April, 1971/75 cents

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the technical journal of the broadcast-communications industry

A HOWARD W. SAMS PUBLICATION

WWJ mobile color coverage

page 24

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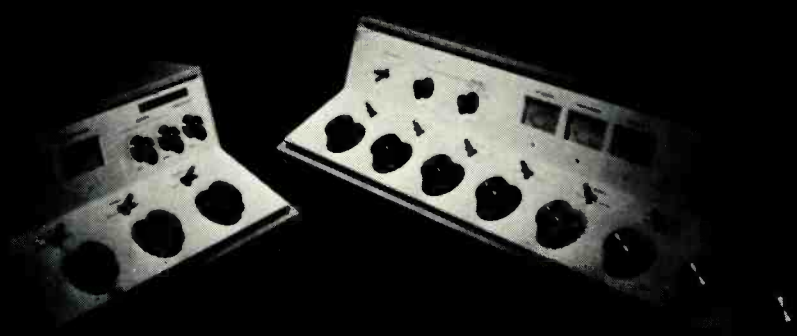

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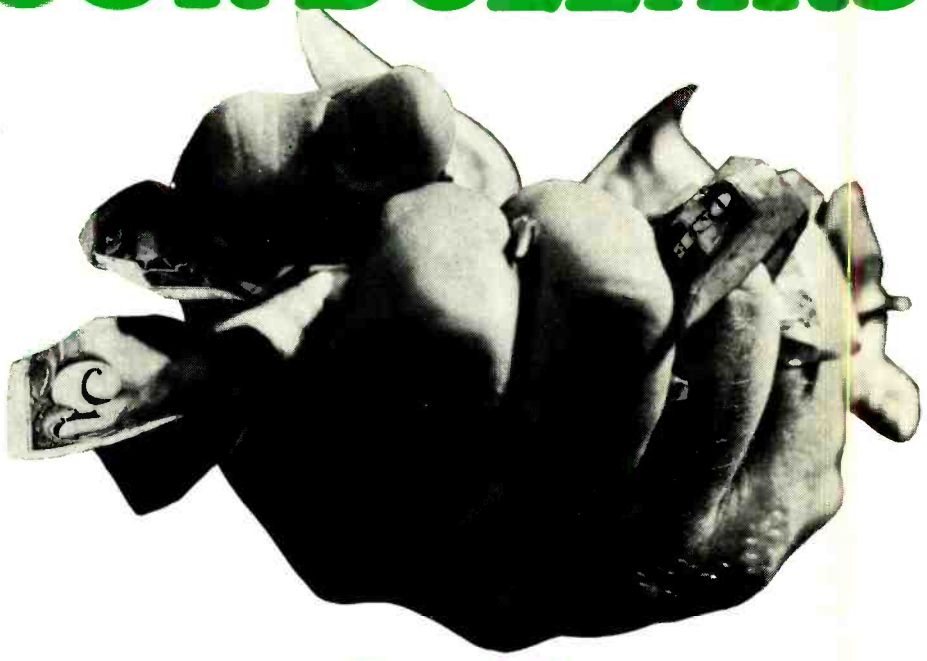

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Circle Number 4 on Reader Reply Card

April, 1971 ■ Volume 13, No. 4

Broadcast Engineering

The technical journal of the broadcast-communications industry

in this issue...

ABOUT THE COVER

Our cover this month was supplied by the staff at WWJ-TV, Detroit. The station, through locally originated and mobile color, has added flexibility that serves the viewer and the advertiser. See article on page 24.

DEPARTMENTS

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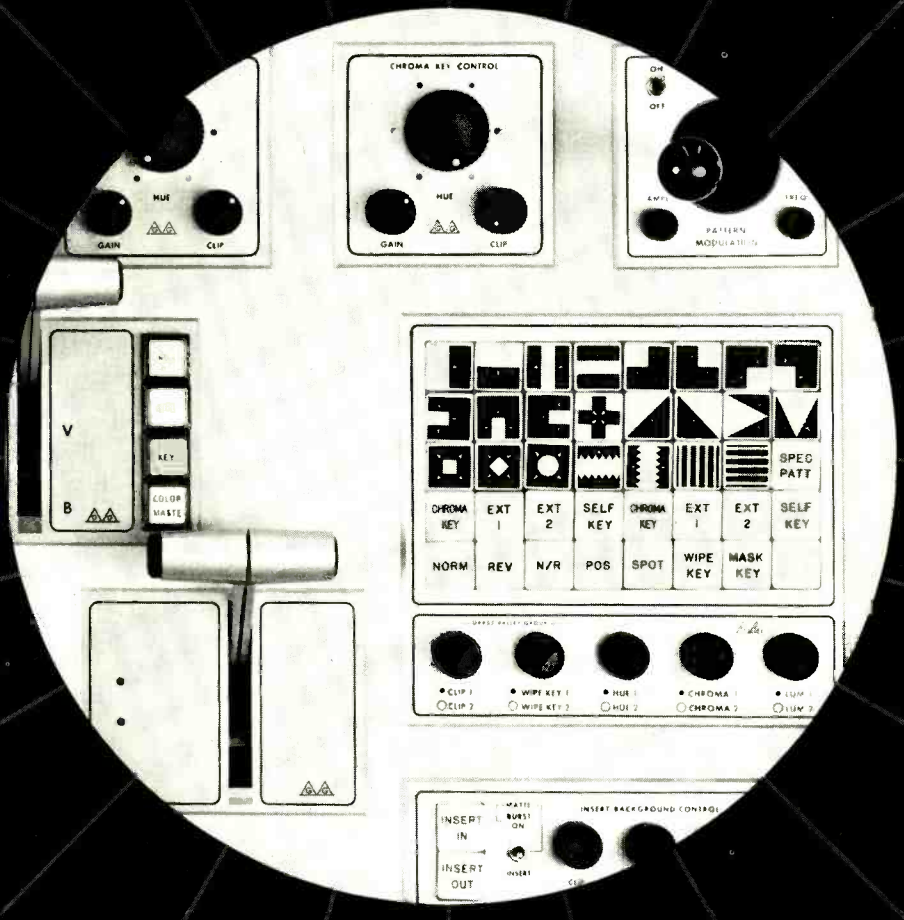

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Circle Number 5 on Reader Reply Card

DIRECT CURRENT FROM D. C.

April, 1971

Howard T. Head

More VHF in TV's Future?

The approach of Canada's Department of Communications (DOC) to television channel allocations departs radically from that of the FCC. DOC Broadcast Procedure #5, Canada's TV Technical Regulations, employs a protected contour concept and avoids reliance on fixed mileage separations as is done in the U.S. As a consequence, there are numerous low-power VHF television stations in Canada (over 65 near the U.S. border alone) which would not meet the U.S. minimum mileage separation standards.

The Commission's staff is quietly studying Canadian experience with low-power VHF operation. At one time, the Commission had proposed comparable operation on Chs. 70-83, but this portion of the UHF band has been reallocated to the land mobile services.

It's too early to tell what course these staff studies may take, but the Commission is known to be exploring all avenues--cable, translators, low-power operation, and UHF stations--to increase the availability of local television service to individual communities.

Excessive FM Subcarrier Levels Cause Problems

Recent studies have traced many reports of FM signal dropouts and "picket fence" effects to the presence of excessively high levels of stereo and SCA subcarrier signals. Apparently these high levels of subcarrier cause cancellation or reduction of the subcarrier sideband in the presence of reflections from terrain and other objects.

The Commission's Technical Regulations require that the modulation of the 19 kHz FM stereo pilot subcarrier be maintained between levels of 8 percent and 10 percent, and in the case of SCA operation that the arithmetic sum of the modulation of the main carrier by the SCA subcarriers not exceed 10 percent. Several stations have been found to be operating with levels in excess of those permitted.

It is believed that some FM stations are deliberately exceeding permissible subcarrier levels in order to assure de-activation of the "stereo-killer" circuits in some FM receivers. However, this is not only a violation of the FCC Technical Standards but also can lead to reception problems.

