurements were made by calorimetric methods into a known, flat, dummy load. The modulation monitor was adjusted to indicate 50 percent modulation on both positive and negative peaks when the transmitter was actually modulating 100 percent as evidenced by an oscilloscope measurement. Thus a quantitative measurement of sideband power versus modulation peaks could be obtained. With this arrangement, the transmitter was first modulated 100 percent

with a sine wave. The power output, measured by calorimetric means indicated a power increase of 50 percent of 16.5 kW. This, of course, is equal to the theoretical average power increase resulting from 100 percent sine wave modulation. The transmitter operating at this power output exhibits negligible carrier shift and audio distortion of less than 1 percent.

Following this test, program material was fed to the transmitter through a Gates solid state limiter adjusted to provide symmetrical control of the limiting action from both positive and negative peaks. The material used consists of both voice and music of various types much of which is known to contain naturally asymmetrical peaks.

The power output of the transmitter during this form of modulation under rather severe limiting conditions reached a maximum of 13 percent over the unmodulated carrier power or a sideband power of 4.4 kW. Approximately 26.5 percent of the sideband power created by sine wave modulation.

For the third test, the limiting amplifier was arranged such that no control of limiting was initiated by positive going peaks, whereas, the limiting action was still in effect for negative peaks. Under this condition, the same program material used for the previous test allowed for increasing the level of the audio input signal 6 dB to produce the same degree of limiting as was occurring in the previous test.

During this test, positive peaks of modulation as indicated on the modulation monitor frequently exceeded 200 percent of those in the negative direction. However, the power output of the transmitter, as measured in the dummy load, increased only 23 percent representing a sideband power of 7.4 kW. This is only 45 percent of the sideband power produced by a sine wave modulating the transmitter 100 percent.

Throughout all of the above tests, the transmitter operated well within the limits of its capability and, therefore, did not introduce distortion products. Carrier shift did not exceed 2 percent at any time and was not detectable for most of the program content. No increase in spurious or harmonic content was detectable and outside the bandwidth permitted in Sections 7.340(a), (12), (13) and (14) as evidenced on a spectrum analyzer.

Gates' Conclusions

Under programming conditions and within the confines of the present Rules and Regulations the average sideband power produced will not exceed nor even approach the sideband power produced by 100 percent modulation with a sine wave. This was true even with a very high degree of limiting and with a transmitter capable of three times the carrier power being modulated. The greater the modulation capability of the transmitter, the greater will be its facility for transmitting naturally asymmetrical audio programming without producing additional harmonic and distortion products.

The removal of all positive peak restrictions from the AM modulation swing increased the utilization of

the AM channel without causing the sidebands to exceed that produced by 100 percent sine wave modulation. In the case of these tests, utilization or modulation efficiency was almost doubled.

Permitting positive modulation swings to rise unbounded did not produce spurious signals outside the prescribed bandwidth limitations and, therefore, did not increase adjacent channel interference.

In summary again, the Gates Radio Company believes that the adoption of Rules limiting positive modulation to 100 percent or to any value would be detrimental to the quality of AM broadcasting and would place a limiting factor on improvements in the state-of-the-art. Specifically, any limitation placed on positive peaks requires additional limiting or clipping which, in itself, can cause additional distortion products. We further believe that the present Rules provide sufficient control for the protection of co-channel and adjacent channel interference and at the same time allow opportunity for improvements in transmission quality and reliability.

Summing Up

At this writing, there has been no further action taken by the Commission. If you ever thought engineering decisions were easy for the FCC, keep this case in mind. They have recommendations from their own 100 percent to no percentage limit, and important considerations for all suggested limits.

We're not certain what final limit will be set, but it is doubtful that no limit will be set.

The Editor



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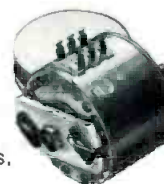
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Circle Number 42 on Reader Reply Card

Canon

TV Translator Tuning

By Alvin H. Smith*

TV translator stations provide program service to many communities that experience difficulty in receiving programs directly from the television stations. Translator stations operate by receiving the desired TV signal at a noise-free location, usually by installing an elaborate receiving antenna system on a high tower.

The received signal is then translated or converted to another unused television channel without any change in the composite signal information. There is no video or audio detection or demodulation, but signal amplification is necessary so that a reasonable power level is attained for retransmission on the new channel. The transmitting antenna for this channel is usually on the same tower as that used for reception. See simplified block diagram of typical translator station in Figure 1.

The following TV translator tuning tips may be of interest or help to engineering personnel responsible for the maintenance of television translator stations. They represent notes obtained during five years of translator field service.

*Chief Engineer, KTIV, Sioux City, Iowa.

When sweeping a low power translator or the IF section of a high power translator, start alignment adjustments at the output stages for best bandpass and maximum sweep output. If the output stages are not tuned for maximum output at video carrier, sync compression may result.

After the desired response is obtained, check the effect on response of varying power output by the power control on the translator and by varying the output of the sweep generator. The response curve should not change appreciably over the normal operating signal input levels that you are subject to. Sometimes the same response curve can be obtained by a different combination of peaking or tuning adjustments, but one set of adjustments will cause less change in the response curve than the other with a change in signal levels.

Attenuation Pads

Sometimes the addition of an attenuation pad of 5 to 10 dB at the input of the translator will improve the linearity of the video signal, and it will hold the response curve more uniform with a varying signal level. What's more, it will provide a better termination for the input transmission line. This better termination will be helpful in reducing

ghosts. It is desirable that the translator input impedance be adjusted to at least reasonably match the impedance of the receiving transmission line, for the best signal transfer and minimum ghosting.

In order to use an input attenuation pad, it is necessary to have a high input signal. Generally, a multi-antenna array will improve the quality of the input signal by increasing the received signal level as well as providing a narrower beam width horizontally and vertically. This is helpful in reducing interference of all types.

A horizontally spaced multi-antenna array is helpful in reducing interference due to the additional nulls produced in the horizontal antenna pattern. By proper horizontal spacing, it is sometimes possible to cause a null in the antenna pattern in the direction of an interfering signal, while still maintaining maximum signal strength from the desired station.

From a signal-to-noise standpoint, the input circuits should be tuned to obtain the highest signal level consistent with required bandwidth and impedance match to the input transmission line. For a good signal-to-noise ratio it is sometimes helpful to try a replacement mixer crystal in the receiver circuits of a translator with a UHF input. The new Shockley hot-carrier diodes ap-

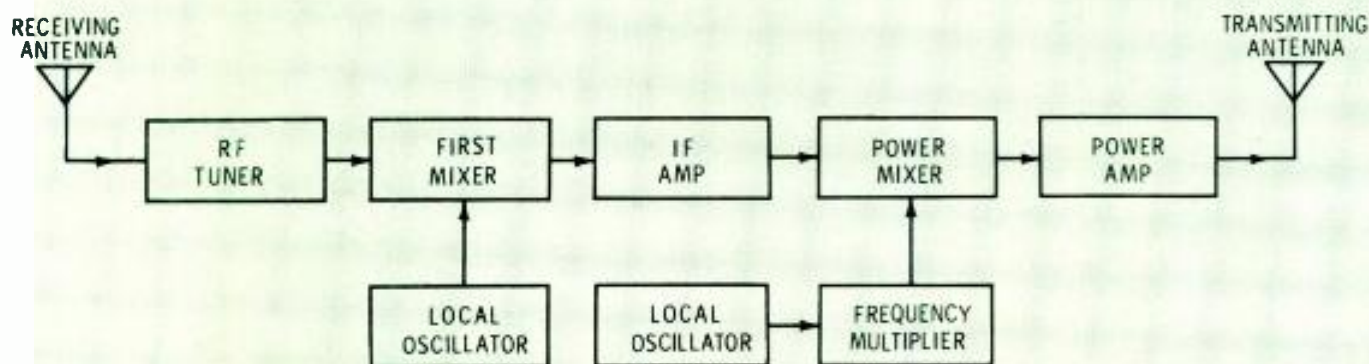


Fig. 1 Translator station block diagram.

pear to have a low noise figure and good conversion efficiency.

It is important to have sufficient continuous wave RF to the input mixer or converter. With UHF diode mixers, a lack of local oscillator input level may, in addition to producing a weak signal, cause sync compression in the output signal.

Amplifier Loading

Loading of the final amplifier is quite important, particularly for UHF output signals. Heavy loading will make the amplifier inefficient, increasing its plate dissipation, power input and signal drive requirements. Very light loading causes the final amplifier tuning to be unduly affected by temperature changes and antenna loading and the type of picture signal being transmitted.

Loading of the high-level second mixer stage, which converts the IF signal to the final operating frequency, also requires careful adjustment. Insufficient loading may cause oscillation in some equipment due to feedback from the final power amplifier. (The plate circuit of the mixer stage is tuned to the same frequency as the input and output circuits of the final amplifier, hence oscillation is possible.) Excessive loading will reduce the efficiency and power output of the mixer and

adversely affect its linearity. Linearity also will be affected by light loading.

Linearity is important, particularly when a color signal is being transmitted. Inefficient mixing action in the high level mixer requires a higher than normal IF output into the mixer, increasing possible intermodulation in the transmitted signal.

Intermodulation

Intermodulation occurring in a translator handling a color program can be quite annoying to a viewer, even when watching on a black and white receiver. The translator is actually involved in the transmission of a visual modulated signal, a color modulated signal and a modulated audio signal. Non-linearities in the amplifying and mixing process in the translator cause intermodulation, producing different frequencies not present in the input signal. The most bothersome is the 920 kHz beat between the 4.5 MHz sound carrier and the color information centered around 3.58 MHz.

New translators are now available that separate the aural signal from the visual circuits. These are not subject to most intermodulation problems. However, a defective tube, almost anywhere in the translator, can cause intermodulation.

Of course, intermodulation is also possible due to an overloaded circuit that needs an adjustment.

Every attempt must be made to reduce circuit non-linearities, particularly those which will produce third harmonic distortion such as amplifier overload. In that case, the signal is distorted on both negative and positive peaks. Mixers must have adequate continuous wave input to allow linear mixing with the modulated signal.

Mixer bias is also important. In high level translator mixers that have individual bias adjustments, intermodulation can be noticeably reduced by varying the bias of each tube for optimum signal quality. This appears to be obtained when

maximum output is obtained from the mixer stage while varying the bias of each tube, taking into account that a near normal plate current reading must show after adjustments are completed.

The 920 kHz is affected by both the sound carrier level and the response of the translator at frequencies where the color information is being transmitted. The aural level should be reduced in the IF amplifier before the high-level mixing operation. The desired tuning condition is to have the response as uniform as possible from about 1 MHz below picture carrier to about 4 MHz above picture carrier. Then reduce the response of the sound carrier level by means of the sound carrier trap to a -3 to 6 dB.

This tuning results in a better overall signal quality for most viewers. ▲



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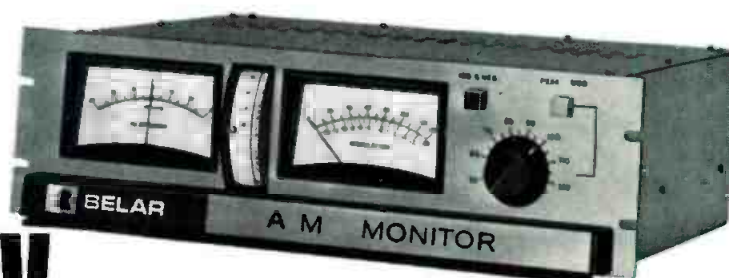
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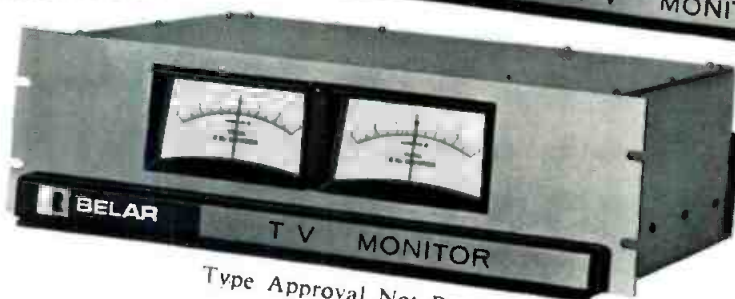
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Circle Number 45 on Reader Reply Card

Looking into Op amps

By Walt Jung*

This month we'll pick up where we left off in our December column on op-amps. Hopefully, you've still got a copy of that issue handy to refer to as we'll be contrasting some of this month's material with what we were talking about then.

The 709 operation amplifier opened up a whole new realm of circuit possibilities because of its relative simplicity, flexibility, economy and good performance. Not only did it improve circuit design capability, but it also opened up entirely new applications which were impossible or impractical before.

*BE Educational Broadcasting Editor

But as they say, into each life some rain must invariably fall, and the 709 had (and still does) a few drawbacks. It was these limitations which led to a new improved series of op-amp IC's (called 2nd generation by some) which removed most of the 709's drawbacks.

Generally the hangups the 709 possessed were things that could cause failure. That indomitable rule of electronics, Murphy's Law came into play, and many 709 circuits blew up before circuit designer's learned to treat certain areas with caution.

First off, the 709 is not short circuit proof. A short to either supply or ground will fuse the output transistors, and you will soon find yourself unsoldering eight leads. Second, it is limited in input voltage range, both differentially (base to base) and common mode. If the differential voltage limit on the input pair of transistors is exceeded, one of the pair will go into zener breakdown emitter-to-base and the current will rise until it is limited by the external circuit resistance. And if it is not limited by the external resistance, guess what happens—you unsolder leads again. So this is another problem area, the differential input voltage must be limited by the circuit external to the IC.

Common mode range is another problem with the 709, although not necessarily a catastrophic one. Driving the input transistors beyond the common mode limit can cause "latch-up", or saturation of the current source transistor Q11 (see Figure 1).

Common mode range is another problem with the 709, although not necessarily a catastrophic one. Driving the input transistors beyond the common mode limit can cause "latch-up", or saturation of the current source transistor Q11 (see Figure 1).

The partial sketch of a 709 voltage follower hookup in Figure 1 illustrates the latchup problem. Basically, it is a regenerative state caused by saturation of Q2. To visualize how this happens, assume this follower circuit with a 10 V p-p input. With 100 percent feedback to Q2, it will see the same signal, 10 V p-p. Now assume a 6 volt operating bias at Q2's collector. If the voltage at Q2's base rises one V_{be} above this, Q2 becomes saturated and no longer inverts the signal. In this case the feedback becomes positive instead of negative and the circuit "latches up". This positive feedback holds the amplifier saturated until the signal is reduced and power is turned off.

These are all things to watch for if you are servicing equipment using a 709 type of circuit. But as we

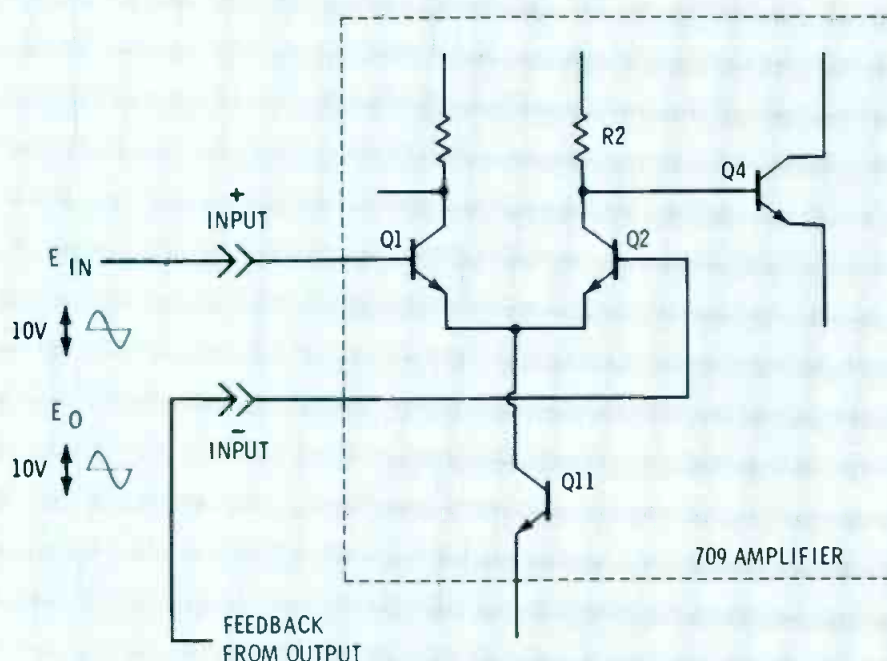


Fig. 1 Illustration of 709 circuit and cause of latch-up.

said, the next generation of IC's solved many of these problems, and added other improvements also.

709 Improvements

709 improvement amplifiers such as the LM101-301, the μ A741-741C solved the major problems of amplifier failure due to shorts and abuses. The output stage remained class B, but internal current limiting was added to protect the output for both positive and negative swings. An entirely new type of input stage was evolved which could tolerate up to $\pm 30V$ differential swing and $\pm 15V$ common mode. This eliminated all problems due to input overvoltage.

Another improvement over the 709 was the change in internal design from a three stage to a two stage amplifier. In the last installment you'll recall the discussion of the three 709 stages and the frequency compensation nodes used to shape the response curve. The new amplifiers simplified this problem greatly by eliminating the extra stage and reducing the required compensation components to a single capacitor. This is the major departure in difference between the LM101 and the 741; the LM101 requires an external 30pf capacitor, whereas the 741 includes it internally. Otherwise, the two amplifiers are similar in performance although their internal circuitry is different.

IC Comparison

The similarities and important differences can be best appreciated by comparing the schematics of the two and reducing them to a simplified form for comparison. Figure 2 shows the 101 schematic, Figure 3 shows the 741 and Figure 4 is a simplified comparison. Although both schematics are a little overwhelming at first, they can both be reduced to an equivalent circuit which Figure 4 closely represents.

Both amplifiers use a NPN-PNP cascode differential amplifier input, shown in Figure 4 as a PNP differential pair. In the actual schematics, the NPN input (Q1 or Q2) drives a common base PNP (Q3 or Q4). The working equivalent of this combination is a high gain, high E-B break-

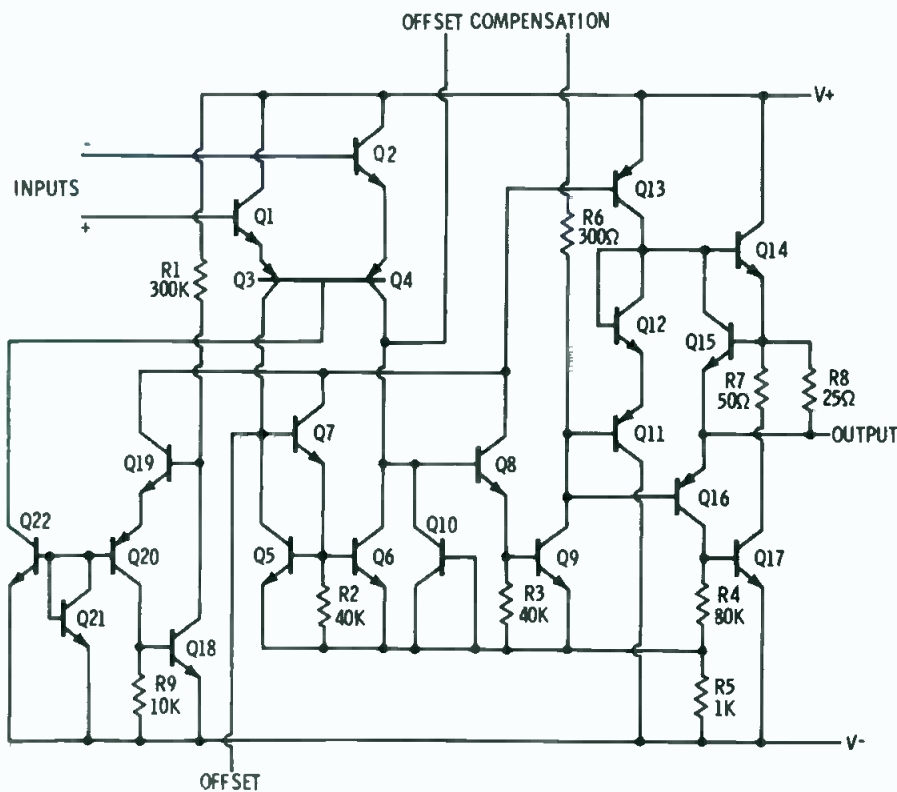


Fig. 2 Schematic of 101 type operational amplifier.

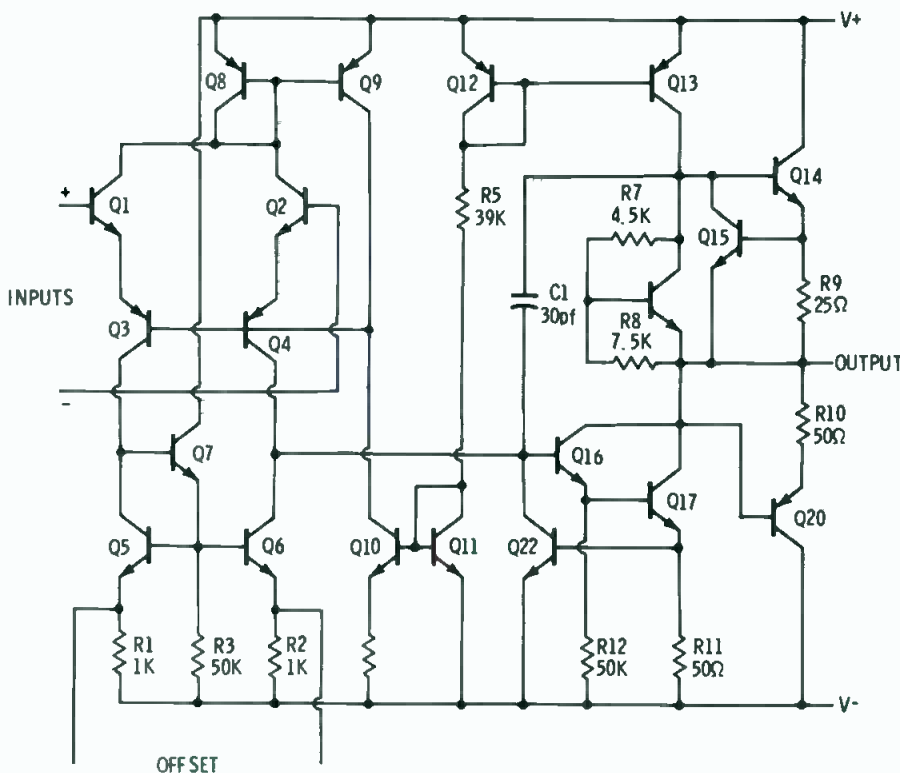


Fig. 3 Schematic of 741 type operational amplifier.

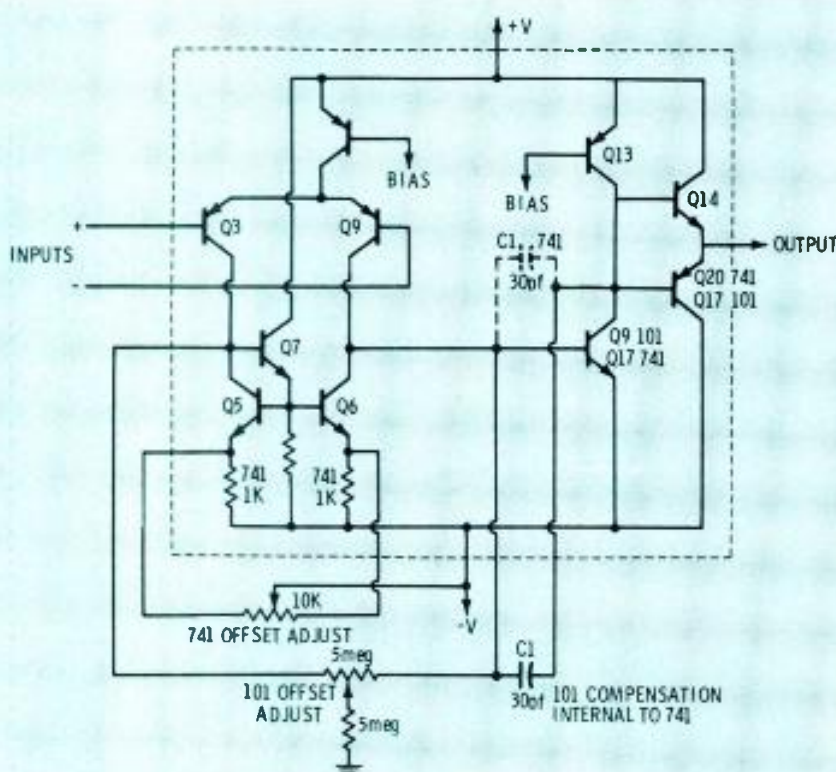


Fig. 4 Simplified schematic showing basic structure and differences in 741 and 101 type op-amps.

down voltage PNP unit, as shown in Figure 4. This gives the circuit the very high $\pm 30V$ differential input range, and prevents popping the input junctions as was possible with the 709. In addition, it has the high gain characteristics of the NPN, al-

lowing the input bias currents to be low.

Note also that the Q3-Q4 pair does not have a normal resistive load, but rather the combination of Q5-Q7, an active constant current loading stage. There are two advantages to this. One is that it allows a high gain to be developed. The other is that it allows a large common input range, as Q3 and Q4 are unrestricted in limits of voltage swing. This eliminates the latch up problem that plagued the 709.

A single ended output signal from Q6 drives a common-emitter voltage gain stage (Q17 or Q9 in Figure 4), which again is loaded by a current source transistor, Q13. An NPN-PNP emitter follower provides the class-B output drive.

A Two Stage Amp

Now if you boil all this down it resolves to only two voltage gain stages, the rest of all those transistors being used for biasing and other purposes. The first stage is the input differential stage, and the second stage is the Q9 or Q17 com-

mon emitter stage. It is a much simpler matter to control the frequency response of a two stage amplifier. (This is one important difference these two amplifiers have over the 709). With the megohm impedance the current source biasing technique provides, very effective rolloff can be accomplished with a single 30 pf capacitor, C1, connected in Miller fashion around the second stage.

The 741 type includes this capacitor on the chip, the 101 type brings the terminals out for outside connection. This allows the 101 type amplifier open loop response to be tailored to suit the application. Representative curves of the open loop response of both amplifiers is shown in Figure 5.

The other difference to be noted is the different approach taken in the two amplifiers with regard to input offset voltage. As we said back in the 709 discussion, every IC will exhibit a slight mismatch of a few millivolts between the input transistor pair. In critical circuits, this "offset" voltage may need to be nulled out. The way this is done in these IC circuits is to unbalance the input stage collector currents until the working input is zero. This is illustrated by Figure 6, where the collector load of a hypothetical input stage is unbalanced by the pot Rbal until the DC difference between the Q1-Q2 bases is zero.

If we return to Figure 4, we'll see how the 741 and 101 amplifiers accomplish this collector load unbalance. Since Q5 and Q6 form the collector load for Q3 and Q4, an imbalance in their currents will accomplish the goal, as this is the same current flowing in Q3 and Q4. The 101 does the job in the collector circuit with a 5 meg pot with the arm returned to ground. The 741 uses a lower impedance pot by inserting emitter resistors in the Q5 and Q6 legs, and varies the ratio of these two resistances. Either method allows greater than ± 10 mv of input offset adjustment.

Amp Comparison

Now, after discussing all these internal workings it might be inter-

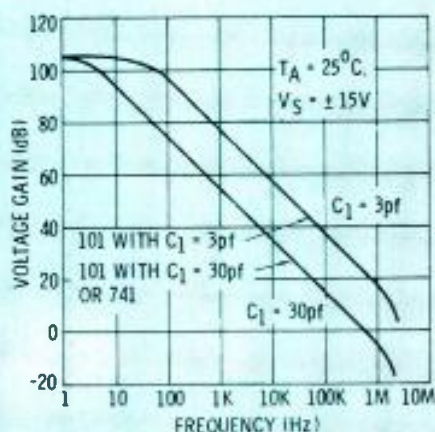


Fig. 5 Open loop response of 741 and 101 amplifiers. Note extra bandwidth available with 101 (3 pf curve).

Here's the new 1kW color transmitter/translator from Emcee



at an
amazingly
economical
price!

Quality plus color capability (NTSC and PAL) for domestic and export requirements.

And a price tag that fits right in with today's drive for economy.

That pretty well tells the story of Emcee's new 1 kW Color Transmitter/Translator. Designed to be utilized for VHF, UHF and CCIR bands I, III, IV, and V.

In fact, Emcee transmitter and translator capabilities includes a complete line of performance-proven units from 1 watt to 1 kW and are used throughout the world.

For the story on the Emcee unit that's designed right and priced right for you, stop in at Booth 328, Continental Room, at the NAB Convention in Chicago. Or write for complete information.



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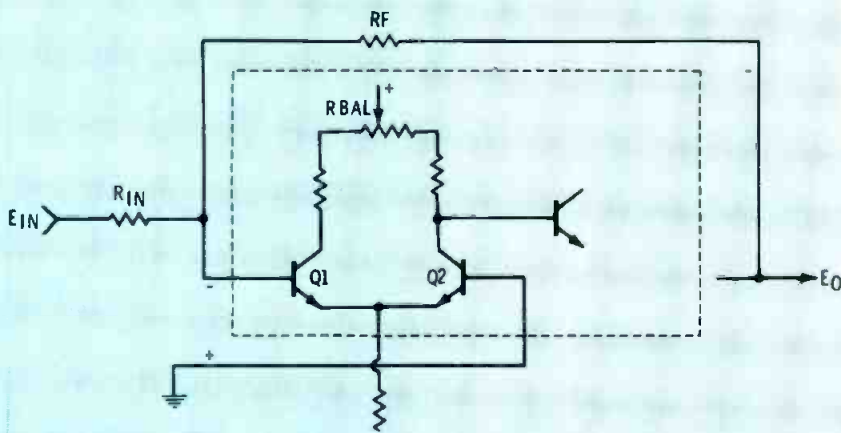


Fig. 6 Method of offset voltage adjustment by unbalance of collector currents.

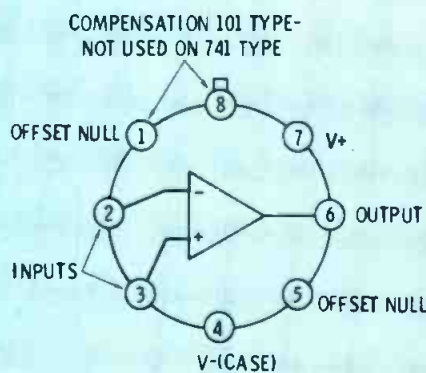


Fig. 7 Pin configuration for 101 and 741 op-amps, TO-S style package. Inputs (2+3), output (6), supplies (7+4) are standard for TO-S op-amps. Use of remaining pins may vary.

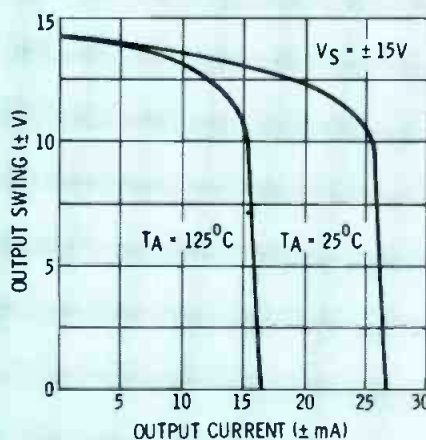


Fig. 8 Current limiting characteristic of 101 and 741 type op-amps. Curves apply to either polarity of output.

esting to compare these two amplifiers with the 709 specs we discussed previously. To keep things on an equitable basis we'll talk in terms of an industrial grade circuit (0-70° C) as we did for the 709. This information is in Table 1.

It is easy to see the areas where the 741 and 101 type amplifiers improve upon the 709. Lower input currents, higher gain, higher input range and of course the short circuit protection. You can expect to see more of this type of amplifier as time goes by, although the 709 is far from dead yet.

There are almost as many different part numbers for 709, 741 and 101 type amplifiers as there are semiconductor manufacturers. You'll usually be able to spot one of an obvious similarity to the generic type number, such as the xx741yy or the zy301A. But don't let this fool you, just about all the circuits boil down to something quite similar to what we've discussed here. And even if you do run across an oddball op-amp, remember the principles discussed in the first part in troubleshooting. Think of it as a high gain box with differential input, and analyze the current in terms of what is taking place between these two inputs. Then see if the output is doing what it should.

Table 1—Comparative Specs

Parameter	709C	741C	301A*
Differential			
Input Voltage	±5v	±30v	±30v
Common Mode	typ ±10v		
Input Voltage	min. ±8v	±15v	±15v
Input Offset	typ 2 mv	2 mv	2 mv
Voltage	max 7.5 mv	6 mv	7.5 mv
Input Offset	typ 100 na	20 na	3 na
Current	max 500 na	200 na	50 na
Input Bias	typ 300 na	80 na	70 na
Current	min. 1500 na	500 na	250 na
Voltage	typ 45,000	200,000	160,000
Gain	min. 15,000	20,000	25,000
Output Voltage	typ ±13v	±13v	±13v
Swing	min. ±10v	±10v	±10v

* "A" version is improved processing over original 101 type, otherwise 0-70°c temp version.

Thoughts For The Future

The subject of op-amps is a difficult one to cover because of the infinite avenues which could be explored. In these two installments we've tried to cover some basics, background and not too much of the future. Applications have hardly been touched upon except for basic configurations.

Here is where you as a reader can step in. Do you now have or can you foresee a unique application for an op-amp? It might be a useful item to others also. Do you need or desire more background? Let us know. If interest warrants it, we can run another installment devoted strictly to applications (hopefully based on your ideas) and give you a greater depth of background on top op-amps. ▲

SEE IT

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POWER OPTICS REMOTELY-CONTROLLED CAMERA SYSTEM

... operating from the GE/BAC 100 Computer—
Supervised Control Center in the General Electric
Company Booth 101 and in our Booth 307
at the NAB Show.