(Continued on page 6)

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(Continued from page 4)

Chicago Regional Spectrum Management Center Planned For Mid-1972

The Commission is moving forward with plans to open its first prototype Regional Management Center in Chicago by the middle of 1972. Such a center was recommended to the Commission by studies of land mobile operation undertaken by the Stanford Research Institute (SRI) (see Jan., 1970 D.C.). The Chicago region will include an area of approximately 96,000 square miles covering parts of Illinois, Indiana, Iowa, Michigan, Ohio, and Wisconsin. Highly automated monitoring equipment will be employed to determine actual frequency usage within the region, and the results of this monitoring will be employed to improve the efficiency of use of the spectrum.

All mobile licensees, including broadcast auxiliary operation such as remote pickup stations in the region, will be handled by the Chicago center. All licensees will be required to file a new license renewal application during the period between July 1, 1971 and June 30, 1972. A new "computer-oriented" application form has been devised for the new licensing system.

Changes Due in EBS

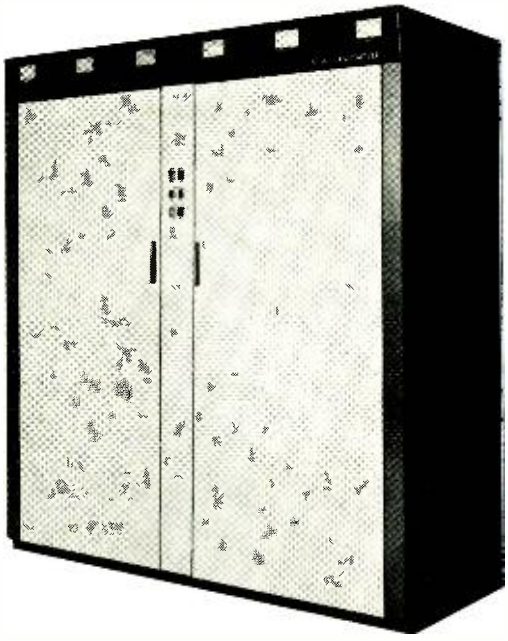
In the wake of the NORAD incident on the morning of February 20, 1971, in which the text of an actual emergency alert was transmitted over the EBS system rather than the customary test message, the Commission is investigating the failure of most radio and television stations to respond to the alert message. This incident emphasizes the imperative necessity of establishing a system less subject to human fallibility that the present system.

We make no claim to clairvoyance, but several readers have called our attention to our last item in "Short Circuits" for D.C. for February, 1971.

Short Circuits

An increasing number of television stations are employing precise carrier frequency control, claiming a worthwhile reduction in co-channel interference . . . The Commission has proposed additional spectrum space for broadcast auxiliary operation in the 2150-2160 MHz band and has invited comments on more efficient utilization of the 947-952 MHz aural STL band . . . The Commission has instructed translator licensees to account for all periods of "down time" . . . FM and TV main studio location requirements have been amended to require specific Commission authorization for main studio relocation to points outside the community of license; an exception is FM studio relocation at the AM site . . . An increasing number of reports are being received of audio buzz in television receivers when VIT signals are present; we would appreciate reports from readers.

For quality in AM transmitters... look and listen to Gates



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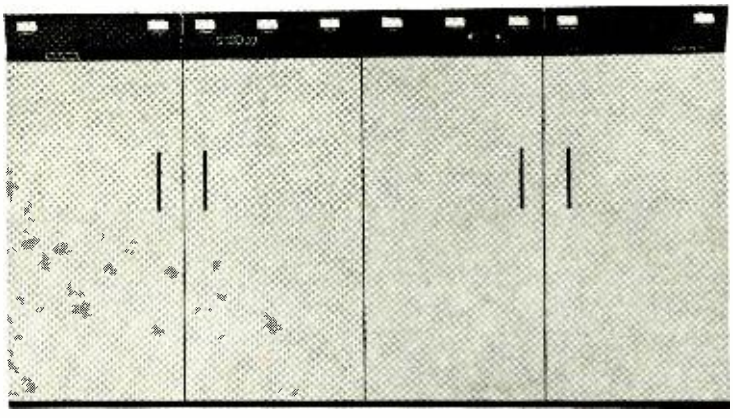

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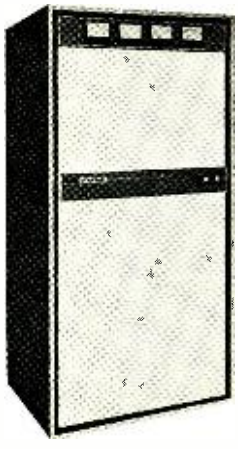

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Circle Number 7 on Reader Reply Card

LETTERS TO THE EDITOR

Pirate's Revenge

Closing The Big Gap

Dear Editor:

Reading Mr. Sprague's letter to the editor (Feb. BE, Pirating Technicians), I can only assume that he lost a highly valued employee to an educational broadcast station, which created a need in his mind to take vengeance on all educational television stations, whatever, his reasons, I suggest he do a little research.

As I know it, educational television either is supported by private contributions or is a part of a governmental agency. In the first instance, some have been supported so lavishly that they have had to discontinue operations; other more fortunate stations operate on a 'hand to mouth' basis. Regarding ETV supported by governmental agencies, the wages are rigidly controlled by that agency, and are commensurate with the prevailing wage in that area.

Could it be that Mr. Sprague's station is not willing to pay the going rate? Or could it be that the working conditions are substandard? Maybe it was a personality clash? Maybe the person that changed jobs just wanted to go home after a day's work and feel that he had contributed something to a very worth while endeavor, instead of feeling . . . "another day—another dollar—for the company."

I'm sure Mr. Sprague is aware of the knowledge and training required to become a competent broadcast engineer. But I wonder if he knows how much more that man could earn as a 110V AC Duplex electrician?

In case you haven't guessed it, I work for an ETV network: Kentucky Educational Television, the nation's largest and greatest educational television network. I took a two thousand dollar a year cut to take this job just over two years ago, after 19½ years of commercial television broadcast engineering.

If Mr. Sprague is willing to go the same route, I would be delighted to send him an application blank. However, I feel that it's only fair to warn Mr. Sprague that recently a state government supported ETV network on the East Coast folded due to lack of funds.

Harold B. Briggs
Kentucky Education Television
600 Cooper Drive
Lexington, Kentucky 40502

Dear Editor:

The broadcast labor market is what you make it. If your operation has a fresh and creative attitude and is willing to pay a fair market wage, your company will not experience the type of technical pirating you have discussed.

How do you treat your technicians? Are you an empire builder at your people's expense? Are you willing to praise them on a job well done? When errors are committed by your technical people, do you burn their tails? Or do you find out what caused the problem, so that you and the technician can work together to eliminate the problem? Men will go where they are wanted and respected!

Many young people are pleading for a chance to walk into your plant and give of themselves. Yes, I said give. If you sap their spirit and make them feel that they are going nowhere in your organization, then they will leave you. You will then probably look for the PTV boogie man to blame YOUR problems on.

Nation-wide, public television stations are the worst payers. They operate on ¼ the amount of capital that is available to their commercial brothers. Most PTV stations are equipped with tired, worn-out equipment given to them by their benevolent local commercial Broadcasters.

When it comes to PTV governmental support, George, well I am

sorry that you are so misinformed. We as PTV Broadcasters are on the bottom of the Government priority list when it comes to cash grants.

Believe me, as a group we are not overpaid. We do more work per man than most commercial operations. Our management people, on the whole, try to be fair and give us a chance to be a part of the station growth and help guide its direction.

It is true that we want the best personnel in all phases of our operations. But we do not have the resources at our command to do the type of pirating you have accused us of.

John R. Hampson III
Broadcast Technician
WTTW/WXXW
Chicago, Illinois

Dear Editor:

I would like to comment on the rather broad, misleading, statements from Mr. Sprague commenting on "Pirating Technicians" in the February issue "Letters to the Editor" department.

Mr. Sprague seems to feel that the ETV pay scale is out of line. Could it be, could it just possibly be, that the stations in his area are the ones that are out of line? I wonder.