With the P.O.I. Remote Camera Control System it is possible to precisely set shots for repetitive exact recall:

**Pedestal Height ... Pan ... Tilt
Zoom ... Focus ... Iris.**

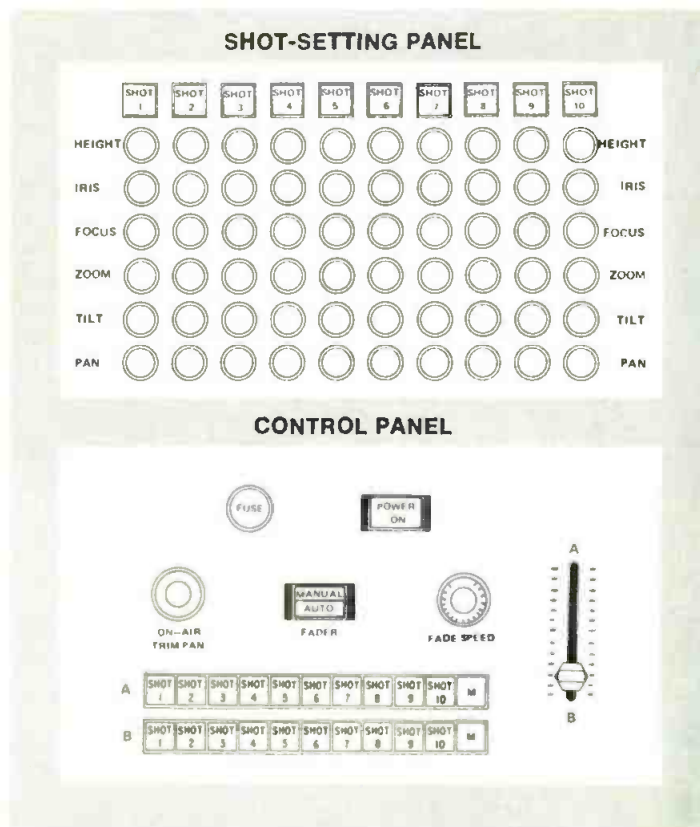
The Shot-Setting Panel provides for up to ten shots, each of which may be carefully pre-set in rehearsal under the complete control of a production staff.

The speed of the shot-to-shot transitions may be varied to suit the situation.

Each shot is recalled, on air, by simply pressing appropriate shot buttons. If a subject should move from prearranged pattern, on-air adjustments can be made at the Control Panel. The pre-set shots may be used in predetermined sequence or at will, depending on the nature of the production.

Investigate the P.O.I. Remote Control System as a production aid. It will open your eyes to unlimited possibilities, not only in production but in the economic aspects of automated camera control.

We invite inquiries on both the standard Remote Control System and The Computer-Supervised System. If you don't make it to NAB send for literature describing them.



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FAIRVIEW VILLAGE, PA. 19409 • (215) 539-5300 • TELEX 846429

Western Inquiries contact: Television Products, Inc. (213) 678-2388

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If spec sheets are among your favorite reading, we don't blame you for getting confused at times. Columns of figures aren't always too eloquent on their own, only in context or comparison with other specs. And statistics can be used to support anything — especially statisticians.

So it's nice to know how to read between the lines of a spec sheet. That not all makers use the same measuring standards. Take overall frequency response, for instance, ours is measured at a -10dB level, the accepted broadcast standard. Yet other brands measure from as low as -24 dB .

Unfair to us? Yes. But more important, it's unfair to you.

Of course, there are other ways to play the numbers game. We say go ahead and compare specs till your head spins. But do it right: consider your own overall needs and compare specs in relation to other specs on the same component. Compare that one spec for spec, *standard for standard*, with competing models. Then go give a list

True, you can't be a computer.

But you shouldn't have to be a speculator, either.

TEAC

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EIMAC's new 8873 family covers the electromagnetic spectrum from DC to 500 MHz.

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CONDUCTION COOLED
ANODE



8874
AXIAL COOLED
ANODE



8875
TRANSVERSE COOLED
ANODE

Consider that the 8873 family provides up to 1000 watts PEP input or 500 watts continuous duty input per tube to 500 MHz. Low grid interception allows low drive power to be combined with low intermodulation distortion in linear service.

Observe that while the 8873 family performs in superior fashion as a linear amplifier in SSB service, it is also ideally suited for high gain, class-C FM or AM service in the VHF/UHF range. Electron control by EIMAC's new segmented, self-focusing cathode and unique aligned grid structure provide the key to this improved performance. The grid, moreover, is terminated in a low inductance contact ring about the base of the tube, permitting very effective intra-stage isolation to be achieved up to the outer frequency limit of operation.

Note that these rugged triodes are exceptionally well suited for class-B audio service as well as for pulse operation demanding high peak current capability at modest drive power.

Remember the 8873 family of triodes covers the electromagnetic spectrum from DC to UHF with ease, meeting widely divergent requirements in a package you can hold in the palm of your hand. Use these compact tubes in table-top design where space is a scarce commodity or where high density packaging is imperative.

Write EIMAC today for details and circuitry on the 8873 family of grounded grid triode tubes. Another example of EIMAC's ability to provide tomorrow's tubes today. EIMAC, 301 Industrial Way, San Carlos, California 94070. Phone (415) 592-1221.



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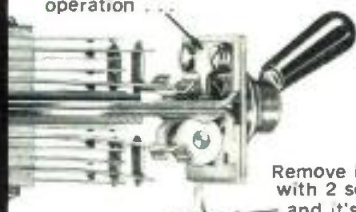
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ENGINEER'S EXCHANGE

Reworking The Sony TC-850

By Dale Wolters, WZZM-FM

The Sony TC-850 audio tape recorder is a quality stereo recorder/playback unit. It has hum and noise, frequency response and wow and flutter specifications better than most broadcast quality decks besides playing either 2 or 4 track stereo tapes. Best of all, the price is attractive.

In order for us to use it in our FM stereo operations, it would be necessary to build an outboard adapter which would provide balanced bridging inputs and 600 ohm balanced or unbalanced outputs. Since we use repeat coils on our console high level inputs, an unbalanced output would be of no consequence and would be easier to design besides saving the cost of transformers.

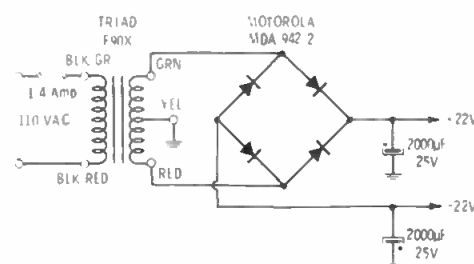
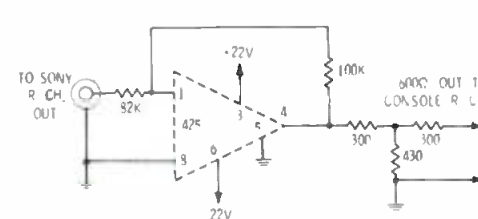
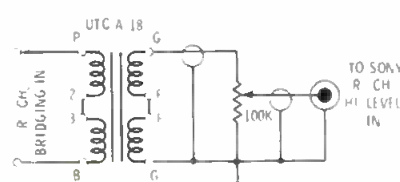
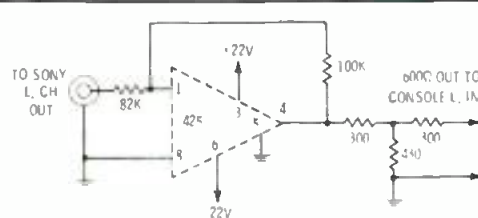
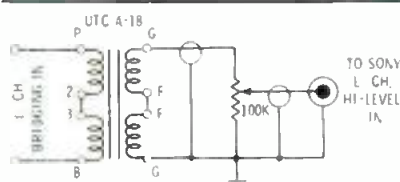
Plate to grid transformers would suffice for the bridging inputs, but the outputs are another story. The Sony is designed to provide .775 volt across 100K unbalanced. A transformer at this point would reduce the playback output level to console mike input level even if the impedances did match. Enter the

adaptable opamp. (Model 425 opamps @ \$25 from Opamp Labs, 172 S. Alta Vista Blvd., Los Angeles, 90036).

The circuit shown in Figure 1 was built up and it performs quite well. It was assembled on a 1 rack unit bathtub chassis, although things did get a little crowded.

The A-18 input transformers as connected provide a bridging input impedance of 15K. The pots across the secondary are screwdriver adjust, locking types and are preset so that when bridging a +10 dBm line the machine record volume controls operate about mid-range.

The opamp output stage provides .775 (0 VU) across 600 ohms, just right for our console input. No change in the machine's published specifications could be measured; we are very pleased with its performance. A glance at these measurements reveal why: Frequency response $\pm .1$ dB 20 Hz to 100 KHz; distortion less than .2 percent, hum and noise greater than 80 dB below 0 VU output; cross talk between channels greater than 80 dB.



OUTPUT AMP SPICES
FREQ RESPONSE FLAT ± 0.1 dB 20Hz $\pm$ 10% Hz
DISTORTION LESS THAN .2% 50Hz TO 20KHz
CROSSTALK GREATER THAN 80dB
GENERATOR INTERNAL DISTORTION: 0.08% AT 50Hz
MODEL 425 OPAMP'S @ \$25.00 EACH FROM
OPAMP LABS
172 S. ALTA VISTA BLVD.
LOS ANGELES CALIF 90036

Where do they go from here?

Home, of course. That's first. Home to hugs and handshakes.

Home to the family. Home from thousands of anonymous assignments around the world.

But—after the uniform's off—what then? Where do they go with their maturity, their abilities, their ambitions? What will they do with the skills they've acquired in service—manual and technical skills, administrative and professional skills?

What will become of the \$3 billion yearly investment the armed forces spend for training? How will they use the over \$1 billion available annually for education and training under the GI Bill? Do they go to work—or do they go to waste? It's up to you. For help in hiring veterans, contact your local office of the State Employment Service; for training information, see your local VA office.

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ROBERT LUSON, EMPIRE NEWS—TIMOTHY L. STAP

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No. 99PS-60 Bristol Multiple Spline Type Screwdriver Set



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Compact, interchangeable blade, Xcelite sets permit quick selection of the right tool for the job. With greater reach than conventional keys, these handy blade and handle combinations make it easier to get at deep set or awkwardly placed socket screws, simplify close quarter work.

Each set contains 9 precision formed, alloy steel, 4" blades; 4" extension; shockproof, breakproof, amber plastic (UL) handle with exclusive, positive locking device.

Sturdy, see-thru plastic cases fit pocket, have flat bases for use as bench stands.

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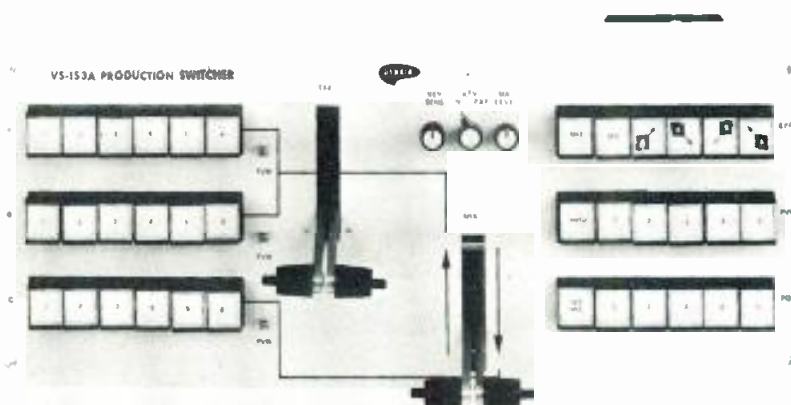
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In Canada contact Charles W. Pointon, Ltd.

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NAB Product Roundup

Continued from page 34

Vertical Interval Production Switcher



Circle Number 139 on Reader Reply Card

DYNAIR Electronics, Inc., will introduce a new low-cost vertical-interval production switcher. The VS-153A is a remote-controlled unit with a full color programming capability. For the more sophisticated small studio, it has provisions for eleven video inputs with basic single re-entry effects and mixing. The control panel is only 3½ inches thick, allowing it to mount in the 7-inch arm of inexpensive consoles.

The electronics unit is remoted by means of a multi-conductor DC control cable.

Special effects capabilities include inserts from each of the four corners, full horizontal and vertical wipes and internal or external keying and matting. The inserts can be expanded horizontally, vertically and diagonally illuminating push-buttons and automatic preview are also provided.

Audio Consoles

From **McCurdy Radio Industries**, the SS4388 8-Mixer Single-Channel Audio Console is designed for desk-mounting in news booths, DJ areas, or educational facilities. One HL and one LL input to each mixer. Monitor, PA feeds, self-contained power supply, and cue system. Also featuring space below the attenuators for optional pushbuttons for remote control of turntables, tape recorders, etc.

The SS4396 12-Mixer Dual-Channel Audio Console from McCurdy Radio Industries features slide (in-line) attenuators, Foldback

and Monitor outputs with selectors and level controls. Built-in Cue system with 16 pushbuttons, amplifiers, and speakers.

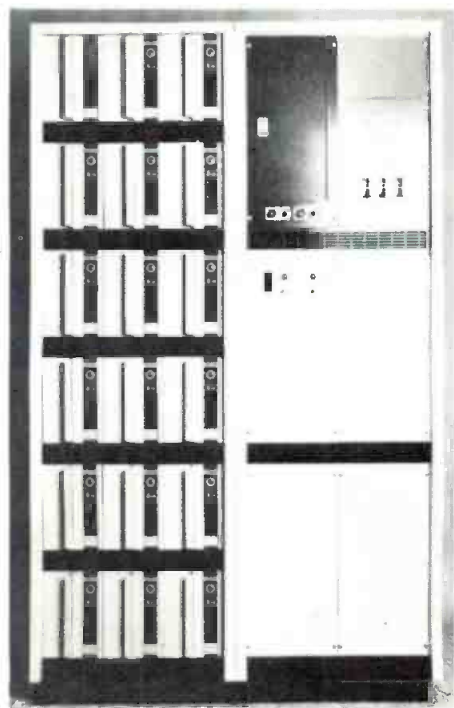
SS4397 12-Mixer Dual-Channel Audio Console is the most comprehensive in McCurdy Radio Industries' line of desk-mounting audio consoles. Includes three submasters, channel ON pushbuttons, auxiliary outputs, Monitor/PA feeds, and Cue system. Space for options such as tone oscillator, Echo Send/Return controls, and remote control push-buttons.

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Modular Rack Dimmer System

Berkey Colortran is now offering the new CRD Dimmers with its new modular rack system. System is UL approved, with a lifetime warranty



on the SCR's. For improved reliability, there are no fuses and no fans in dimmers or racks. The filtering system has a 600 microseconds rise time. A new circuit permits precise factory set control curves. Custom front ends of all types including "computer systems" are available from Colortran for use with these dimmers.

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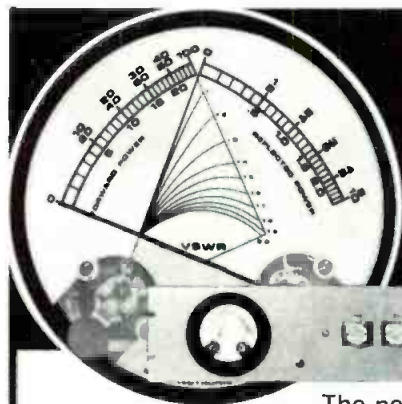
Character Generator

A new character generator, with numerous features available for the first time in such a unit, will be introduced by TeleMation, Inc.

The TCG-1425 provides full-page and partial-page alphanumeric displays for any television application, producing up to 14 lines of 25 characters each. A fifteenth line is available for "preview" copy.

To facilitate composition and editing, the unit includes automatic line-by-line centering; a unique hop function to shift a group of characters or a word one space simultaneously; deletion of any letter or line with a keyboard control, insertion of "preview" line copy into any other line on the page; and a "clear page" control to delete the entire display. A flashing control is included to emphasize a letter, word,

(Continued on page 86)



**We've got it ALL
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**VSWR and
RF Power—both ways
on ONE meter face!**

The new THRULINE® model 3122 Dual Wattmeter-VSWR Monitor displays all three measurements at once on a single meter face: Forward and reflected power are indicated by individual pointers and VSWR is monitored on a third scale from the intersection of the two pointers.

Unlike most VSWR meters, the economical model 3122 does not require *any* full scale deflection adjustments, or switching for VSWR readings: The entire set of three transmission parameters is read out simultaneously during normal RF operations or maintenance adjustments. Elements determine power and frequency ranges.

SPECIFICATIONS

FORWARD POWER: 10-5000W $\pm 5\%$, 2-1000MHz
REFLECTED POWER: 1-500W $\pm 5\%$, 2-1000MHz
VSWR TO PT. OF MEASUREMENT: 1.035 max.
MONITORS LOAD VSWR FROM 1.0 TO 2.0

MODEL 3122 PRICE (WITH N/F Conn): \$200

PLUG-IN ELEMENTS (Choose 2) \$30-50 ea.



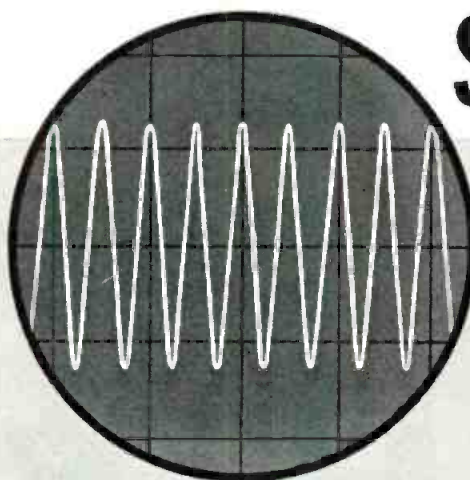
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Send now for this compact 12-page attenuator catalog, filled with detailed information on numerous rotary step variable audio and R.F. models. Circuits include ladder, potentiometer and T types. It has application data, gain-loss table, circuit diagrams and outline drawings. Shallco products have a 2-year warranty covering material and workmanship. Standard items are delivered in 3 weeks.