As long as station owners, and managers, consider the technician as a necessary evil, and not part of a team effort, and call them in, like substitutes from the bench, when they need some all-night maintenance, carpentry, plumbing, electrical work, etc. . . . done and having done their job(?) relegate them back to third string status, what can they expect? Chances are any one of these latter trades have an hourly rate higher than that of the technician. Some managers wonder what happened to the technician that did not "watch the clock" and devoted all the hours necessary to do a good job with no thought of overtime. I suspect that a lot of these people are moonlighting trying to make ends meet.

If Mr. Sprague means that the Legislature, or local governments, of North Carolina are playing fast and loose with the taxpayers money (I took a $1000 per year cut in the transition from commercial to ETV) let him plainly say so. This

(Continued on page 10)

(Continued from page 9)

"bonanza" has provided a cost of living pay raise or less than 4 percent in the last two years, while the cost of living has increased 12 percent or more. This "bonanza" pays less than the going rate in the larger cities. This "bonanza" pays no overtime, ever. This "bonanza" requires the individual to pay for some necessary items out of his pocket and wait thirty days or more for reimbursement. This organization that "lacks good business practice" probably paid less for its equipment, item by item, than did Mr. Sprague's. This organization that "lacks good business practice" does treat its technicians with respect and consideration, does provide a participating retirement program, does provides regular and sick leave, and does recognize technicians as part of a team effort.

Mr. Sprague if you provide the technician with fair pay, a sense of being part of the team, recognition that he is an individual just as sensitive to his treatment as the fairest "prima donna" in the production department (would you ask **him** to unclog the commode?), you will have a willing worker that will give you more than your money's worth even, even, if it is somewhat less than another station pays. If ETV has pirated some of your people who worry only about pay then you are in our debt as we have surely done you a favor. Believe it or not we have trained more than a few that have left this "bonanza" to seek higher pay at commercial stations, so you see it is a two way street. By the way, Georgia State employees do pay taxes also, and some of us do like to feel we are contributing, at least in some small way, to furthering education in our State.

Wallace T. Lynch, CE
WDCO-TV
Cochran, Ga.

Open Letter

Defense Commissioner Wells
Federal Communications Commission
Washington, D.C.
Dear Sir:

I am writing (you) concerning the recent false alert Saturday, February 20, 1971. Most stations did not go off the air which has caused great concern among broadcasters and others, should there be a real alert. We normally have a newsman in our news room at 9:30 a.m. on Saturday mornings, but he happened to be out of the news room at the time the alert came over the wire. Our other method, off the air monitoring of the primary EBS station for Western North Carolina, did not work. I do not know why they did not sound the attention signal, perhaps their reason was similar to ours.

At other times, if a real alert came over, we would not be informed of it. For example, our station is the only 24-hour a day station in Western North Carolina. Should an alert come over after midnight, we would not receive the alert, because we operate the 12 midnight to 5 a.m. show from our transmitter studio, and the primary station, WWNC, is off the air. We do not have a teletype machine at the transmitter.

At any rate, I feel this false alert demonstrates the system has flaws. All the stations receiving the message should have, without question, gone off the air. Since they did not, I feel what I propose below should be considered.

Most stations have either a teletype or network service. A simple alerting device, similar to the CBS Net alert system, should be connected to either the wire or the network, that would be activated in the event of a test or emergency. When the alerting device, which would be installed at all broadcast operating positions, went off, the operator on duty could either go to the wire or monitor the network line for the nature of the alert. For small or educational stations not having a wire service or network line, a line would have to be run to the nearest point where any network appeared for the sole purpose of the EBS system. Verification lists similar to the present system used for the teletype alert could be worked out for this system.

In summary, it is obvious that the system could possibly fail in an actual crisis. My suggestions are a simple attempt to solve the alerting problem.

N. Eric Jorgensen
Basic Media, Ltd.
WISE Radio Station

Educational Station Needs Air Material

Dear Editor:

The South Dakota School of Mines will soon have an Educational FM radio station on the air at 88.1 MHz. At the present time we are awaiting FCC approval of our call letters. However, we are already in the process of building up a library of broadcast material so we may present a full program schedule when we go on the air next month.

Do you, or any of your readers, know of any free or low cost material that we might be able to use on our station? We will be serving an area of about 60,000 people and will try to be of service to both the academic community and general public.

Any information would be greatly appreciated.

Gary C. Brown
Vice President
Tech Edu. Radio Council
Rapid City, S.D. 57701

Station Searching For Instruction Manual

Dear Editor:

Recently we acquired a Foto-Video Model V-7 TV Sync Generator, Serial Number 142. We did not receive an instruction manual with this unit and attempts to contact Foto-Video have not brought any results. Apparently the company no longer exists.

We are trying to train students in Broadcast Engineering and so far, we have a TV transmitter and TK-15 camera, but of course, without a sync generator, we cannot proceed.

We would appreciate any help your readers can give to us.

LeMar Van Heuveln
Electronics Division
Southern State College
Springfield, S.D. 57062

SEND YOUR
LETTERS TO THE EDITOR
to
Broadcast Engineering
1014 Wyandotte
Kansas City, Mo. 64105

INDUSTRY NEWS

Relocation Rules Amended

FM and TV rules have been amended by the Commission to conform requirement for prior Commission approval for main studio moves in most respects.

The amended rules require specific Commission authorization for relocation of all FM and TV main studios to points outside the community of license (including a change from one location to another outside the community) except for FM main studio relocation at the AM main studio site, in the case of commonly-owned AM-FM stations licensed to serve the same community.

Only prompt Commission notification will be required for such FM moves, and for FM and TV main studio relocation within the community of license or from a place outside the community to another within the community.

The amendments to Parts 1 and 73 change authorization requirements for TV main studio removal only to eliminate the implication that Commission approval is needed for a move from a location outside the community of license to another within it. The amendments clarify and change the authorization requirements to require specific approval for FM main studio relocation outside the community of license except when the change is to the main studio location of a commonly-owned AM station licensed to the same community.

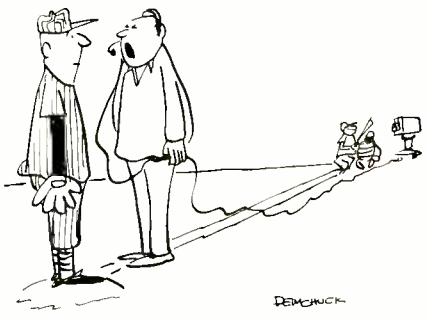
The FM rules have not required prior Commission authority for main studio relocation at the transmitter site outside the community of license unless the site was in another community. The Commission is not amending the AM rules (which do not require Commission authorization for main studio relocation at the transmitter site outside the principal community).

Technical considerations governing AM transmitter site selection usually require AM sites to be in close proximity with the community of license.

The Commission said that it is not requiring specific authorization for FM relocation at the AM main studio site of commonly-owned AM-FM stations licensed to serve the **same** principal community since the AM location could be presumed to comply with the rules. However, where commonly-owned AM and FM stations in the same area have **different** communities of license, the Commission stated that it will give prior consideration to proposed FM studio relocation at the AM transmitter site in relation to the FM station's community of license.

The new rules specify that a main studio may be located outside the principal community to be served where an adequate showing is made. No relocation of the main studio to a place outside the principal community, will be permitted without the licensee's first securing a modification of construction permit or license.

Prompt notification to the Commission is required for move of the FM main studio to the main studio site of a commonly-owned AM station licensed to the same community. FCC Form 301 is to be used for applications.



"HAVE YOU GOT ANY PITCHES THAT DON'T BOUNCE TWICE BEFORE THEY GET TO MY CAMERA?"

It will not be necessary to obtain Commission authorization to relocate a main FM or TV studio within the principal community to be served, or to move the main studio from outside the community to a place within it, but the licensee is required to notify the Commission promptly of the relocation.

The Commission pointed out that it is not the intent of the new FM rules, which require prior authorization for studio moves outside the principal community, including those to the transmitter site, to discourage or forbid such moves in the future if they do not defeat the intent and purposes of the rules. Moves will be permitted "where an adequate showing is made that good cause exists," the Commission said.

Community Problems Primer Adopted By Commission

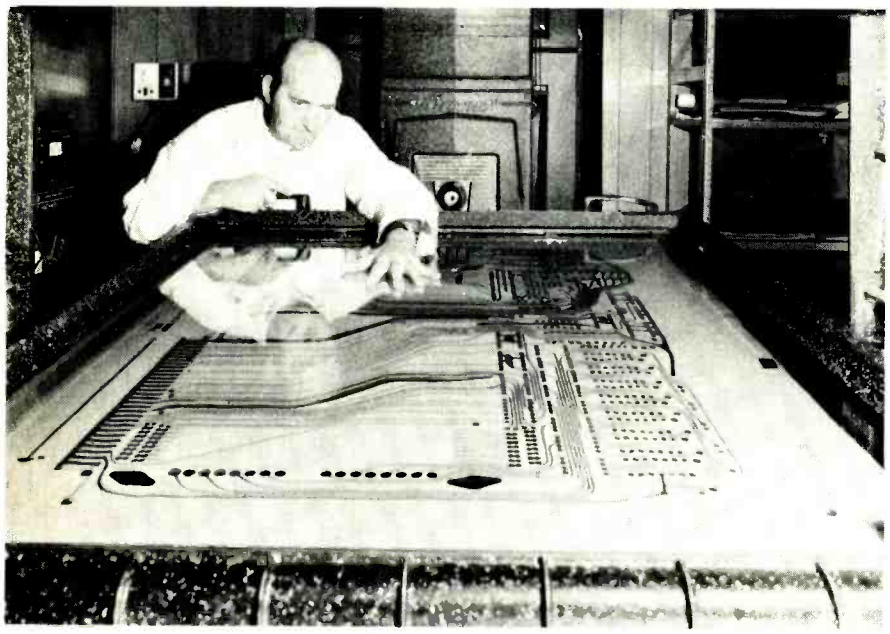
A Primer on the ascertainment of community problems for use by specified broadcast applicants in preparing Part I of Section IV-A (radio) or IV-B (television) of the application forms has been adopted by the FCC.

Applicants for new facilities, certain major changes in authorized facilities, and proposed assignees and transferees will be required to comply with the standards set out in the Primer. In addition, the Primer will be used on an interim basis by renewal applicants, the Commission said.

Copies of the Primer will be available at the Commission, 1919 M Street, N.W., Washington, D.C. 20554, and will be sent to renewal applicants during the interim period, along with the renewal application forms and other material.

The Commission indicated that applicants in pending hearing cases will be permitted to amend Section IV-A or IV-B of their applications within 90 days to comply with the Primer. Applications which have not been designated for hearing may be amended as a matter of right prior to designation.

The Primer adopted is much the same as that proposed in December 1969, in Docket 18774, with revisions in light of the comments filed by broadcasters, public groups and professional research organizations. It provides that the applicants subject to its provisions must submit a showing as to the composition of the community for which they are applying, of contacts with leaders of the significant groups in the community, and of the broadcast matter to be presented to meet the community problems as determined through this process. Contacts with members of the general public are also required, the Commission said.



Printed circuits this big? They are at least in one stage of their production. This shot shows the preparation of the master for photography at Westinghouse.

NIAC Recommendation

EAN Takes New Route

Temporary procedures designed to avoid erroneous Emergency Action Notification (EAN) on the Emergency Broadcast System (EBS) have been recommended by working Group I of the National Industry Advisory Committee (NIAC).

Under the new procedures, the Associated Press New York office and the United Press International Chicago office, which previously had been transit points for transmission of EBS test announcements, will now receive the test announcements at their broadcast news desks and relay them through their regular switching systems only after they have been authenticated. The procedure became effective February 27, 1971, and requires no change in station routines.

The EBS provides for communication in time of war, grave national emergency, disaster and threats to public safety. It is completely voluntary and is maintained by broadcast stations, networks and other non-Government communications services.

Under emergency notification procedures, the Associated Press and United Press International alert subscribing broadcast stations; networks inform their affiliates by internal communication facilities, and specified broadcast stations obtain information by off-the-air monitoring. All are required to maintain receiving equipment for Emergency Action Notifications.

The FCC supervises emergency communications systems and is assisted in its work by NIAC. Special NIAC working groups are assigned to make specific studies of emergency communications problems.

NAB Wants CATV Panel Reps

The National Association of Broadcasters recently informed the Federal Communications Commission that it wishes to designate four broadcast representatives to serve on panels set up to study various aspects of community antenna television systems.

Each would serve on one of four panels organized by the FCC. The panels first met on March 11.

The NAB representatives and topics of the separate panels are:

Dale G. Moore, president, KGVO-TV, Missoula, Mont., chairman of NAB's Secondary Market Television Committee. Possible benefits and detriments of CATV operation in markets below the top 100.

Jack Harris, president, KPRC-TV, Houston, Tex., a member of NAB's Future of Broadcasting Committee. CATV operation in the top 100 markets.

A communications attorney. Various subjects relative to the directions in which CATV should be headed.

Paul B. Comstock, NAB executive vice president for government relations. Commercial switching, funding for the Corporation for Public Broadcasting and an appropriate copyright settlement.

Comments Time Extended For Docket 18179

In response to requests by nine television producers for extension of time to file comments and reply comments in the proceeding involving the proposed amendment of Part 73 of the rules regarding the availability of television programs produced by non-network suppliers to commercial television stations and CATV systems, the FCC has extended the time for filing comments to May 3, 1971 from March 3, 1971, and for reply comments to June 3, 1971 from April 5, 1971. (Docket 18179).

In their petition, the producers requested a four month extension stating that because of the complexity of the matter they would not be

able to present meaningful comments within the March and April deadlines.

The Commission stated that while it appreciated the desire of the group for additional time to prepare its factual data, in its Notice of Proposed Rule Making (adopted January 13, 1971) it had stressed the need for reaching "an expeditious decision" and therefore it was necessary to strike "a balance between competing considerations." In granting the two-month extension the Commission said that "interested parties will simply have to submit as detailed studies as this time period will permit."

The nine producers are: Allied Artists Pictures Corp.; Columbia Pictures Industries (and its wholly owned subsidiary, Screen Gems, Inc.; Independent Television Corp.; Metro-Goldwyn-Mayer, Inc.; Metromedia Producers Corporation; Twentieth Century-Fox Film Corporation; United Artists Corporation; and Warner Bros. Inc.

Action by the Commission February 25, 1971. Commissioners Burch (Chairman), Robert E. Lee, Johnson, H. Rex Lee, Wells and Houser with Commissioner Bartley dissenting.

New Translator Renewal Forms Now Available

New application forms (Form 348) for renewal of translator station licenses, revised in October 1970, recently became available for public distribution. These forms require that translator station permittees and licensees report periods of inoperation, whatever the reasons for such inoperation. Often, new permittees and licensees are not aware of the fact that they must, ultimately, account for "down time" and they have not kept a record of station outages.

Although the rules do not require that translator station permittees and licensees maintain operating logs, a record of periods of inoperation should be kept, on a voluntary basis in order to provide the permittees and licensees with the information which they will need to furnish in their applications for renewal of their licenses.

(Continued on page 16)

Translator station permittees and licensees are also reminded that the rules require that they report to the Engineer in Charge of the radio district in which the station is located any period of inoperation for 10 days or more.

Radio Station KFTW Has Established Broadcast School

The management of Radio Station KFTW has announced the establishment of a radio broadcasting school. The name of the school is KFTW School of Radio Broadcasting Experience.

Unlike most schools that teach radio broadcasting by correspondence or with simulated studio equipment, KFTW will actually give the students experience by allowing them to broadcast on the air.

The management of KFTW feels there is no substitute for experience and have established one of the most unique broadcasting schools in the United States. Classes will be held for three month periods. Upon graduation students will have three months experience and will have Third Class License with Broadcast Endorsement from the Federal Communications Commission.