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MONO \$5900
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Now broadcasters can automate on a partial or full time basis for a modest initial investment. Can be expanded to meet majority of applications.

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(Continued from page 85)

or group of words.

The TCG-1425 provides a horizontal crawl display without requiring an external memory. After a page of information is entered in the static mode, keyboard controls switch the unit to the crawl mode. The one-line crawl can be positioned on any of the 14 lines. A separate disc memory, optional with the character generator, stores multiple pages of information and offers instantaneous random access to any pre-recorded page. When used with the disc memory, the TCG-1425 will function in a vertical roll mode.

Circle Number 142 on Reader Reply Card

Zoom Lens

Tel-Cine, Inc., Massapequa, New York, Booth 116, will feature Schneider 11.2 to 1, f/2.1 manual/servo zoom lens. Its complete operational flexibility and close focusing will be demonstrated.

A new line of color camera special effects optics, including a unit that adapts any standard film

lens for use on a color TV camera and a behind-the-zoom rotating prism that allows both rotation and zoom action simultaneously, will be introduced.

Other products on display will include the model 5404 Tele-Tec Video Tape Editing Programmer, the model 294 Tele-Slate, the Son-dor Magnetic Film Recorder/Re-producer and the complete line of Schneider television camera lenses.

Circle Number 143 on Reader Reply Card

Dual Wattmeter VSWR Monitor

Voltage Standing Wave Ratio—the ratio between crest and trough of a standing wave in a line—is a convenient measure of mismatch conditions in a transmission system. Along with power supplied to the antenna and power reflected from a mismatched load, VSWR data are very helpful in station maintenance.

The new Bird Electronic Corp. THRULINE model 3122 Dual Wattmeter-VSWR Monitor displays all three measurements at once on a single meter face: forward and re-

20T Pulse, Bar Generator

By developing the new Gain and Delay Test Set, Type SPAF, and adding it to the 2T/20T Pulse and Bar Generator, (SPF or SPIF), Rohde and Schwarz has now created a measuring system which permits objective direct reading measurements of envelope delay and amplitude response distortions between the luminance and chrominance areas of a TV transmission system.

The Test Set has calibrated adjustable gain and delay networks. The test signal is divided into its

low and high frequency components which are corrected by the adjustable network in such a way that after adding the corrected frequency components, the test pulse is reconstituted in its original undistorted form. Any suitable TV oscilloscope can serve as indicator.

Direct reading of the measured values is possible at a line rate, as well as of a VIT rate, thus making it possible to perform these vital measurements during the normal program hours.

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flected power are indicated by individual pointers and VSWR is monitored on a third scale from the intersection of the two power pointers.

Unlike most VSWR meters, the model 3122 does not require any adjustments to full scale deflection, or any switching before VSWR readings can be taken: The entire set of three transmission parameters is read out simultaneously during normal RF operations or during maintenance adjustment procedures

Power and frequency range of the new Bird Dual Wattmeter-VSWR Monitor depend on two Plug-in Elements selected from more than ninety choices available with the company's popular THRULINE Model 43: Full scale power levels at $\pm 5\%$ accuracy range from 10 to 10,000 watts for forward indication and 1 to 1000 watts for reflected, in discrete frequency bands from 0.45-2300 MHz (For increased resolution, the reverse power Element is ten times more sensitive than the forward power Element).

Circle Number 145 on Reader Reply Card

Slide Changer

Rank Precision Industries, Inc. will introduce a new slide changer to the North American TV broadcast industry, according to Neil E. Burtonshaw, Product Manager of Rank Cintel.



Interchangeable with similar units now in use, the complete package of the new Rank system includes a changer mechanism, slide gate and external logic circuits, operating on binary code for sequential or fully random access to the 30 2"x2" slides housed in the changer's maga-

zine. With solid state logic and control circuits for accuracy and reliability, the change time between two adjacent slides is less than one second and only three seconds between two slides located farthest from each other in the magazine.

Light operated photo transistors are used to detect the position of the carriage, operating rod and slide in the gate, with the light piped to the point of detection and reflected back by two-way fibre optic light guides. This makes possible use of a common light source consisting of two long-life lamps, either of which will operate the mechanism. A warning light indicates failure of either lamp.

Circle Number 146 on Reader Reply Card

Quiet Lavalier

Electro-Voice claims that annoying friction noise, usually a deterrent to the use of lavalier microphones, has been eliminated with the introduction of their new RE85 dynamic lavalier microphone. One design technique that allows this

(Continued on page 88)

MOBILE AND MICROWAVE REPEATERS

AUTOMATIC WEATHER STATIONS

TV TRANSLATORS

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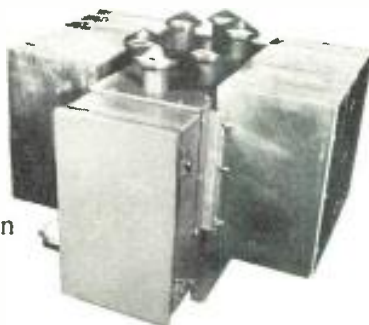
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JAMPRO

ANTENNA COMPANY

A DIVISION OF
COMPUTER EQUIPMENT CORPORATION

6939 Power Inn Road
Sacramento, Calif. 95828

Circle Number 58 on Reader Reply Card

(Continued from page 87)

claim is the double-wall construction of the unit, with two separate cases being used. One case is nested inside the other and completely insulated from all shock and vibration with highly compliant rubber.

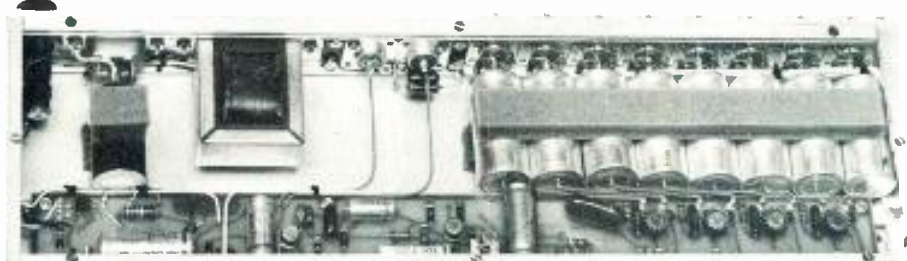
The internal case is a capsule containing the generating element and isolated to a degree never before known in the microphone industry. Even cord-conducted noise has been eliminated with this sophisticated shock-mounting technique. Another factor contributing to the friction-free claim is E-V's use of extra smooth microphone case finish and special, smooth coated cable. No grain or bumps are present to set up friction even

when the microphone or cable is brushed against the user's clothing.

It weighs only 8 ounces, is 2½ inches long, and has a diameter of less than one inch. When used with the supplied belt clip to hold the cord in a constant position and with even tension, it offers no hindrance to professional, hands-free use.

The RE85 also features the exclusive Electro-Voice Acoustalloy non-metallic diaphragm which is durable under high humidity conditions, temperature extremes, against corrosive effects of salt air, and severe mechanical shock. An integral windscreen and blast filter provides protection from wind noise, excessive sibilance, and pops.

Circle Number 147 on Reader Reply Card



Video/Pulse Distribution Amplifier

International Nuclear Corporation will show a new line of amplifiers and generators. Among those on display at the NAB convention will be the TDA-2-D/8 video/pulse distribution amplifier.

This one is a compact, solid state amplifier designed to bring solid state efficiency to any television operation. The differential input sup-

presses spurious voltages built up on the sheath of input cables. It mounts in a standard 19-inch rack, using VHF connectors throughout.

The unit draws only 6.5 Watts, a consideration where heating might have been a problem. Also, input and output is 75 Ohms, and its eight outputs are internally terminated. Test jacks for the most important voltages and signals are color coded and external.

Circle Number 148 on Reader Reply Card

Light Weight Pedestal

CinTel Corporation, a Los Angeles subsidiary of Technology Incorporated, is introducing a new line of light weight television support equipment.

The new equipment is designed to meet the requirements of the new generation of light weight color and monochrome television cameras. Included in the line is a light weight pedestal, plus a tripod tripod dolly and a cradle head. They are low cost, built for life, easy to operate, and have fingertip control and a wide C. G. displacement

capability.

This line of off-the-shelf support equipment has a variety of applications. In addition to television (studio, CATV, CCTV, and educational), it can be used for the microwave, laser, optical, radar, civil engineering and antenna industries.

CinTel, in addition to its television studio equipment line, is engaged in the development, manufacture, and sale of film processing and handling equipment, and photographic laboratory installations.

Circle Number 149 on Reader Reply Card

Acrodyne Industries, Inc., of Montgomeryville, Pa., now offers two UHF television translators—Model T130V-U and Model T130U-U—featuring solid state integrated circuitry and standardized modular construction. Designed and built by Acrodyne for maximum reliability, low-cost maintenance, superior color performance, each translator carries a three-year manufacturers warranty, and provides a UHF retransmission for VHF or UHF input signals.



Solid state integrated circuit technology has been applied to all low level stages of the two translators. This includes the front end receiver, frequency conversion, gain and AGC circuits, and the UHF amplifier circuit which boosts levels to final drive power. Two special field proven Acrodyne output tube cavity stages amplify the drive signal up to the 100 watt output level. These are the only vacuum tubes in the entire system. A single cabinet completely houses each system, including power supplies and double tuned coaxial vacuum tube final amplifiers.

Other features of the Mode T130 translators include a field-proven 4,000 hour MTBF output stage; automatic on-off operation; fully shielded RFI construction; automatic main breaker reset; elimination of high power local oscillators, separate AGC circuits for sound and visual carriers, featuring proprietary

(Continued on page 90)



Photos of Radio Comerciales S.A., Guadalajara, Jal., Mexico

How to get your share of the Latin American broadcast market.

Right now, there are close to 6,000 radio and television stations in Spanish-speaking areas of the world. Competition among stations is keen. To remain competitive - and keep pace with Latin America's rapidly growing economy - their equipment must be kept in top condition. Clearly, a substantial market exists for all kinds of broadcast equipment and components. New and used.

One publication — **RADIO y TELEVISION** — serves this vast purchasing potential. It provides saturation coverage among buyers and those who influence purchasing at broadcast facilities throughout Latin America and Spain. Owners, managers, engineers and technicians at commercial and educational radio and TV stations, recording studios, electronic equipment manufacturers and related businesses.

As the Spanish-language counterpart of Broadcast Engineering, **RADIO y TELEVISION** delivers technically-oriented editorial aimed at helping readers to select, operate and maintain equipment and components for maximum **signal quality**. This unique content provides the precise environment that induces buyer receptivity. It enables advertisers to "sell the broadcaster when his mind is on signal quality."

There's a lot more to the story. And we'd be happy to give you more information about this unique medium and the dynamic market it serves. Just circle the Reader Service number or write directly to:



Radio y Televisión

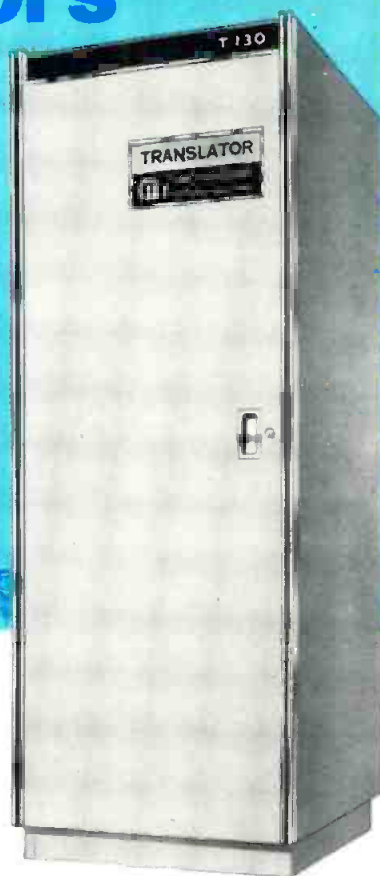
The technical journal of the Latin American broadcasting industry.

1014 WYANDOTTE STREET

KANSAS CITY, MISSOURI 64105

so advanced so dependable... they carry a 3-year warranty the new acrodyne Television Translators

- solid-state integrated circuits
- standardized modular construction
- virtually maintenance-free
- and priced to compete!



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For full information—mail this coupon today!



Please send details of ACRODYNE T130 TRANSLATORS to:

Name _____ Position _____ Affiliation _____

Address _____ Zip _____

Prime Area of Interest _____

21 Commerce Drive, Montgomeryville Industrial Center, Montgomeryville, Pa. 18936
215-368-2500 TWX 510-661-7265

1809M-BE

Circle Number 60 on Reader Reply Card

(Continued from page 89)

techniques which handle all picture conditions including all black transmissions, linear phase multi-resonant driver and final design, and weather proofed remote receiver modules that can be installed anywhere.

The T130 series is the first of a new line of broadcast quality translation equipment offering VHF and UHF configuration in one watt to one kilowatt power option.

Circle Number 150 on Reader Reply Card

Modulation Monitor

True off-air operation is offered by a new FCC type approved AM modulation monitor formally introduced by Moseley Associates, Inc.



This monitor, the Model AMR-1, utilizes complete solid-state circuitry, including fieldeffect transistors and integrated circuits. Operation is accomplished with a simple antenna for recovery of an off-air signal which is an unaltered replica of the transmitted signal. When used in AM wireless remote control applications, the AMR-1 provides an indication of percentage of modulation and recovers subaudible remote control metering information from the carrier. Additionally, 600 ohm and high Z program audio outputs are provided as well as a 10 kHz notch filter.

Circle Number 151 on Reader Reply Card

Low Price CCTV Camera

Sony Corporation will unveil a proto-type model of an innovational color television camera. It is of the NTSC standard TV signal output with a single pickup tube.

The new camera features compactness and a low price, with its picture quality comparing well with broadcast colors.

The company plans to begin marketing the camera this year, and anticipates that large scale production will possibly make the retail price less than 300,000 yen (about

BROADCAST ENGINEERING

\$833.00) in Japan.

The camera's associated electronic circuits are entirely new. The camera is altogether IC and solid-state circuited: it functions on a radically new color image responsive element and the coding principle of the company's invention.

Sony expects the introduction of the new camera to speed the expansion of the video tape recording market, and open new markets for CATV and closed circuit color TV.

Sony pointed out that for on the spot recording, or for special training instructions, individual requirements frequently call for immediate playback capability. Sony's new camera, combined with the VTR, is capable of meeting this requirement.

Sony officials believe that the introduction of the new camera will contribute much to the growth of the general VTR market.

Circle Number 152 on Reader Reply Card

Coax Cable

Phelps Dodge Communications Company has announced the immediate availability of Cuflex, an all new series of copper corrugated Foamflex coaxial cables, 50 ohm impedance, in 1/2", 7/8" and 1 5/8" diameters.

The new coax was designed specifically for long run transmission applications as well as for high frequency transmitting and receiving station antennas. Copper corrugated Cuflex offers the advantages of high power, low attenuation, good fre-

quency response, high phase temperature stability and low radiation plus the assurance of uniform electrical properties over wide temperature variations, unlimited operating life, light weight and low cost.

Distinguished by a copper corrugated sheath which adds considerably to flexibility as well as to strength and corrosion resistance, basic cable construction consists of a copper clad aluminum inner conductor in 1/2" and 7/8" cable sizes and a hollow copper inner conductor in the 1 5/8" cable size.

Circle Number 154 on Reader Reply Card

Solid State TV Monitors

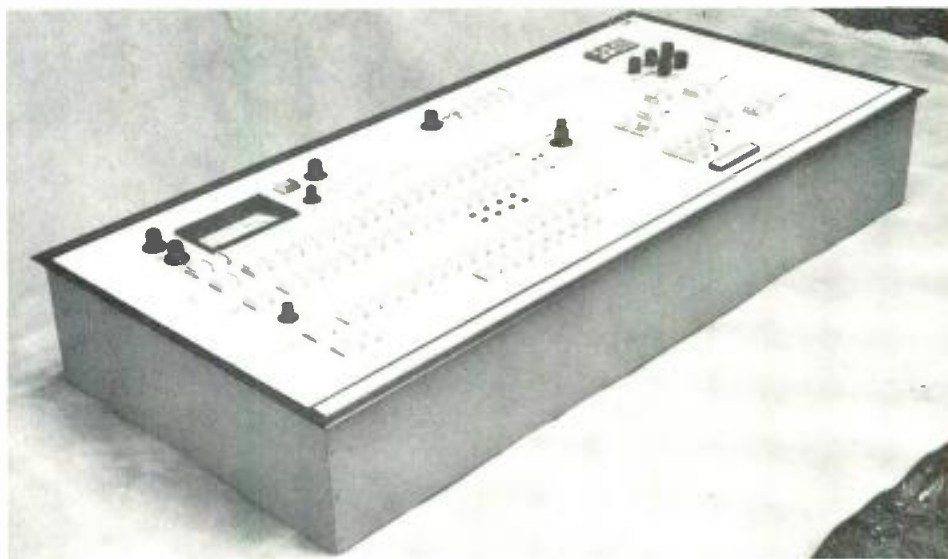
Two new solid state television monitors—a 22 inch color unit with NTSC decoding and a 20 inch monochrome monitor with illuminant "D" phosphor—have been introduced by **Rank Precision Industries, Inc.**, according to Neil S. Burtonshaw, product manager of Rank Cintel, manufacturer of the equipment.

Both units are designed with the same finish and overall front dimensions so that they present a coordinated appearance when used together in a stacked configuration.

They both operate on either 525 or 625 line standards.

The 22 inch color monitor, which is also available with PAL decoding, has a new 4 x 3 aspect ratio tube and is equipped with transistor matrixing circuits to ensure a high

(Continued on page 92)



Vital Industries, Inc. will exhibit at NAB '71, March 28-31, Vital Automation Equipment, a new Production Switcher, Video Processing and Special Effects Systems.

Circle Number 153 on Reader Reply Card



The SIMEX TIME STANDARD

WWV Radio Receiver

- 24-hr. no-tuning reception
- 6 pre-set crystal controlled freq.
- Battery, or 12V current
- Output jack • Brushed aluminum case
- Size: 4" 8" 8" • Wt. 3 lb. • Portable
- Unconditionally Guaranteed

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NEW Q R K CARTRIDGE EQUIPMENT at Realistic Prices

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Mono Record/Play \$545

Triple Mono
Automatic Playback \$995

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can obtain quality cartridge
equipment from a reputable
source at attractive prices!!

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NEW JERSEY 08030 • Phone: 609 456-1716

Circle Number 62 on Reader Reply Card

(Continued from page 91)

standard of stability. The unit has active convergence circuits for precise and independent registration, with an ergonomic layout of convergence controls.

The new 20 inch monochrome monitor has a number of features, including scan generators of high linearity and stability, two video inputs with electronic switch selection, a notch filter to give a 12dB notch at the color sub-carrier frequency, and an independent solid state e.h.t. generator providing a stabilized supply at low impedance.

Circle Number 155 on Reader Reply Card

Closed Circuit Video Monitor

GBC Closed Circuit TV Corp. now makes available to broadcast stations its 5" video monitor as a single unit or as 3 units in a 19" rack mount. Both carry the GBC one-year guarantee.



Heretofore available primarily for security and closed-circuit TV applications, the monitor is suitable for the broadcast industry for high-density monitoring.

GBC invites broadcast stations to try the single unit or the triple rack unit on a FREE 10-day trial basis.

Circle Number 156 on Reader Reply Card

Video Metering System

A new video metering system that eliminates technical set-up procedures on color television cameras has been announced by **International Video Corporation**.

A single meter on the camera control panel permits the operator to establish accurate color balance, master gain and master pedestal simply by pressing each of the four channel push buttons, and setting the correct reading on each of the channels on the meter.

This eliminates the expense and time of a lengthy technical set up as well as the cost of buying external electronic equipment. Everything needed is built into the camera, Moscarello said.

Circle Number 157 on Reader Reply Card

TOOL KITS

FIELD ENGINEER TOOL KIT JTK-17



More than 100 fine tools required for servicing in the field. Used on communications equipment, business machines, computers, all kinds of electronic systems. All tools and VOM tester are furnished in deluxe attaché case. Write for details.

JTK-17.....\$222.50

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ELECTRONIC ASSEMBLY TOOLS

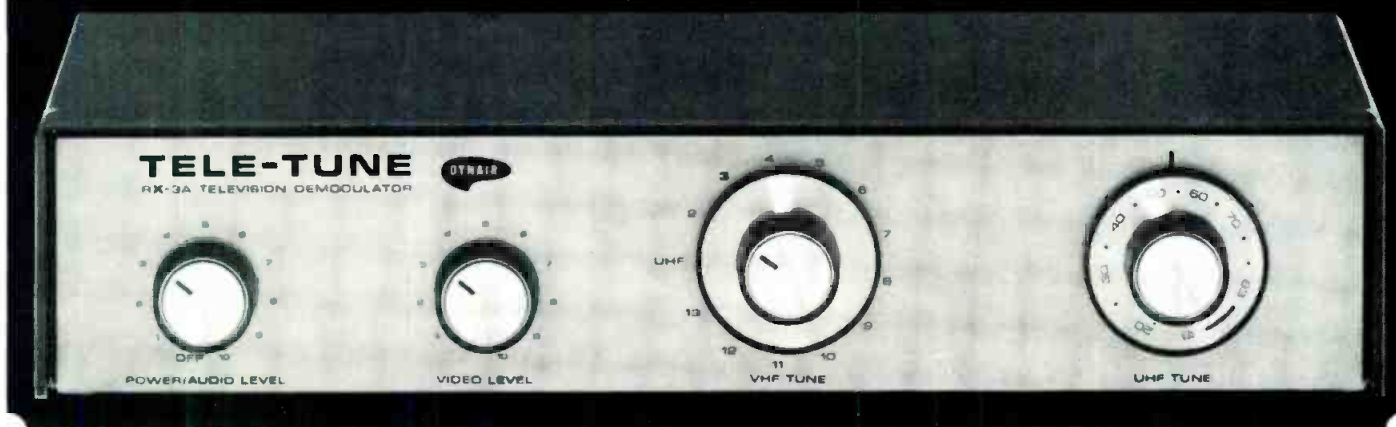
JENSEN TOOLS AND ALLOYS
4117 N. 44th Street, Phoenix, Arizona 85018

Circle Number 63 on Reader Reply Card

Helical Scan Dropout Recorder

A helical scan dropout compensator, professional audio recorder, and an improved Chromabeam video tape to color film transfer system will be shown by **3M Company's Mincom division** at the NAB show in Chicago March 29-31.

NOW...a solid-state TV tuner for only \$550.00.



Ideal for general monitoring applications, the TELE-TUNE offers solid-state reliability and professional performance at a price you can afford. When used with a quality video monitor, it will provide color or monochrome performance superior to that of commercial TV receivers. It can also be used to select broadcast TV channels for viewing on an RF distribution system. In such cases, the output of the TELE-TUNE is remodulated on the desired closed-circuit channel by a DYNA-MOD modulator.

The TELE-TUNE is housed in an attractive metal cabinet and has rubber feet for desk-top use. Brackets are also supplied which easily adapt the unit for 19-inch rack mounting. A built-in speaker is also provided.

Available off the shelf...write today for complete information.

DYNAR ELECTRONICS, INC.
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Telephone: (714) 582-9211

DYNAR

Circle Number 64 on Reader Reply Card

The Chromabeam recorder-printer system was introduced in 1970 NAB Development days, has since then, the color fringing added a videofix in the film the system—
 ing on Reader Reply Card
Receiver/Monitor
 s new commercial color TV cr—Model JP-968W—is designed to serve as a general purpose utility monitor for numerous studio



applications including direct off-air monitoring functions. Especially designed for non-critical viewing spots in the studio, this set features 23" diagonal picture tube for use even in large areas. It's equipped to accept RF or bridged direct TV video and audio line feed without costly adaptors, and includes a separate 75-ohm video input for direct off-air recording.

Circle Number 159 on Reader Reply Card

Omni Directional Dynamic Microphone

A new professional omni-directional dynamic microphone from AKG which has applications for in-studio use and on-location pick-up work.

It features a removable, rugged



March, 1971

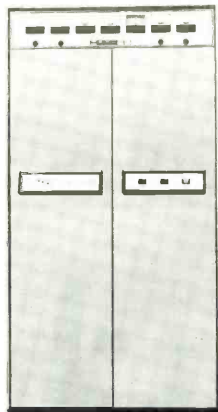
wire mesh windscreen which, when mounted, locks securely to the microphone body. Without the windscreen the microphone has an absolute linear frequency response; with the windscreen, the unit has a presence rise of 4-5 dB between 3,000-12,000 Hz.

The D-160E's response characteristics are maintained uniformly over the entire polar range of 360° and it has an above average output level of -55 dB.

Circle Number 160 on Reader Reply Card

FM Transmitter

American Electronic Laboratories, Inc., announces that its FM-10KCG grounded grid, 10,000 watt FM transmitter has been granted FCC type acceptance.



This transmitter is the latest development in AEL's transmitter line and completes the change over of all its high power FM transmitters to a grounded grid triode final tube configuration.

The FM-10KCG has a stable, low harmonic generating final amplifier using a 3CX10,000A7 output tube in conjunction with a 4CX1000K IPA driver.

Circle Number 161 on Reader Reply Card

Studio Lighting Control Systems
 Skirpan Lighting Control Corporation will introduce a new modular approach to the design and assembly of studio lighting control systems.

(Continued on page 94)

Spotmaster

Tape Cartridges



All lengths and sizes stocked — fast service — highest quality

Series	Type	Time at 7 1/2 ips	Unit Price
300	20 sec. (13")		\$ 2.00
300	40 sec. (25")		2.05
300	70 sec. (44")		2.10
300	100 sec. (63")		2.25
300	140 sec. (88")		2.35
300	3 1/2 min. (132")		2.50
300	5 1/2 min. (207")		2.90
300	8 1/2 min. (320")		3.70
300	10 1/2 min. (394")		3.90
300	empty cart.		1.60
600	16 min. (600")		6.25
600	empty cart.		2.80
1200	31 min. (1163")		10.45

Also: DL cartridges (for Spotmaster delay machines), bulk tape, tape-tags and other accessories.

ANY ASSORTMENT—NO MINIMUM ORDER

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REK-O-KUT

S-320 TONE ARM



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Circle Number 65 on Reader Reply Card

(Continued from page 93)

tems. The Company now manufactures a total of 40 different control panels and solid state dimmer modules which mount in standard enclosure systems based on EIA Standard RS-310.

Using this equipment, stations may assemble their own lighting systems with reduced cost and limited system expandability. A completely operative modular system will be displayed as well as the Company's new audio-visual systems controlling a sound, slide and light show.

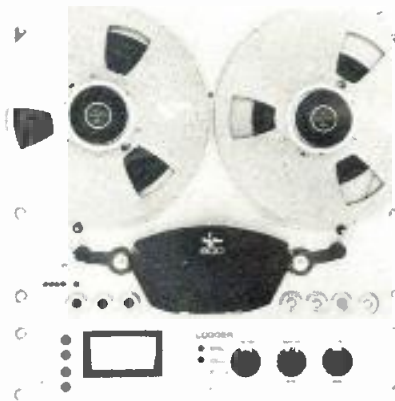
Circle Number 162 on Reader Reply Card

Station Logger

A new radio station tape logger featuring advanced performance and control capabilities has just been announced by **Tape-Athon Corp.**

The new unit, Tape-Athon's model 900 logger, is said to be the first such recorder using dual capstans. According to a Tape-Athon spokesman, the performance level developed by their dual capstan drive approaches that of a professional recorder/reproducer system. Wow and flutter specifications of

less than .3% at 15/16 ips and less than .5% at 15/32 ips are typical of the quality attainable.



A unique control feature has also been incorporated in the logger to simplify and speed up audio playback. The logger is equipped with an automatic reversing feature at each end of the reels to assure continuous recording. This would presumably require directional indication in playback mode, but an exclusive self-seeking system in the logger automatically plays the correct track in the right direction when the desired "track" button is depressed. The push button itself is

played to show the track being
The N...
able in 2, 4,
tions, with 1,
per track. Special... is avail-
8 tracks and 8 chan...
provided. Overall fre...
sponse at 15/32 ips is ± 3 ...
150 to 2500 Hz, and S/N r...
40 dB, unweighed, at the sa...
speed.

Circle Number 163 on Reader Reply Card

Television Film Camera

A new color television film camera, the PE-245, will be introduced by **General Electric** at the show.

According to GE, the PE-245 was solid state designed for reduced maintenance. It offers sharp pictures, a flat response curve and new dichroic mirrors. The manufacturer claims improved colorimetry from new optical glass, a new color masking amplifier, and new optical trim filters with wider response curves.

The PE-245 film camera is a 4-vidicon, separate luminance, camera. Its design is based on the PE-

Neve

SOUND CONTROL EQUIPMENT

Incorporates 26 full mixing equalized input channels each with microphone and line inputs. There are eight output tracks with three mixed down groups for stereo and mono mastering, six echo groups, studio foldback, and an impressive list of built-in equalizers, compressors and other signal processing devices. A comprehensive communications system links the Studio floor, balance engineer, projection room and the producer. The Neve organization specializes in the design and installation of complex professional control consoles and systems for clients throughout the world.



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Rupert Neve & Co. Ltd. Cambridge House, Melbourn, Royston, Herts, England.

Circle Number 66 on Reader Reply Card

240, now in general use across the country.

Circle Number 164 on Reader Reply Card

Solid State Compact Console

A new concept in recording studio consoles has been announced by **Altec Lansing**, Anaheim, California. Altec's new entry in the console field provides up to 28 inputs and 16 outputs, measures only four feet in width and is delivered to the user fully wired ready to operate. The console is identified as Altec model 9300A.

With the requirements varying between studios, Altec decided to design a fully modular, plug-in type console which would avoid obsolete as the studios requirements grew. The console can be expanded in capabilities by adding plug-in wired modules.

An exclusive feature of the console is the application of the Altec

Modulite™ volume level meter, a major development in accuracy and reliability in monitoring console outputs. Modulite is virtually instantaneous in following the audio envelope with a sequential pattern of colored lights giving the mixer a true picture of modulation. Response time is faster than the conventional meter and it is easier for the eye to catch colored lights than to focus on a meter needle.

Circle Number 166 on Reader Reply Card

Automation Systems

Central Dynamics, with heavy emphasis on automation, will show their PEC-102 automatic tape editor and station automation designed around the APC-610 master control switcher and mini computer.

The master control switcher and computer package is designed to interface with Sales and Traffic and all areas of technical operations. Also, the system will automatically

(Continued on page 96)

Lighting

Kliegl Brothers sees lighting controls as having entered a new phase with the advent of the random access memory storage unit. These memory devices called Q-File, can be used in conjunction with a small console completely operable by one person. The advantages of a properly designed memory system are many. For example, there can be accurate and positive memorization and readout of dimmer intensity. There can be a reduction in oper-

ating personnel. There can be more time for lighting since the time required for manual recording or resetting of intensity information is eliminated.

A most important advantage is that memory control can make possible cue and fading sequences not previously obtainable. This possibility allows a new creative impact upon the performing arts. With "Q-FILE", lighting control is extended to a degree of sophistication.

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Just send your worn cartridges to us
Our individual professional reconditioning

Assures you of properly serviced cartridges



FOR BETTER
LONGER
PERFORMANCE

—JOA will inspect, service and reload your cartridges with ANY LENGTH tape

NO MINIMUM—NO EXTRA CHARGE FOR—

- (a) FOAM TEFLON-FACED PRESSURE PADS
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- (c) VISIBLE SPLICE

All cartridges PRETESTED under actual broadcast conditions—48-hour Processing 20 or more cartridges SHIPPED PRE-PAID

Need NEW CARTRIDGES fast? JOA will ship immediately . . . from stock . . . any size Fidelity, precision manufactured NAB cartridge.

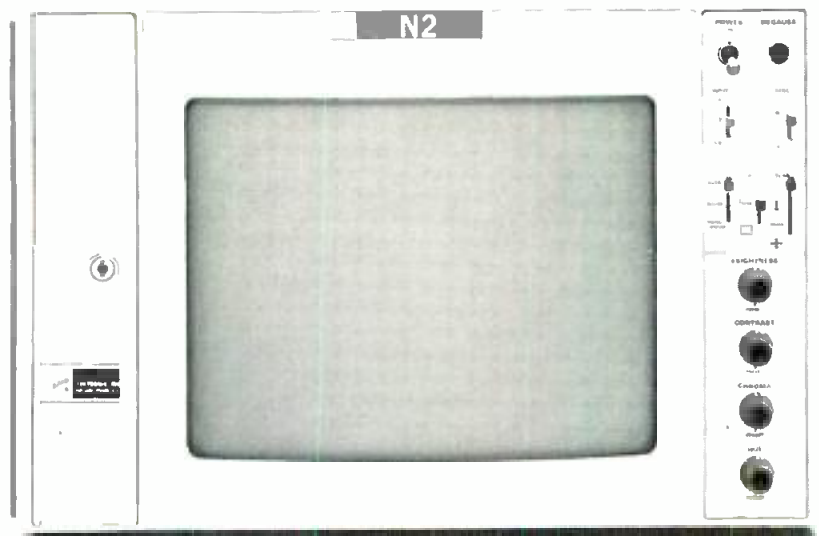
JOA—the cartridge service of authority—serving the broadcast industry.

Authorized distributor for NORTONIC HEADS
phone or write



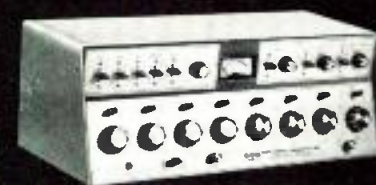
Cartridge Service
P. O. Box 3087
Philadelphia, Pa. 19150
Area Code 215, Turner 6-7993

Circle Number 67 on Reader Reply Card



Tektronics will enter the TV monitor market with this 650 color monitor. Circle Number 180

Q R K
AUDIO CONSOLES at
REALISTIC PRICES



	MONO	STEREO
5 CHANNEL	\$ 995.	\$1595.
8 CHANNEL	\$1695.	\$2495.
PRE-WIRED 5 SYSTEM	\$1995.	\$2995.