The school will begin classes June first with the charter enrollment. Because students will receive on-the-air experience only a small, limited number of students will be accepted for each class.

KFTW Radio Station and School are owned by Robert F. Neathery, a multi-station owner and CATV Operator of West Plains, Missouri. John W. Billingsley is General Manager of the station and school.

"IS THIS THE CREATIVE EFFORTS OUR EQUIPMENT AUTOMATION RELIEVED YOU GUYS FOR ?"

With "Reservations"

NAB Backs Operator Rules

The National Association of Broadcasters has endorsed proposed Federal Communications Commission rules covering operator requirements for radio stations, but it has "severe reservations" to some portions.

The NAB said it is "in full accord with the Commission's efforts to review the present operator requirements and provide a workable solution to eliminate many of the present restrictive requirements."

However, the Association pointed out that many of the requirements "are overly restrictive and do not truly reflect today's state of the art or the technological advances which have taken place in recent years."

NAB said it agrees with the Commission that at least one first-class license holder be a full-time employee at stations utilizing directional antenna systems. However, it said contractual or "backup" license holders should not be required.

NAB said the employment and utilization of additional manpower is the responsibility of the licensee and "should be of little interest to the Commission."

The Association also said the need for a first-class license holder to be on duty when the station begins directional operation or changes from one directional pattern to another "serves no useful purpose."

NAB said that with adequate maintenance and periodic inspection, "the incidents of directional antenna switching or component failures at the time of activation are rare indeed and could be relegated to the freak accident category."

Another objection is the proposal that a first-class license holder read and countersign the previous day's operating log within one-half hour of sign-on unless a first-class operator was on duty at sign-off.

NAB said a third-class license holder should be responsible for the routine operation of the transmitter and its associated directional antenna system.

It said that "in the event a variation from the established tolerance takes place or an out-of-tolerance condition prevails, the first-class license holder must be immediately notified and remedial action taken."

FCC Renewal Guidelines Available

The Commission has adopted a Primer to clarify and provide guidelines to its requirements and policies applicable to certain broadcast applicants in answering Part I of Section IV-A or IV-B on ascertainment of community problems.

This Primer is to be used by all renewal applicants until such time as the Commission finalizes its Notice of Proposed Rule Making relating only to commercial television licenses issued in Docket No. 19153.

The Proposed Rule Making issued in Docket No. 19153 among other things would require commercial television licensees to submit an annual report listing what they consider to be the most significant problems and needs of their service area during the preceding 12 months and listing the programs televised during that period that dealt with those problems and needs.

The Commission intends to consider the merits of proposing for commercial radio these or other new or additional methods on reporting of ascertainment procedures and the stations response to community problems and needs.

Therefore, until such time as the Commission finalizes the Proposed Rule Making in Docket No. 19153 and/or modifies Part I of Section IV-A, all commercial renewal applicants will use the Primer adopted in February.

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TV modulator circuits

By Leo G. Sands*

Television modulators are used in CATV systems as a primary broadcast transmitter or as the transmitter of a repeater system. Of course its output feeds into the cable system instead of a radiating antenna. To enable it to provide high quality television pictures and sound, a TV modulator must approach or meet broadcast standards.

When used as the transmitter of a repeater system, a TV modulator is connected back-to-back to a TV demodulator (a TV receiver without picture tube circuitry) as shown in Figure 1. The TV demodulator delivers the intercepted and demodulated video signal to the TV modulator, and also the accompanying sound as a 4.5 MHz FM signal (undemodulated).

At a head end, several TV demodulators and TV modulators can be used for pickup, conditioning and retransmission of off-the-air TV programs, and perform the functions of the channel-translating type of single-channel head end amplifiers. Each TV modulator operates on a different channel.

To transmit locally originated programs (LOP) over a CATV system, both video and audio signals are fed into a TV modulator which functions as a combination visual-aural transmitter. In a very simple LOP system, the video output of a vidicon camera (with internal sync generator) and the audio output of a microphone (through a pre-amplifier) would be fed directly to the TV modulator, as shown in Figure 2.

In a more elaborate system, the TV modulator would be fed by the video and audio systems of the LOP studio.

To discuss the circuitry of all of the TV modulators on the market would require more space than is available. Therefore, much of the discussion here is based on an analysis of the manual for the one

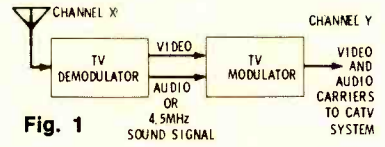

Fig. 1

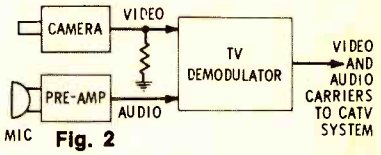

Fig. 2

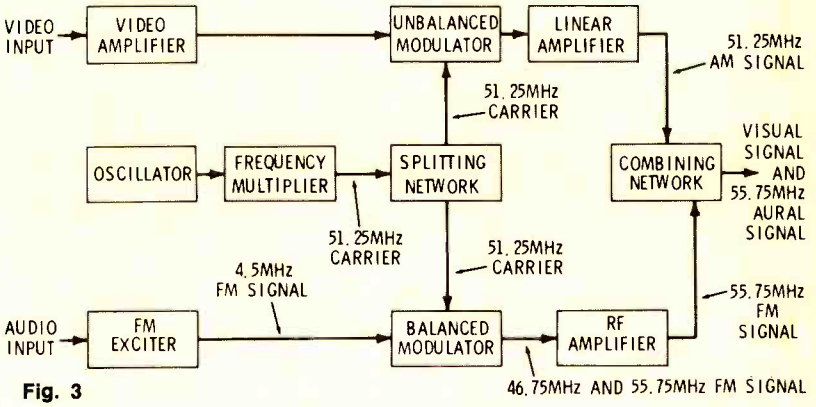

Fig. 3

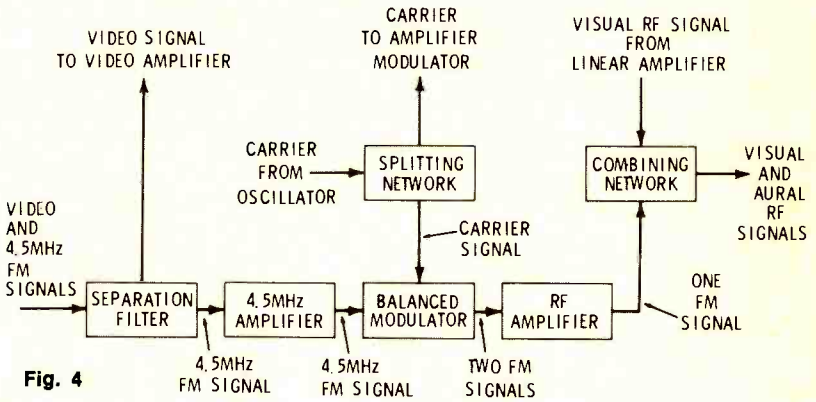

Fig. 4

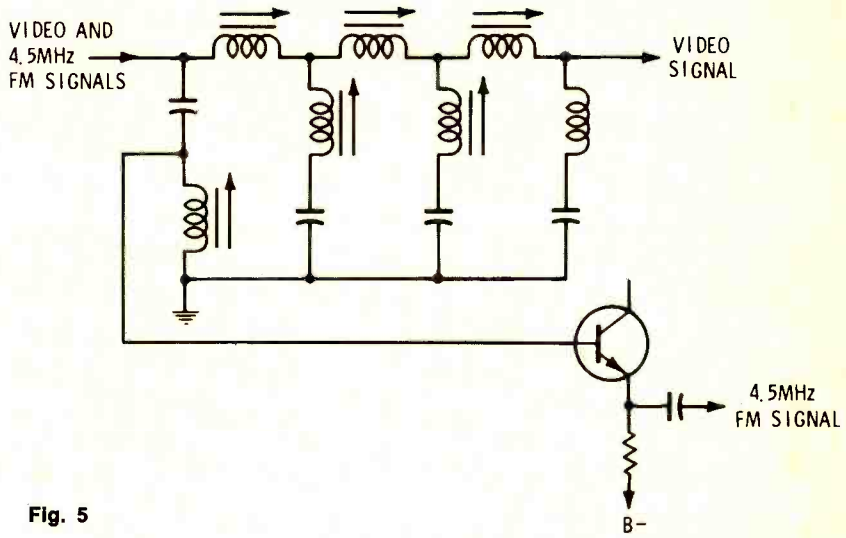

Fig. 5

*BE CATV Editor and President of Leo G. Sands & Associates, New York City.

of the popular units.