QRK ELECTRONIC
PRODUCTS, INC.

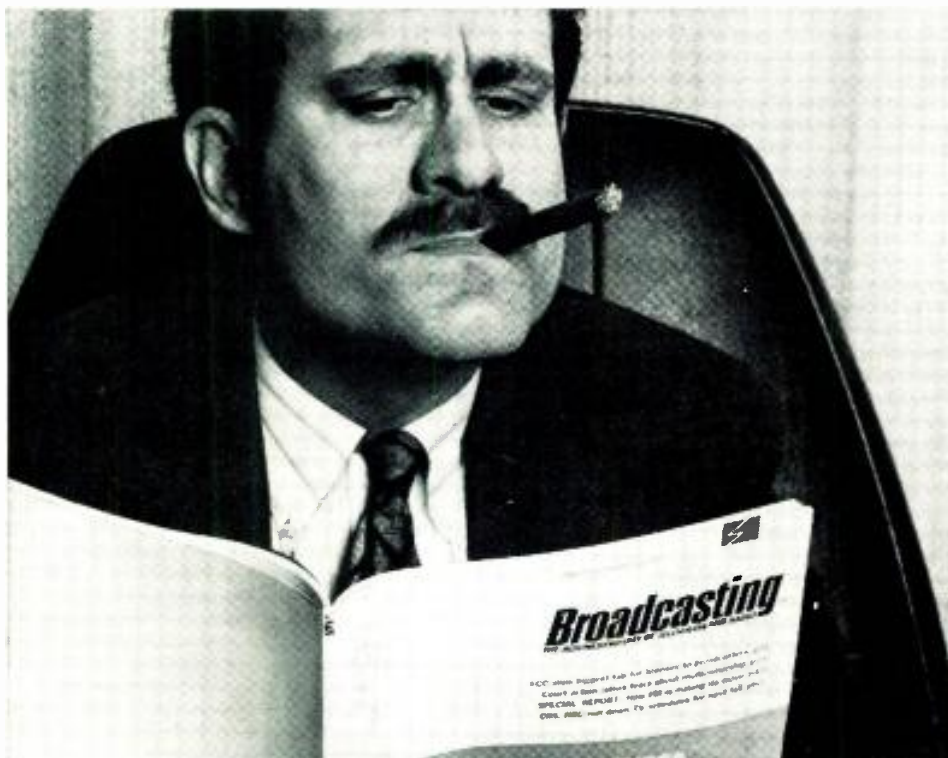
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If you want a tube distributor who knows your business, give it to him.



He's your RCA Broadcast Tube Distributor. No.1 in tubes for all broadcasting applications.

What made him No. 1? Emergency service is one reason. It's like money in the bank.

For example:

You're on the air. It's late, a tube fails. You're low on replacements. Too low for comfort. So you call your RCA Broadcast Tube Distributor. To keep you on the air, he'll get out of bed to fill your order!

There are more reasons.

Experience. He talks your language, knows your needs. Some of our distributors have been in the business of supplying broadcasters for as long as we have—40 years!

Engineering service. He has a "hot line" to RCA's Field Engineers. Call him any time you need their services. Call even if you need help in servicing our competitor's equipment!

Quality. You know the story. He stocks the finest.

In power tubes, for example, brand preference studies by leading electronic publications have listed RCA as the first choice of professional designers year after year!

Inventory. The widest. Power tubes, rectifiers, vidicons, image orthicons. Think of his establishment as your tube warehouse. For all practical purposes, that's what it is!

Need more reasons? Call your local RCA Broadcast Tube Distributor. For starters, ask him for the new 1971 Guide to RCA Industrial Tube Products, or write: RCA Electronic Components, Commercial Engineering, Dept. 20C-1, Harrison, N. J. 07029.

P.S. Your RCA Broadcast Tube Distributor is also the man to call for RCA Starmaker Microphones.

The Action Man

RCA Industrial Tube Product Guide

1971 Guide

RCA

Circle Number 69 on Reader Reply Card

(Continued from page 95)

produce an FCC log.

The tape editor is a new concept for video tape editing. It uses a computer controller and a time code generator with the new SMPTE time code.

Circle Number 167 on Reader Reply Card

Video Tape Evaluator

Recortec's new Video Tape Evaluator (VTE) is a desk-top device for cleaning and testing tapes to ensure quality record and playback of video signals. The evaluator tests tape longitudinally at 120 ips to provide an indication of tape length, number



of edge damages and number of tape surface defects. Its ability to operate automatically at this high speed enables the user to evaluate tapes at a fraction of the cost using video tape recorders.

Although testing format is longitudinal, there is good correlation between tapes tested on regular video tape recorders and the VTE. After all, a tape showing defects in longitudinal mode is usually not good for quality recording in video applications.

Circle Number 168 on Reader Reply Card

Electrostatic And Dynamic Headsets

Stanton Magnetics' entry into the stereo headphone market is spearheaded by a highly sophisticated electrostatic system, according to Marketing Director, Dan Collins.

"The Mark III Isophase Electrostatic Headphones," said Mr. Collins, "are an extension of Stanton Isophase speaker engineering, which helped bring electrostatic sound reproduction into being in the '50's. The Isophase headphones are the lightest, quality headphones available."

The unique feature of the Isophase system, which is exclusive with Stanton, is a special protective

circuit that prevents overloading of both the headphone and the listener's ears. Built into the system's polarizer, the overload relay automatically triggers when the power



being fed to the headphones approaches the maximum listening level that is safe for the ear. A simple reset button reactivates the relay and allows the headset to operate again after the power surge has passed or excessive power is reduced.

Circle Number 169 on Reader Reply Card

Studio Production Center

A new color studio production center, part of the Dage 800 educational TV system from Dage prod-



ucts section of **Visual Educom**, is capable of self-contained video production. It is comprised of an upper monitor section and a lower control section, each of which is portable and weighs only 60 pounds.

Circle Number 170 on Reader Reply Card

Tape Cartridge

In addition to **Marathon Broadcast Equipment Corp.**'s regular line of cartridges and cartridge maintenance tools, the new marathon Model 300S Stereo cartridge will be

shown. Stereo phase measurement will be shown as well as actual performance using stereo program material.

Circle Number 171 on Reader Reply Card

TV Zoom Lens

Angenieux Corporation of America will exhibit the 15x18E (f/2) zoom lens with a focal length capability of 18-270mm. The complete 15x18E with rear turret for remote positioning of range extenders, is an entirely new concept in studio/re-

mote lenses, and, potentially, a new standard since the introduction of the first 10:1.

The 6x9.5 high aperture (f/1.6), wide angle (68°) zoom lens with a focal length of 9.5-57mm will be exhibited for the first time to the television news industry.

The 15x18E has a close focusing distance of 25" (22" for the "L" model) and still retains its full zoom capability. With a close-up adapter and range extender the lens is also

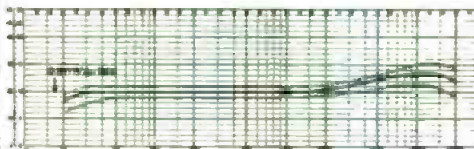
(Continued on page 98)

If performers sound
a bit better these days,
this could be the reason.

The MKH 125 lavalier condenser microphone



The tiny microphone above and the response curve below don't seem to go together. But they do. Because the world's smallest lavalier condenser microphone is one of the world's finest condenser microphones—of any size. Using the unique Sennheiser solid-state RF system, the omnidirectional MKH 125 delivers the smooth response and low noise our microphones have become famous for.



The MKH 125 is especially suitable for on-location filming and wireless applications in television with its electronics and matching transmitter

concealed in clothing. With its cable attached, it provides excellent performance in any lavalier application requiring precise reproduction or ultra-small size.

To find out more about the MKH 125 (as well as the many other professional products in our line), send for our free Micro-Revue. You'll find it contains a wealth of useful audio information as well. Please write or call us at the address below.



Sennheiser Electronic Corporation

500 Fifth Avenue, New York, N.Y. 10036. Telephone 212-564-0433



Circle Number 70 on Reader Reply Card

(Continued from page 97)

capable of full-screening an object of less than one-half inch in height. The exclusive combination of close focusing and longer focal length in the 15:1 makes available new possibilities for simulators and other optical systems.

Circle Number 172 on Reader Reply Card

Automation Systems

CCA Electronics will display its new automation systems. They include the Mini-Automation system that sells for \$6,000 and the Midi-Automation system that sells for \$15,000.

The company also will show a new line of special consoles that permit simultaneous operation of AM and FM at the same location.

Circle Number 173 on Reader Reply Card

TV Film Chain

New Model OM-300 Multiplex TV Film Chain by **Kalart Victor Corporation**, Plainville, Connecticut, has Maxi-Media capability in that either 16mm movies, 35mm film-strip, or 2 x 2 slides can be projected for television from its input stations.

One station is used for the TV camera. In use, either of its inputs can be put "on line" instantly. Optical transfer time is only 175 milliseconds maximum, and audio transfer is accomplished simultaneously with the picture.

A typical combination of equipment used with the Model OM-300 may include two Kalart Victor Model STV-TB 16mm TV projectors, a Kalart Victor Model PS-65 TV combination filmstrip and slide projector, and a model VR-622 TV camera.

Circle Number 174 on Reader Reply Card

Computer Automated Systems

Schafer Electronics will be showing models of their PCC-8000 and 800 at the 1971 NAB Convention.

The PCC-8000 computer controlled system will be displayed in an AM/FM configuration. A single computer will be operating separate AM and FM programming . . . this is an industry first!

Both the Schafer PCC-8000 and 800 systems on display will be equipped with CLEAR language verified logging, alpha numerical in-

formation recorded on cartridges or reel-to-reel tapes, will print out on a teletypewriter to verify that the spot, ID, or other announcement was aired as programmed. These innovations are now available.

Circle Number 175 on Reader Reply Card

Translator Antennas

A series of new translator antennas for UHF and VHF transmission has been developed by **RF Systems, Inc.** A Zig Zag antenna element is used as the basic radiator in both types of units.

Circle Number 176 on Reader Reply Card

Audio-Video Switching

Chrono-log Corporation will show, at the NAB Convention, the Chrono-log Pinboard STEP System for low cost, time-tested practical automation of video and audio switching during breaks.

Chrono-log will also display the new TV Video Clock System which provides a digital display of time on existing video monitors throughout the station without need for installation of cables.

Circle Number 177 on Reader Reply Card

STRIP-LINE CIRCUITRY IS THE BEST TRANSMITTER INSURANCE YOU CAN BUY

Strip-line non-moving contacts end pitting and burning. Our 20 KW FM model 620 uses Strip-line. This reduces maintenance up to 60% and insures longer component life. If an overload occurs, our exclusive "tally light" system remembers the fault and where it was.

The 620 also has a VSWR sampling system which turns off the power if VSWR is excessive, and an automatic power output control. These features are offered at no greater cost than ordinary transmitters. There's a Sparta Transmitter to fill every Broadcast need.



SPARTA ELECTRONIC CORPORATION

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14616 SOUTHLAWN LANE, ROCKVILLE, MARYLAND 20850 (301) 424-2920

A DIVISION OF COMPUTER EQUIPMENT CORPORATION

Circle Number 71 on Reader Reply Card

FCC Proposes New Land Mobile Rules

New, regional systems of radio spectrum management, reducing the 20 or more blocks of land mobile frequencies presently available for allocation to two blocks, and opening the first Regional Spectrum Management Center in Chicago, Illinois, in mid-1972, have been proposed by the Commission in a rule making notice. The changes would amend Parts 1, 2, 21, 74, 89, 91, 93 and 95 of the rules.

The Commission said that the changes are necessary because of the rapid growth of private land mobile communications services. It noted that at the close of fiscal year 1970, it had authorized over 300,000 land mobile systems, varying in size from a few radio transmitters to upwards of 1,000 transmitters each, and said that its proposals are designed to deal with the heavy concentrations of land mobile systems in the larger metropolitan centers, where there are often critical frequency shortages.

In advancing its suggestions, the Commission utilized a number of private and Government studies, including those prepared by the President's Task Force on Communications Policy, the Joint Technical Advisory Committee (JTAC) and contract studies performed for the Commission by the Stanford Research Institute (SRI). All the studies emphasized a regional management concept.

The Commission proposed an initial frequency pooling plan for the Chicago District that would divide land mobile frequencies into two categories. Category I would consist of the spectrum space allocated to the Police and Fire Radio Services; Category II would consist of the other land mobile services, Public Safety, Industrial, Land Transportation, Broadcast Remote Pickup, Domestic Public Land Mobile and Citizens Radio. Part of the spectrum would be maintained as a frequency reservoir for the District.

If the regional management concept is to be applied to all metropolitan areas where there are or will be land mobile frequency problems, the Commission said, ten to 12 regional centers may ultimately be required. It stated that the ultimate number of centers can best be projected after further experience.

To facilitate establishment of a nationwide data base, the Commission also proposed that all Industrial, Public Safety and Land Transportation applicants for land mobile facilities using frequencies in the band 470-512 MHz, shared with UHF TV in the top ten urbanized areas, be required to use the new form beginning on July 1, 1971 or whenever frequencies in this band are made available as a result of the further proceedings in Docket 18261. (See Notice of Further Proposed Rule Making, FCC 71-93, released January 28, 1971.) No change in the fee structure or the five-year license term is being proposed at this time for persons operating on these frequencies outside the Chicago Region.

Interested parties were invited to submit comments on Commission proposals by April 16, 1971, and reply comments by April 30, 1971.

March, 1971

TELEVISION

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- AUTOMATION SYSTEMS
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BY

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FEATURING:
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P/V KEY BUS
32 WIPES
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SWITCHER
- THE VSP-830 MASTER
CONTROL SWITCHER
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AT BOOTH 103

(VSP-860 AT PHILIPS BOOTH 327)



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RECORTEC VIDEO TAPE EVALUATOR



- Display total number of edge damages.
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Longitudinal testing of video tapes at high speed makes it possible to evaluate and rewind a one-hour reel in 10 minutes. Tape edge damage which can cause control signal variations and audio drop-outs is readily identified. Detected video dropouts exhibit excellent correlation with results obtained by evaluating the same tape on a VTR.

If your operation requires testing of tapes, this equipment will quickly pay for itself by keeping your valuable VTR for more productive applications. Additional savings can be obtained by rehabilitating tapes and reducing VTR head wear.

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RECORTEC, INC.

160 East Dana St., Mountain View, California 94040

bookreview

Circuit Casebook

Circuit Consultant's Casebook (TAB Book No. 288) has been written for the circuit designer who encounters difficulties either in conceiving a suitable circuit configuration to meet a required specification or in obtaining optimum performance from a newly designed circuit.

The author, T. K. Hemingway, gives a wide range of practical examples of things that occur frequently, ranging from beginner's mistakes to those pitfalls into which even the best designer occasionally tumbles. It is a practical guide of value to anyone involved in circuit design work, from theory to actual breadboard performance.

Part 1 is devoted to the discussion of basic problems, including common errors and their correction. Among the subjects dealt with are: DC conditions, protection, microcircuit usage, dynamic effects, system defects, and errors in testing.

Part 2 discusses ways of meeting specification requirements not readily achieved by standard circuits. In certain cases a simple modification to a standard circuit configuration is shown to be sufficient; in others a novel approach is given.

Some of the standard circuits for which modified versions are provided include multivibrators, Schmitt triggers, and time interval circuits. Special designs included are meter-driving circuits and precise constant current sources. The text is mostly non-mathematical and can be followed by anyone who has a basic knowledge of circuit design technique.

The 224-page book contains 17 chapters plus bibliography and index, and 114 illustrations.

The book is available through TAB BOOKS, Blue Ridge Summit, Pa. 17214.

Integrated Circuits

The ABC's of Integrated Circuits is the ideal book for getting acquainted with the newest member of the semiconductor family, the integrated circuit, or IC. The author, Rufus P. Turner, has written this book to serve as an elementary introduction to the IC, its construction, behavior, and uses. Theory and mathematics have been purposely kept at a minimum; instead, the approach is descriptive and practical.

The fundamentals of integrated circuits are discussed in the first chapter. This includes such topics as amplification, gain, input impedance, frequency response, noise figure, power output, supply current, supply voltage, and temperature effects. Remaining chapters cover IC applications in amplifiers, oscillators, control circuits, communications, and test instruments. The final chapter includes a few supplementary applications of a mathematical nature, such as integrators, adders, and subtractors.

This book is available through The BOBBS-MERRILL CO., INC., 4300 W. 62nd St., Indianapolis, Ind. 46206.

Instructional TV

Classroom Television explores the strange part of television at the hands of broadcasters, educators, foundation and government officials and publicists. George N. Gordon concludes that while broadcast Instructional TV faces a dubious future, increasing use of videotape, pre-recorded and inexpensively produced local TV lessons should become indispensable teaching tools during the next twenty-five years, and will substantially affect the nature and quality of most of our schools tomorrow.

Dr. Gordon discusses realistically the equipment, uses and limitations of Instructional TV on all levels of education, accenting the practical ways that TV may be employed to improve instruction and learning as well as raise the productivity of skilled teachers.