A TV modulator can usually be equipped to operate on any of the VHF television channels (2-13) and is designed to feed both the visual and aural carriers into a single 75-ohm unbalanced line.

The maximum visual RF signal output capability is specified by one manufacturer is +56 dBmv; aural is +46 dBmv. For video, the input level is 0.6 volt peak-to-peak for 87.5 percent modulation, and for audio −10 dBm level will produce 100 percent modulation. Audio frequency response is rated at 50-15,000 Hz with standard 75-microsecond preemphasis.

Both the visual and audio carriers, in this particular TV modulator, are generated by a single crystal controlled oscillator whose output frequency is multiplied and fed to a splitting network, as shown in Figure 3, on which Channel 2 frequencies are noted as an example.

The signal branches out to an unbalanced modulator where it is amplitude-modulated by the video signal. The signal also branches out to a balanced modulator to which is also fed the 4.5-MHz FM aural signal.

The balanced modulator develops two sidebands, one 4.5 MHz above and the other 4.5 MHz below the carrier frequency. The unwanted lower sideband is filtered out and the carrier signal is balanced out (suppressed).

The video carrier frequency is determined by the crystal and the audio carrier (4.5-MHz upper sideband) is obtained by heterodyning. Thus, only one frequency controlling element is required for stabilizing both carriers. The rated visual carrier frequency stability is rated at ±0.005 percent at room temperature, and the aural center frequency is held to within 1 kHz of the visual carrier frequency.

When used in LOP applications, the audio signal is fed to an FM exciter whose 4.5-MHz output signal is fed to a balanced modulator,

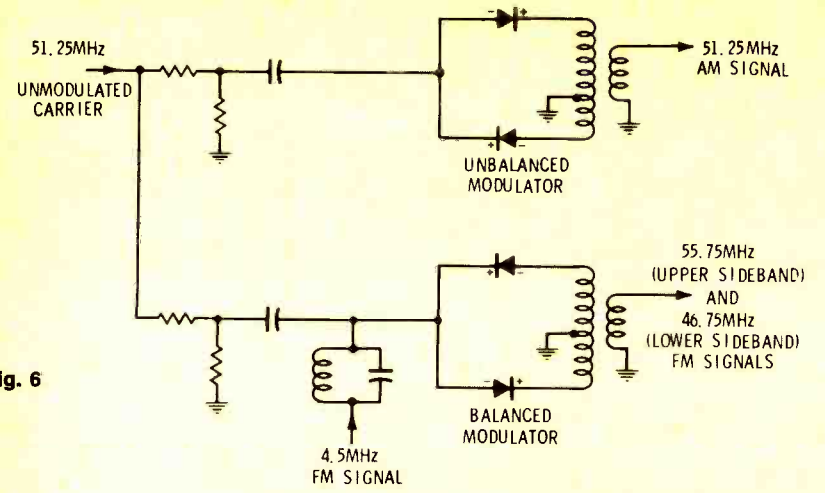

Fig. 6

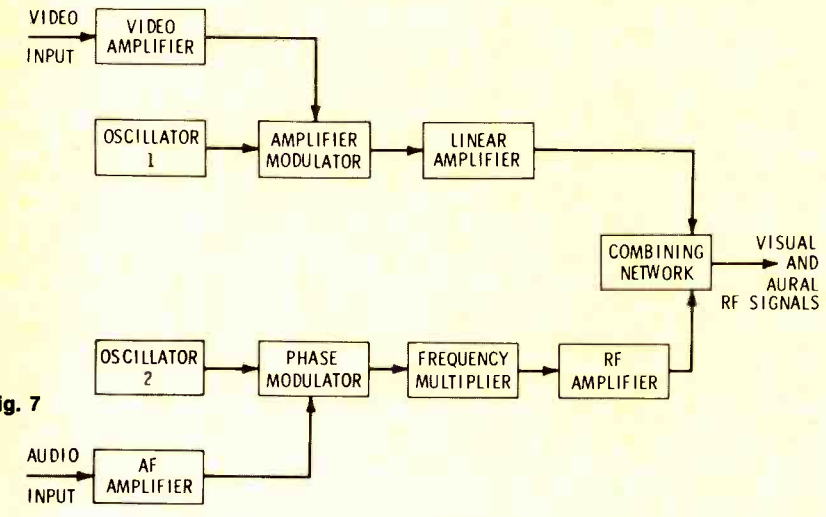

Fig. 7

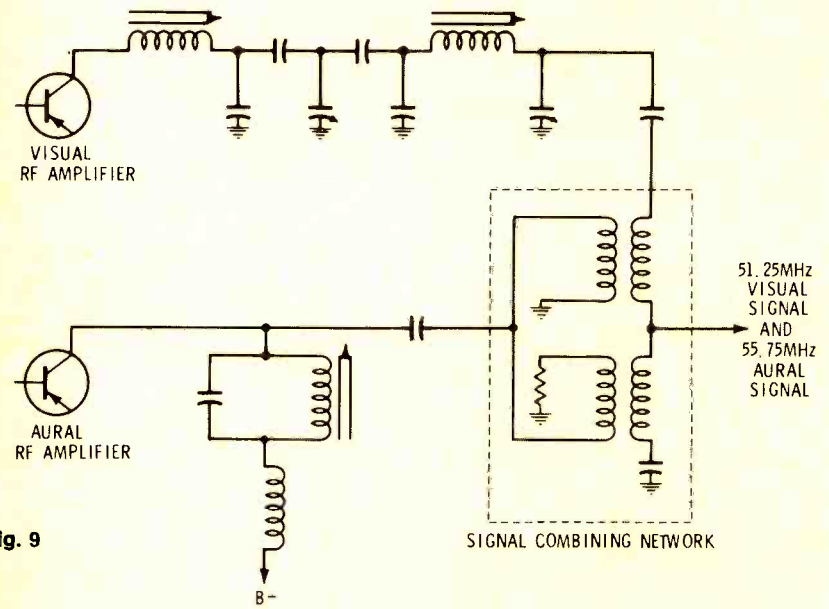

Fig. 9

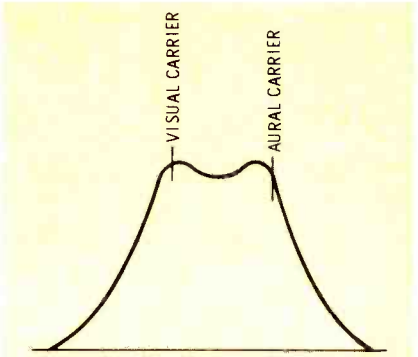

Fig. 8

as previously shown in Figure 3. When used for retransmitting off-the-air TV programs, the arrangement shown in Figure 4 is employed. (The video amplifier and visual transmitter circuits are not shown in this diagram since they are the same as in Figure 3.)

Both the video signal and the accompanying 4.5-MHz FM sound signal are fed simultaneously to a separation filter whose circuitry is given in Figure 5. The extracted video signal is fed to the video amplifier (not shown in Figure 4) and the 4.5-MHz FM sound signal is fed to an amplifier and then to the balanced modulator.

Figure 6 is a simplified schematic of the two modulators. The output of the unbalanced modulator is a double sideband AM signal (including the carrier) carrying the video information. In the balanced modulator, the 4.5 MHz FM signal is heterodyned with the 51.25 MHz unmodulated carrier signal (at Channel 2 to cite an example), and two sideband signals, one at 55.25 MHz (upper) and one at 46.75 MHz (lower) are produced. The carrier is suppressed by the balanced modulator.