Neither dry nor academic in approach, **Classroom Television** analyzes TV's poor start in the educational world and brings to the subject of ITV a fresh approach. The book demonstrates that in spite of its record to date, classroom video is one of the most challenging frontiers in today's educational world.

This book is available through Communication Arts Books, HASTINGS HOUSE PUBLISHERS, INC., 10 E. 40th Street, New York, N.Y. 10016.

Special Effects

The Technique of Special Effects Cinematography is a book all who will strive for creative methods should read. This is not another wild idea book. It is a practical guide, showing equipment, examples and staging, with a thorough discussion of why each approach should be considered.

The book includes examples of effects from original sources, as well as showing how to detail such scenes as miniature backdrops.

This text is recommended by BE as standard on lab processes, in-the-camera effects, and a combination of both. It should be of infinite interest to the low budget producer. It is 398 pages, and all make for interesting reading.

This book is available through Communication Arts Books, HASTINGS HOUSE PUBLISHERS, INC., 10 East 40th Street, New York, N.Y. 10016.

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DIGITAL CLOCK DRIVER

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Cooke Engineering — well known for "Quality In Communications" now introduces a new line of time distribution products for the Broadcast Industry:

728 - Program Timer — A must for any production facility. — Instant and accurate determination of time segments — Plus-or-Minus minutes/seconds read on legible Nixie Tubes — Timing count may be preset and held or started at any time — Minimizes "False Starts."

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Logging For CATV

Rules requiring standardized program logging of CATV cablecast programming have been proposed by the Commission. The proposed rule making, which is part of a broad rule making and inquiry into CATV (Docket 18397), would amend Subpart K of Part 74 of the Commission's Rules. They are intended to insure a uniform basis for maintaining cablecast programming data required by the revised annual CATV report (FCC Form 325) and to simplify the gathering of this information.

Under the proposal, the program log would be kept by a representative of the CATV system who would sign the log when starting duty and again when going off duty. The log would be retained for two years.

Entries, to be made at the time of the cablecast, would include the time each program begins and ends. Programs would be classified as to type and source. The logs would identify the channel lessee and show the name and political affiliation of any political candidate. If the CATV system used a program furnished by a CATV network, the network would supply the CATV system with all information needed for the program log.

For commercial matter, the entry would identify the sponsor or sponsors of a program and would state who paid for the announcement or furnished materials or services for the programming. The entry would also show the total duration of the commercials in each hourly time segment with as close as approximation of time consumed as possible.

Where public service announcements are cablecast, the log would list the name or interest of the organization involved. (A public service announcement is one which promotes programs, activities, or services of Federal, state, or local governments, programs, activities or services of nonprofit organizations, and other community interests.)

If automatic logging is to be used, the CATV system would have to submit a certificate attesting to the accuracy of the log. Information which cannot be incorporated in the automatic process would have to be maintained separately and similarly authenticated. The CATV system would be required to extract any information in the recordings requested by the Commission or its representative and submit it in written log form along with the automated records.

KPFT Bombs On

Pacifica Foundation, Inc., licensee of FM station KPFT, Houston, Texas, a station that has been forced off the air twice by bombings, has been granted temporary emergency authorization by the Commission, through April 13, 1971, to build and operate its station at a newly proposed site.

In asking for temporary emergency authorization, Pacifica stated that KPFT(FM) was bombed on May 12 and October 6, 1970. After the first bombing, the station was able to resume operation at the same site on June 1, 1970, but after the second bombing, the station remained off the air and was forced to seek a new site.

THE DELTA TRIO

for optimum
monitoring
of your
antenna
system



1 Model OIB-1 Operating Impedance Bridge measures "in circuit" impedance of networks, transmission lines and antennas. Accuracy $\pm 5\% \pm 1 \text{ Ohm}$. 5 kW Power rating-VSWR 3:1.



2 Model CPB-1 Common Point Bridge measures resistance to $\pm 2\% \pm 1 \text{ Ohm}$ and reactance to $\pm 5\% \pm 1 \text{ Ohm}$ at full power.



3 Model RG-1 Receiver/Generator combines a high output power signal generator with a shielded receiver for use with Model OIB-1 or any other impedance bridge.

With this "Delta Trio", you can either "spot check", or continuously and accurately monitor actual "on-the-air" operating impedance of transmission lines, networks and antenna systems to maintain a "clean signal" at peak operating efficiency.

If you're operating with a directional antenna, there's real value in being able to keep the radiating system in close adjustment at all times...continuously verify common point impedance to insure full power output...plus locating and correcting any antenna problems—fast!

Complete details and application data are available without obligation—just write or call Bill Cottles, DELTA ELECTRONICS, INC., 4206 Wheeler Avenue, Alexandria, Va. 22304 (703) 751-3133.

DELTA ELECTRONICS



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13 E. 40th St., New York, N.Y. 10016-Cable "ARLAB".

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

99. ASM Corporation—ASM has a new catalog that features comprehensive coverage of explosion proof rotary switches designed specifically to MIL-S-3786, type SR04. The catalog contains fold-out Switch Selector Chart, detailed descriptions, enlargements of functioning parts, simplified identification code and 63 pages of switch information.

100. AMPEX CORPORATION—A new catalog containing descriptions and specifications of the complete line of Ampex professional audio products is now available. Ampex professional audio recorders, duplicators, amplifiers, mixers, magnetic tape and accessories are used in broadcast stations and master recording studios and by serious hi-fidelity listeners.

101. BIRD ELECTRONIC CORPORATION—A new 48-page RF Instruments catalog of coax load resistors and attenuators, absorption wattmeters, Thruline® directional peak and average wattmeters, RF Filters and Power Sensors is now available. This comprehensive reference of RF measurement instrumentation from 25 milliwatts to 250 kilowatts in the frequency range of 0.45 to 2300 MHz features over fifty new listings. In addition to convenient order forms for stock instruments, GC-71 includes scope patterns and frequency spectra of CW, AM, SSB, TV and pulsed RF transmissions, comparing peak envelope power and average heating power, as well as other tables and graphs useful in RF power measurement.

102. CHIRON TELESYSTEMS—A two-page data specification sheet describing Chiron Telesystems Videograph Model 9901 Character Generator is now available. Options include roll/crawl, edging, word-by-word color, automatic centering and others. The Model 9901 is used in conjunction with the Chiron Vidi-loop Title Storage System.

103. COHU ELECTRONICS, INC.—How an observatory ex-

pands the viewing of its celestial shows is detailed in a four-page technical application bulletin (8-96) now available. Included are eight photographs and a block diagram showing how a television camera is connected to the Palmer Observatory telescope at Santa Barbara, California.

104. COLUMBIA ELECTRONIC CABLES—A 20-page illustrated catalog condenses in tabular form full information about the company's line of hook-up and lead wire for internal wiring of electronic and electrical equipment and appliances. The brochure graphically illustrates UL and military type wires, both Teflon™ and plastic insulated. For quick reference, conductor sizes, conductor stranding, insulation types and thicknesses, voltage and temperature ratings, applications and similar data are listed by type designations. Condensed specifications detail resistance of various wires to aggressive environments. For reader convenience, the new catalog, designated No. CEC-HU-770, contains both a table of contents by types and a numerical index by catalog numbers.

105. COMPONENTS SPECIALTIES, INC.—The 32-page, 1971 SPECO Sound Products Catalog containing 180 items related to the Electronics and Sound Industries is now available. Namely, Speakers from 1" to 15", Speaker Enclosures, Speaker Systems, Trumpet and Reflex Horns, Mobile Amplifier, Commercial Amplifier, Automobile Speakers, and Audio Accessories.

106. THE DENSON ELECTRONICS CORPORATION—A new 143-page catalog showing new and used TV cameras and associated equipment for broadcast, closed circuit TV, audio and video systems is now available. Also included is technical information and references which can be helpful.

107. FAIRCHILD SEMICONDUCTOR—Fairchild Semiconductor's complete TTL line is described in a new 112-page color brochure

that contains specifications for more than 150 circuit functions—The brochure, "Fairchild TTL Family", includes design information about logic, memory and interface circuits in standard, low power and high speed ranges. In addition to simple TTL devices (SSI), it includes more than 75 proprietary and widely accepted second source MSI devices offered by Fairchild. Both currently available devices and those scheduled for future introduction are described. The section on custom devices includes a description of Fairchild's TTL/ Micromosaic capability, which provides low-cost, fast turn-around custom circuits through computer aided design.

108. GENERAL AUTOMATION, INC.—A newly revised 24-page brochure describing General

(Continued on page 104)

CCA

TRUE CIRCULAR FM ANTENNAS



MODEL FMC

CCA offers its 2nd generation design — model FMC — with increased power rating, corona free construction, and identical phase centers for horizontal and vertical components!!

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(Continued from page 103)

Automation's SPC-16 Automation Computer is now available. This low-cost, high performance computer is designed for automation projects in industrial applications, such as manufacturing, process control, data acquisition, laboratory and instrumentation, and communications. The two-color fully-illustrated brochure provides up-to-date information and specifications on the SPC-16 Computer, including available software support, interface units, and compatible peripherals. A listing of computer applications, office locations, and a brief description of the company is also included.

109. HEATH COMPANY—Heath Company has its 1971 Heath-kit catalog ready for mailing. The catalog includes several new units in their test equipment, ham radio, and TV receiver lines. Includes several kits with all solid state circuitry.

110. HEWLETT PACKARD—Application Note 126, "Theory and Applications of Wave Analyzers", is now available. This 14-page application note will help those who must measure signals that range

widely in level and frequency, and that must be measured in the presence of other signals. It discusses wave analysis and spectrum analysis, and the differences in the methods used in the two techniques. Sections of the applications note include discussions of time domain versus frequency domain, important definitions, and a section on applications.

111. LENKURT ELECTRIC—A 12-page brochure describing the type 26C Data Set is now available. Extreme accuracy and efficiency keynote the design of the 26C, a data communications set which processes serial digital data at speeds of 150, 300, 600, 1200 and 2400 bits per second over a standard voice-grade telephone circuit.

112. LIBERTY INDUSTRIES, INC.—A new data sheet describing Liberty's Isolair Unit for VTR equipment is now available. The Isolair unit requires no additional floor space, requires little maintenance, meets Federal Standard 209a, Class 100, and the high efficiency of the unit eliminates the need for any other dust control equipment.

113. NATIONAL SEMICONDUCTOR—A TTL and low power TTL guide is now available from National Semiconductor. The guide provides pin connection diagrams for every National TTL device, including National proprietary units, second source 7400 TTL, and flat pack and dip low power TTL.

114. OHMITE MANUFACTURING COMPANY—The electrical industry's most up-to-date guide to close control rheostat selection and availability has been published by Ohmite. The 40-page publication uses photographs and line drawings along with electrical characteristics and mechanical specifications to describe the technical benefits of Ohmite rheostats. The widely used all-porcelain vitreous-enameled close control rheostats come in 12 sizes ranging from 7.5 watts to 1000 watts, in 14 models. A step-by-step rheostat selection guide in the catalog discusses determining resistance and watts, power rating or physical size of rheostat, factors affecting temperature rise, and selecting the rheostat model and mechanical features.

115. PHELPS DODGE COMMUNICATIONS CO.—A new bul-

the new mcmartin consoles



The new 8-mixer McMartin consoles feature outstanding flexibility, ease of operation and clean-cut styling. All modules are plug-in. Up to 27 inputs may be accommodated. Highest quality components, including maintainable step-type attenuators, are used.

Typical program circuit program specifications are: ± 0.5 dB frequency response; distortion of 0.5%, 20 to 20,000 Hz; and signal-to-noise ratio of 74 dB for all models. Full cue, intercom and monitor facilities are standard.

Mono, stereo or dual channel models are available. The new McMartin B-800 series consoles deliver performance, operating flexibility and are priced right.

MONAURAL	
B-801.....	\$2,350.
STEREO	
B-802.....	\$3,200.
DUAL CHANNEL	
B-803.....	\$2,650.

For details, contact:
Broadcast Product Manager

McMartin
mcmartin industries, inc.
605 north thirteenth street
omaha, nebraska 68102

Circle Number 78 on Reader Reply Card

letin describing Cuflex, a new copper corrugated Foamflex coaxial cable is now available. The four-page catalog describes the new coaxial cable and includes electrical and mechanical data and shipping information on all available sizes. Also covered are connectors specially designed for Cuflex™ plus accessories including cable grips, guide ring hangers, splice protection kits, grounding kits, and strapping. Curves indicating attenuation versus frequency and average power rating in air at 40° also are included.

116. PICKERING AND COMPANY, INC.—Pickering and Company, Inc., has recently revised informative literature designed to assist the hi-fi enthusiast in selecting the proper cartridge for his playback equipment. General Product, four-page brochure, which includes product specifications and data on Pickering's complete line of XV-15 and V-15/3 Series of magnetic cartridges and replacement styli, plus a new addition to the line, the V-15/PHASE IV Series Cartridges and Styli. Bach, Berlin and Beatles is a fold-out, color brochure which illustrates Pickering's exclusive Dynamic Coupling Factor (DCF) concept . . . a professional analysis which rates the XV-16/Series of Magnetic Cartridges and Styli to the type of playback equipment used. DCF Chart (Dynamic Coupling Factor) is a guide which helps the stereo enthusiast to choose the right model SV-15/DCF-Rated Magnetic Cartridge for his particular playback equipment.

117. PREFORMED LINE PRODUCTS COMPANY—Fast, easy installation, permanent sealing and positive protection are among the many benefits of Re-Enterable Stainless Steel Splice Cases described in the latest trade literature published by Preformed Line Products Co. Used on aerial, direct buried and manhole systems, these splice cases permanently enclose splices in lead-jacketed or plastic-jacketed cables, both single and double-sheathed, and permit quick re-entry when desired. The cases can be used on pressurized or non-pressurized systems and are split to permit use on either cut cables or through cables.

118. PRINCEON APPLIED RESEARCH CORP.—A fast, accu-

rate and reliable method for measuring chopping frequency responses in photomultipliers and photodiodes is explained in a new application note. Application Note T-241 describes the use of a new frequency-tracking phase-sensitive detector/light chopper system which: Automatically sweeps the frequency range of interest; permits checking photodetector response to signal currents that are buried in noise from the detector under test; provides accurate result repeatability due to the system's low drift; and provides automatic plotting of results.

119. RCA—Solid State Division. "MOS FET Product Guide" describes RCA's line of MOS insulated-gate field-effect transistors. Included in this new publication are comprehensive data on single-, dual-, and dual-gate-protected MOS FETs, typical circuits utilizing these devices, and background information on MOS construction and application. MOS-160C supersedes the MOS-160B, and has been completely revised and updated to reflect the latest information on RCA's current line of MOS FETs.

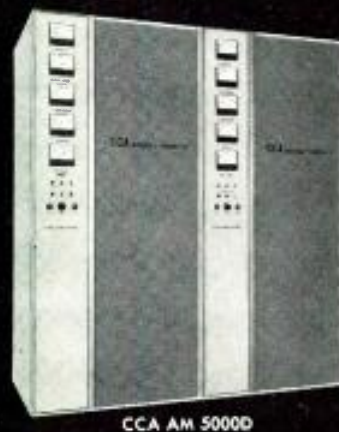
120. RF SYSTEMS, INC.—A new bulletin describing translator antennas for both UHF and VHF transmission is now available. Using Zig Zag elements, the antennas can be tailored to fit any broadcasting pattern. UHF and VHF standard models are described separately. Both are complete with integrated support structures for top mounting on towers or buildings. Electrical and mechanical features are described.

121. ROTRON INCORPORATED—A new 32-page Quick Reference Catalog containing useful information on the selection of fans

and blowers, as well as descriptions on Rotron air moving devices within the categories of: Propeller, Tubaxial and Vaneaxial fans, Squirrel Cage Centrifugal, Centriaxial, High Pressure/Vacuum, Spiral and Panel blowers, and their applicable accessories is now available. Sections are color-coded and indexed on the basis of specific speed, to enable the user to determine the most efficient type of air mover for parameters involving airflow, pressure and shaft speed. Device descriptions include static pressure imped-

(Continued on page 106)

An Outstanding 5 KW AM Transmitter...



CCA AM 5000D

For reliability, economy and a high fidelity sound, the CCA AM 5000D is unsurpassed. Contact your CCA representative or, better yet, — ask your "Good Sounding" fellow broadcaster.



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GLOUCESTER CITY, N. J.
(609) 456-1716

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TRANSLATORS

DESIGNERS AND MANUFACTURERS OF VHF, UHF, FM
ALSO REPAIR PARTS AND UP DATING KITS FOR
ALL ADLER AND LITTON TRANSLATORS

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9150-B Brookville Road, Silver Spring, Md. 20910
(301) 588-8836

(Continued from page 105)

ance curves. Also included are dimensioned outline drawings and pertinent electrical and mechanical data.

122. SHARPE AUDIO DIVISION—Scintrex Inc. The complete line of Sharpe Stereophone equipment is attractively displayed in a new four-page, full color brochure. The colorful brochure fully illustrates and provides complete specifications for each of six Sharpe Stereophone models. It also features the new Sharpe "Sterco Central" remote control units which offer independent volume control for both left and right stereophone channels at locations remote from the original sound source. The brochure emphasizes the completeness of the Sharpe Stereophone line, offering designs to fit the most discriminating audiophile and the most disciplined budget. Top-of-the-line models meet the most critical standards of professional sound engineers. Lighter weight, budget priced models in the line bring all the benefits of private stereophone listening to any family

home entertainment center.