In lieu of the single-oscillator technique discussed here, the visual and aural carriers can be generated and modulated separately, as shown in Figure 7. Here oscillator 1 generates the visual carrier at the channel frequency (or at a lower frequency which is multiplied). This signal is fed to the amplitude modulator to which is also fed the video signal. The resulting AM signal is amplified and fed to the cable system through a combining network.

Oscillator 2 generates the aural carrier signal. Its constant frequency output can be fed to a phase modulator as shown. Or, the oscillator can be directly modulated by a varactor diode (varicap). The resulting FM signal is multiplied to the channel frequency and is then fed through an RF amplifier and the combining network to the cable system.

In the single-oscillator technique (Figure 3) in which two FM aural signals are produced by the balanced modulator (4.5 MHz above and below the visual carrier frequency), one is suppressed by tuned circuits in the RF amplifier. This is not necessary in the case of the

(Continued on page 63)

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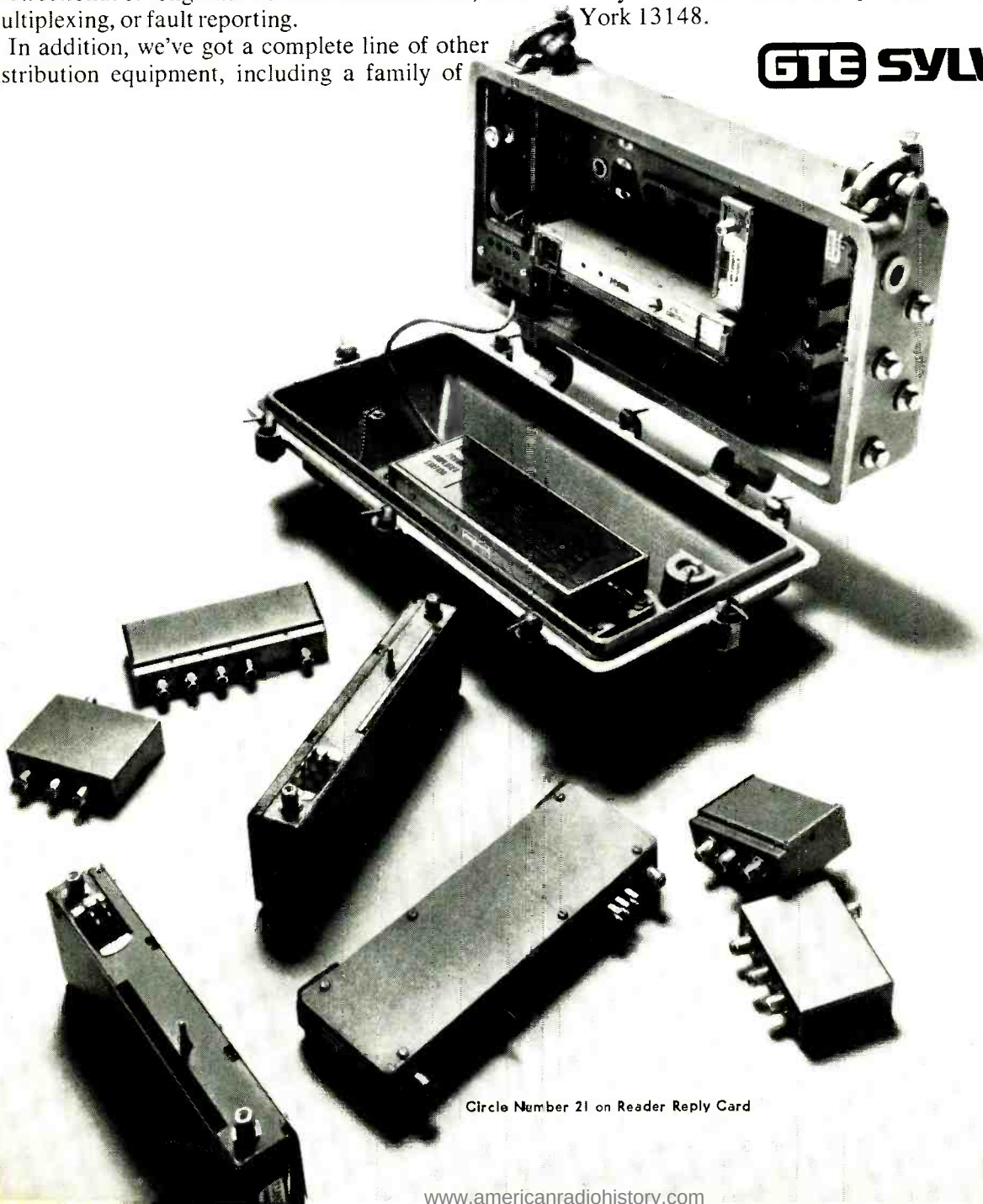

Circle Number 21 on Reader Reply Card

The color mobile van

Serving the public interest

By Donald L. Balcom and Donald F. DeGroot*

WWJ-TV chose the occasion of last summer's 1970 Power Boat Regatta to inaugurate live, direct-from-the-scene color coverage from its newly outfitted mobile color studio. The initial colorcast covered six separate races in the Power Boat Regatta, largest inboard racing event of the year, including final heats of the 5-Liter, 7-Liter, and Ski Runabout classes.

In addition, WWJ-TV presented the special U.S. Steel 10-mile Grand Prix Invitational Race for 5-Liter, 7-Liter and European 900-Kilogram class hydroplanes.

Three PE 250 GE color cameras were positioned along the mile-and-two-thirds course on Ford Lake near Ypsilanti, Michigan. One camera was mounted atop the mobile color studio, which until its recent conversion to color could provide black and white coverage only. The other cameras were spaced out so as to offer the director a choice of pictures from any part of the course.

Sportscasters Al Ackerman and Don Kremer gave lap-by-lap coverage as well as background features and interviews during the two-hour Sunday afternoon telecast. The result was a colorful, fast-moving presentation which captured not only race action itself but also the charged atmosphere surrounding this big-time power boat regatta.

Detroit-area viewers are delighted with WWJ-TV's new dimension in

*Balcom is the CE and DeGroot the GM at WWJ, Detroit.

Fig. 1 WWJ-TV's color mobile van is a regular visitor to the Detroit Zoo as the station videotapes its weekly "At The Zoo" series.

Fig. 2 The interior of the mobile unit boasts an exceptionally large operating area. Producer, director and technicians work in comfort even during day-long taping and telecasting sessions.

Fig. 3 The conversion from black and white to color mobile facilities was supervised by Ned May, WWJ-TV facilities supervisor. Here he tries the unit's VR 1200B videotape machine.

local coverage of special events, and advertisers, including U.S. Steel, which sponsored the Power Boat Regatta, are enthusiastic.

WWJ-TV is also utilizing its color mobile studio on a regular basis to videotape its weekly "At the Zoo" program.

This series is both entertaining and educational. Animals are shown in their "natural" settings at the Detroit Zoological Park, with Zoo officials describing their habits and habitats to host Sonny Eliot. The format requires several different lo-

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Chroma III also lets you forget about temperature extremes, line voltage variations, daily re-registration, and other usual set-up adjustments.

This, in brief, is Chroma III:

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- **Pushbutton set-up**—one man does it in seconds.
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We've made the camera that our experience and field research have told us you want. These features just begin to tell the story—but we think you'll agree it's a great beginning.

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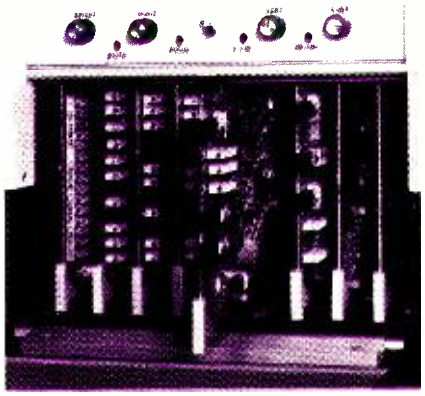

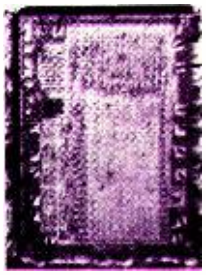

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Fig. 4 Retention of studio production facilities was a "must" according to the remote color conversion plan finally adopted. This is the control room of Studio A, one of four WWJ-TV permanent studios.

cation shots during each half-hour program. WWJ-TV's color mobile studio with its complement of three cameras and videotape facilities has proved ideally suited to the demands.