123. SONY CORPORATION OF AMERICA—Video Products. A six-page folder describing Sony's new-generation helical scan video tape is now available. Included in the four-color brochure is a pasted-in sample of half-inch-width tape to permit inspection of Sony's proprietary, dull-finish treatment of the polyester backing.

124. SPRAGUE ELECTRIC COMPANY—A series of six Integrated Application Notes are now available. The illustrated Notes include Noise Margin In Series 54H/74H TTL Logic Gates; N-Bit Binary Adder And Subtractor Using US5480 And US7480 Gated Full Adders; Typical Count Configurations Using The US5490 And US7490 Decade Counters; Functional Description Of The US5491 And US7491 Shift Registers; Functional Description Of The US5492 And US7492 Divide-By-Twelve Counters; and Divide By N Ripple Counters Using US5493 And US7493 Binary Counters.

125. STANTON MAGNETICS, INC.—Stanton has recently revised informative literature designed to assist the audiophile in selecting the proper cartridge for his playback equipment. The 16-page General Product booklet details the intended applications and full technical specifications on Stanton's 681 Professional Series and 500 Broadcast Series of Magnetic Cartridges and Replacement Styli. The Stanton Cartridge . . . A Critique By the Experts, is a four-page brochure composed of tests performed and reviews made by audio publications on the Stanton 681 and 500 Series of Magnetic Cartridges.

126. SYLVANIA ELECTRIC PRODUCTS, INC.—Technical information bulletins on three series of copper-base electrical resistance alloys are now available. The bulletins describe low resistance alloys, Cupron alloy, and Manganin alloys. All three are used in application where low to medium resistance is required. They are widely used by the electronic, electrical, communications, and automotive industries.

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Also, the surrounding area in which an Isolair unit is operating benefits by a progressively reduced level of airborne particulate matter.

Chief engineers who have used the Isolair unit have attested to the multiple advantages provided by this low-cost VTR accessory.

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BROADCAST ENGINEERING

The bulletins discuss nominal composition, physical and mechanical properties, and availability.

127. UNITRODE CORPORATION—A new 34-page design guide and short-form catalog describing the Company's line of high reliability rectifiers, zener diodes, microwave diodes, high voltage Doorbell® rectifier modules, Magnum™ high current bridges, bridges and stacks, thyristors (SCRs), Transistors, PUTs, solid state AC switches, and gate turn-off SCRs. Included is a complete listing of JAN and JAN TX rectifiers, zeners, and SCRs. Also included is a listing of popular JEDEC zener types and their Unitrode replacements. This catalog describes, in condensed form, the total product line capability of Unitrode.

128. WESTINGHOUSE ELECTRIC CORP.—A new, 12-page application note comprehensively covers mounting high-power silicon semiconductors. Since present-day semiconductors control large amounts of power, mounting decisions like surface selection and heat sinking are crucial to device performance and reliability. The fully illustrated application note provides

extensive data on this important subject. The new application note first simplifies working with heat flow problems by providing electrical analogs for thermal parameters. The application note then discusses surface requirements including flatness, finish and chemical treatment and cleaning of mounting surfaces. Additional theory sections cover thermal joining compounds and optimum mounting pressures. A table gives mounting pressures by device and package type. The remainder of the text is devoted to detailed descriptions and drawings for mounting all standard power semiconductor configurations including stud-type devices, flat-base devices, and Pow-R-Discs in individual, parallel and stack-mounted configurations. A final discussion summarizes selection of heat sinks by composition and shape.

129. WOLLENSAK, INC.—Electro-Optics capability of Wollensak Inc. in the area of Precision Optical Systems and Electro-Optical Products is explained in the new brochure for the now independent company. Products range from lenses and shutters to com and other special purpose cameras.

SMPTE Technical Conference Set

The 109th Technical Conference and Equipment Exhibit of the Society of Motion Picture and Television Engineers will be held April 25-30 at the Century Plaza Hotel in Los Angeles. Frank P. Clark of the Research Center of the Association of Motion Picture and Television Producers, Hollywood, is Program Chairman.

The Program will be a full and varied one, Clark reports, with sessions in the following topics: Sound Recording and Reproduction, Television Systems, Laboratory Practices, Motion-Picture Systems, Theater Presentation and Projection, and Small-Format Films (8, super 8, 16, super 16, cartridges and cassettes). In each of the sessions a number of papers will be presented covering specialized portions of the topic. Approximately 30% of the papers presented are tutorial in nature dealing with theory, technology and applications.

The Equipment Exhibit, under the Chairmanship of Warren Strang, Hollywood Film Co., Hollywood, will run from Monday afternoon through Thursday evening. Over 90 booths will display the latest in television, motion-picture and laboratory equipment.

As a prelude to the Conference the Association of Cinema Laboratories will meet on Friday and Saturday April 23 and 24. Two special film presentations are planned, **The History of the Wide-Screen Motion Picture** and a Special Showing on Sunday evening, April 25, of **The Andromeda Strain**.

SMPTE Technical Conferences are held twice yearly in major cities in the U.S. and Canada. Scientists, engineers and executives from all over the world in the fields of television, motion pictures and photographic instrumentation participate in the papers presentations, panel discussions and social activities.

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General Electric Will Offer New CATV Service Concept

A new system concept for extending the range of services offered by the CATV industry through two-way cable communication has been developed by **General Electric's** Research and Development Center. Called the "Extended Services Concept", it will provide a means for cable subscribers to respond to the cable system information or to other equipment operating on the system.

Shopping at home could become a reality through direct two-way communication allowing the purchaser to see the merchandise on the home screen and place the order immediately. The same type of arrangement could be employed by brokerage houses or banks to service their customers.

Due to a once-a-second sampling of all subscribers, other avenues of service are also possible. Such opportunities include services for utilities, fire alarm and intrusion protec-

tion, market research and television viewer polls. In addition, community and educational service communications can be provided by this new concept.

Present coaxial cable systems typically utilize a band-width of 95 MHz out of a possible 300 MHz. The GE extended services concept will be a wide-band communications system employing 275 MHz. Two-way communication will be made possible through the use of a dual network amplifier enabling wide-band gain in both directions.

Up to 10,000 subscribers can be sampled once each second by a data control unit located at a central message center. All information is held until keyed by the message center impulse and then transmitted.

Cable subscribers will communicate by using a unit similar to a Touch-Tone telephone control pad or a small teleprinter. Data and image displays will be provided in a standard home television set.

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FCC Approval For CBS Coded Signal

The Columbia Broadcasting System, Inc. (CBS), has been authorized by the FCC to use, on a continuing basis for TV network purposes, a visual signal to appear as a rectangular white block occupying the last ten microseconds of lines 21 through 23 in both fields of the transmitted picture.

For each use CBS said the transmission time of the flashing signal would be about 7 seconds, and should not exceed two or three minutes in a single day.

The Commission said the authorization would be subject to review and possible withdrawal if developments made such action advisable. It pointed out that its main concern is to insure that extraneous matter is not included in a broadcast signal in such a way as to degrade service to the public.

CATV Convention

The annual spring meeting of the Pennsylvania Community Antenna Television Association will be held

on May 4, 5 and 6 in Philadelphia at The Marriott, according to John Rigas, president of the Association.

Program highlights will be announced at a later date.

Notices For CATV Now Available

The cablecasting requirement is part of a set of program origination rules adopted by the FCC in 1969 and 1970. Other cablecasting rules, which are already in effect, concern: cablecasts by candidates for public office; cablecasts involving the Fairness Doctrine, personal attacks, or political editorials; advertising in conjunction with cablecasts; sponsorship identification; cablecasting of lottery information or advertisements; and cablecasting involving per-program or per-channel charges. The CATV annual fee (30 cents per subscriber) is part of the Commission's revised fee schedule adopted in July 1970.

The Commission's Rules make carriage of any television broadcast stations by a CATV system which is cablecasting (either voluntarily or pursuant to the 3500-subscriber requirement) conditional on the sys-

tem's compliance with all of the cablecasting rules. In this connection, three Commission Public Notices, which are largely applicable to CATV, are available from the Cable Television Bureau: "Use of Broadcast Facilities by Candidates of Public Importance" (Public Notice of August 7, 1970); "Applicability of the Fairness Doctrine in the Handling of Controversial Issues of Public Importance" (Public Notice of July 1, 1964); and "Applicability of Sponsorship Identification Rules" (Public Notice of May 6, 1963).

The FCC address is 1919 M Street, N.W., Washington, D.C. 20554.

NAB Exhibitors

The National Association of Broadcasters said that 124 NAB associate members will exhibit their products during the Association's 49th Annual Convention in Chicago, March 28-31.

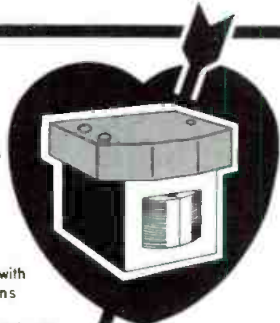
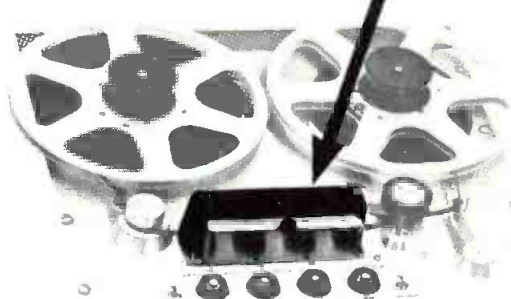
Everett E. Revercomb, NAB's secretary-treasurer and convention manager, announced that the Broadcast equipment exhibition will require several exhibit halls at the Conrad Hilton Hotel.

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Wanted: Gates FM-11 Antenna or dual ring for 90.5 mhz. KWCW, Walla Walla, Wash. 99362. 3-71-1t

WANTED: Spare cavities for RCA TTU-1B television transmitter. We need doubler, I.P.A. and final cavities. Contact: David Layne, Chief Engineer, P. O. Box 3689, Modesto, California 95352. 3-71-2t

Equipment for Sale

RCA Transmitter Type TT-5, water-cooled —(Ch. 2) used as a spare at the above location until October 1, 1969. Equipment still installed; to be sold as is. Buyer to remove. \$5,000. L. A. Pierce, 630 N. McClurg Court, Chicago, Illinois 60611. (12) WH 4-6000. 1-71-tf

FOR SALE: TK-26B color film chain less projectors and multiplexer. FOB plus crate and shipping. Broadcast Engineering, Dept. 250, 1014 Wyandotte St., Kansas City, Mo. 64105. 3-71-2t

FOR SALE: Palmer 16MM B/W Kinescope system model VFR-2S. FOB plus crate and ship. Broadcasting Engineering, Dept. 251, 1014 Wyandotte St., Kansas City, Mo. 64105. 3-71-2t

FOR SALE: AMPEX VR-7800-16 color helical recorder with processor. FOB plus crate and ship. Broadcast Engineering, Dept. 252, 1014 Wyandotte St., Kansas City, Missouri 64105. 3-71-2t

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Equipment for Sale (Cont.)

GROUND SYSTEM COPPER: 600 pound reel of no. 10 bare solid copper, as packed by the manufacturer. \$800. Contact Greg Zaker at WIXZ, McKeesport, Pa. 15132, 412-678-8888. 3-71-2t

One KW 20V Collins Transmitter in A-1 condition. Anyone interested contact Radio Station WPRT in care of D. C. Stephens. Prestonsburg, Kentucky 41653. 3-71-1t

CARTRIDGE TAPE EQUIPMENT—Completely reconditioned Spotmaster and Tapecaster Record/Playbacks. \$375.00. Playbacks \$250.00. 30-day money-back guarantee on all equipment. BROADCAST PRODUCTS CO., INC. 12330 Wilkins Avenue, Rockville, Maryland 20852. Ph: 301-933-3400. 10-69-tf

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Bargain—General Electric Pyranol capacitors. 25 mfd. 6250 volts. 18 inches by 17 inches by 5 inches. Weigh 65 lbs. \$20 F.O.B. William Ackard, 729 E. 17th Ave., Denver, Colo. 80203. 1-71-3t

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1 TV19B Video mixing amplifier 50.00
1 TV 51B sync mixing amplifier 50.00
2 TV 17B video DA and power supply each 150.00
1 Zoomar lens 10:1 50mm-175mm 895.00
1 Eastman 275 movie projector 3000.00
1 Ampex VR1000B tape recorder with 3 Mark III heads 4500.00
Contact: Chief Engineer, WXXI-Channel 21, 410 Alexander Street, Rochester, New York 14607. 3-71-2t

Excellent buy in new General Radio AM frequency monitor, also good reconditioned Gates and G. R. monitors, on your frequency. Will consider monitor trade-in. Eidson Electronic Co., Box 96, Temple Texas 76501. phone 817-773-3901. 3-71-2t

Prodelin No. 122-845 6 1/8" line breakaway ass'y \$225.00. ea. Andrew No. 23187 adaptor section w/O ring and hardware \$10.00 ea. Bird No. 46100 line section 60KW. 50 ohm. with 2 - 30 MC elements \$100.00 ea. All items are unused. A.R.C. Sales, 181 E. Wilson Bridge Rd., Worthington, Ohio 43085. 2-71-2t

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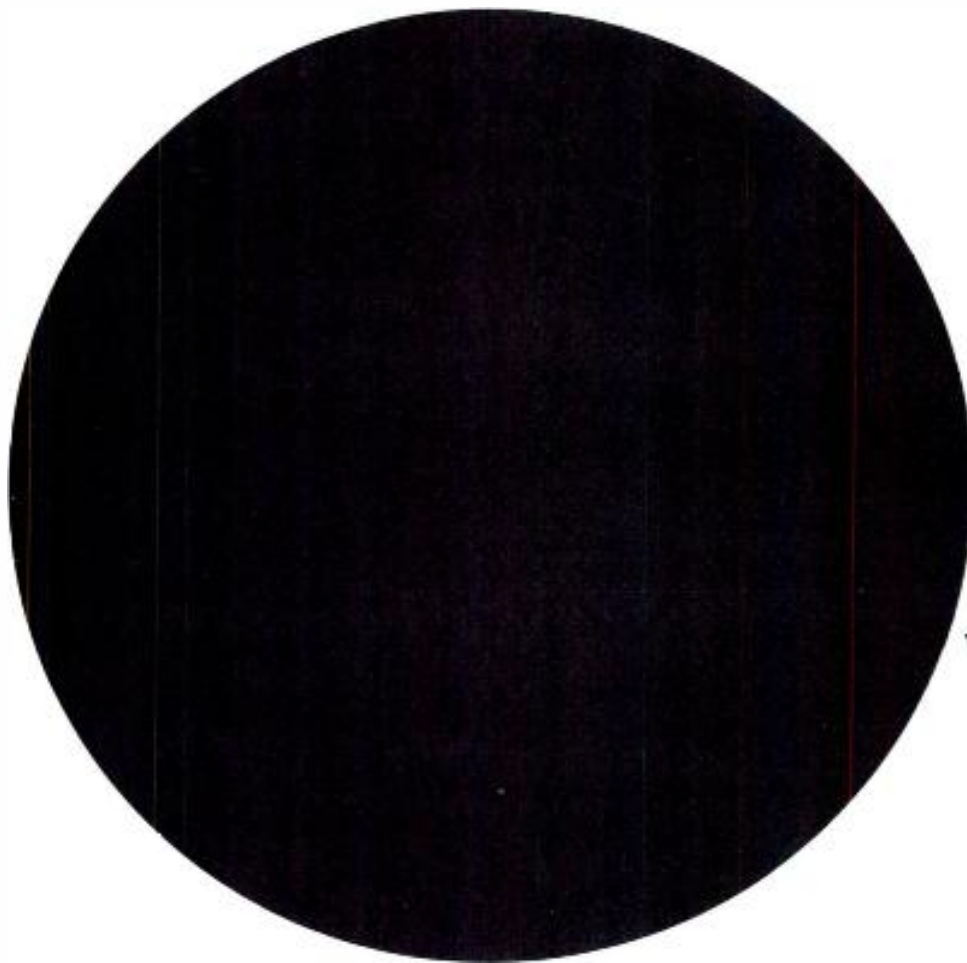
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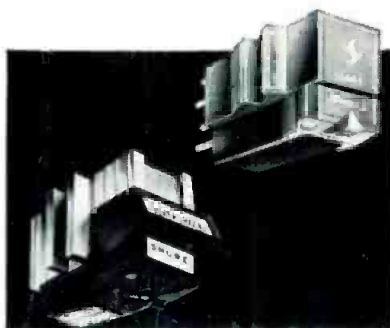
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 WSDO Portraits in Southe
 Russell Oberlin and
 tenor
 10:15 Musical Round
 Moussorgsky: Picture
 Exhibition (34)
 REFLECTIONS
 WTBT ● Feat Ramsey Leader
 WVFM ●

11:00 P.M.

WSDO Evening Concert
 Haydn: Symphony #23
 Delius: Hassan (29)
 WTBT ● Stereo Tips and Bits of
 WUSC ROCK CLASSICS

Just for the record...



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