Other events colorcast recently include the famous J. L. Hudson Thanksgiving Parade, a special Detroit Symphony Orchestra Christmas Concert from Ford Auditorium and Christmas Eve Mass from Detroit's Blessed Sacrament Cathedral.

Serving The Public

WWJ-TV's new all-color mobile unit is a natural outgrowth of our all-color studio facilities, and a vital means of broadening the scope of our service to the community and to our advertisers.

Television has always been at its unique best when communicating live and direct some on-going event. Today, that formula must include color because nothing less than this added dimension of realism is acceptable in top quality video. WWJ-TV is Detroit's first color station and we are eager to maintain our number one technological ranking.

Until recently however, the lack of a mobile color capability has limited some areas of our programming. But with this new equipment our program planners automatically give consideration to a wide range of sports, exhibitions and remote programs of all kinds that formerly were ruled out.

There are many important programming opportunities apart from sports and so-called special events that can be telecast live and direct. Most of the sophisticated video effects control available in our studio control rooms are available in our mobile unit, which means that we can produce almost any kind of show on location.

In the case of regularly scheduled shows, there is an added factor of economy in that it frequently is possible to videotape several complete episodes during one session at the remote location, thereby cutting production costs per episode.

There are overall values too. Several productions heretofore shot on color film at remote locations are now videotaped by the mobile unit with a notable improvement in both video and audio quality.

Advertising Uses

Advertisers have indicated a growing interest in documentaries and special programs closely related to the community, and in this area the all-color mobile unit with its studio quality equipment is an invaluable extension of our production facilities. We are also generating new interest in locally produced commercials which employ the mobile unit to make use of local backgrounds for various campaigns.

In fact, we hope to stimulate more agencies and advertisers to creatively use the television medium. By producing TV tape commercials with our mobile color studio, we can provide proof of the results and afford an opportunity to perfect the commercial. Videotape also provides an assured high level of commercial production quality.

In addition to its many obvious advantages in our own operations, this unit has attracted network and other outside programmers who have requested information regarding the leasing of this equipment for sports and other special events throughout this region.

All in all, we consider the all-color mobile studio a necessary component of the modern television studio, a solid investment and a service arm with a great potential.

Converting From B&W To Color

In planning for conversion to color remote facilities, three alternatives were offered by the engineering department.

Plan 1 included an all-new three-

Editor's Note: There always has been a need for more local, live coverage of interesting events. And sports certainly can lead the way. Yet it is puzzling that many stations in sports minded cities do not cover these events. In many places, more people crowd in to see car races than attend baseball or soccer games, yet there is precious little coverage.

Aside from sporting events, there are many other worthwhile and interesting events that can be covered. But, as WWJ-TV found, it takes a committment. Of course, if you don't care to consider local, live coverage you take on the alternative and all that goes along with it.

Fact is, it is the opinion of a great many that if television had been out covering the local scene, the FCC and Congress would have seen little need to lend their support to cable TV.

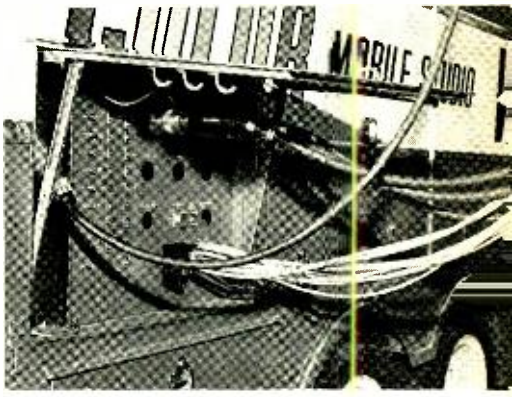


Fig. 5 The color mobile unit becomes the Video control center for fixed studio colorcasts simply by hooking up these cables to the unit as it is parked in the WWJ-TV garage.

camera unit with color tape recorder plus complete audio and video systems and accessorics, with the capability of cxpanding to a five-camera unit by utilizing two studio cameras. Approximate cost of the new vehicle completely furnished was $750,000. If we installed our own equipment, the estimate was $600,000.

Plan 2 considered refurbishing our present vehicle with color equipment. This plant was fundamentally similar to Plan 1, including replacement of cameras, videotape machine and video switching and distribution equipment. The audio system was to be retained along with the mobile unit. Cost was estimated at $450,000.

Plan 3, which became the basis of the plan adopted, proposed colorizing our current vehicle by equipping it with only basic control units. All camera heads, for example, would be borrowed from an idle permanent studio when a remote colorcast was scheduled. Approximate expenditure was $300,000.

Naturally, cost considerations made Plan 3 very attractive.

It soon became evident, as planning progressed, that further savings could be made if new control units and monitoring were not necessary. This could be done by using the mobile unit as the control room for "A" studio. The problems of providing color-phased film and tape feeds to the unit and not having the complete facilities of "A" control made this unattractive. The approach that was finally decided upon and which allows us to "have our cake and eat it too" was to use the unit for video control only. The cameras are genlocked to studio A's "color black" and color phased to the existing film and tape inputs to the "A" switcher. The cost of the color remote unit, including a new 1200-B videotape machine was reduced to $150,000 by following this plan.

The decision to use the present unit instead of building a complete new unit was based upon the many facilities available. The van had low mileage, four tons of air conditioning, heat, a good audio system, regulated power and plenty of storage in the sides and back. There was room enough to provide a quiet, spacious production area which is lacking in so many units.

The unit was stripped of all equipment and sent to Gertenslager's for a complete refurbishing of the body, including painting. A new air-ride system was also installed. The unit was then brought back to the remote garage where the balance of the work was done by WWJ-TV personnel.

Three cable reels, containing 250 feet of camera cable each, were installed in the rear. These are split reels which make it possible to use any portion of the 250 feet and still have access to the male end. The reels are powered and have proven to be very convenient, as in many cases 250 feet of cable per camera is adequate. Additional cable is carried in side compartments.

The procedure described has resulted in two advantages: first, our personnel had regularly produced black and white programs from our mobile unit and also were quite familiar with the equipment in our fully colorized studios. Thus transition problems were minimized and our remote colorcasts have demonstrated a great deal of reliability from the very beginning.

Second, by restricting costs, we will be able to take advantage of technical improvements to come. We expect many innovations in color cameras within the next few years. Miniature remote cameras will be available. We now can utilize this more mobile type of equipment —in conjunction with our large production unit—as it becomes available. ▲

Air! Give Me Air!

By Walt Jung

The dissipation of heat in electronic equipment has been a problem of major consideration for as long as we have had the technology. An essential part of the care and feeding of high power vacuum tubes has always been their thermal considerations.

No one doubts for a moment the necessity of proper air or water movement to carry away heat generated in the final stages of a transmitter when hundreds of watts or kilowatts are involved.

But the age of the semiconductor has brought about some unfortunate misconceptions on the dissipation of heat. In contrast to a 10 kW final the dissipation requirements of a 20 watt solid state chassis may seem relatively insignificant. The real danger here is that the potential trouble is not nearly so obvious, and so all too often the tendency is to disregard potential heat problems with transistorized equipment.

In this article we're going to dig into a few of the physical basics of semiconductors and heat dissipation to understand how potential heat problems can arise. Once the mechanisms are understood, preventive medicine can forestall heat problems in transistor and IC equipment.

The Problem Developes

There would be few if any problems from heat in solid state equipment if everyone used but one piece of gear and mounted it all by itself in a control room environment, adequately spaced from its brethren and well ventilated. But this extreme is far removed from the real world where many pieces of gear become stacked one above another. And **this** extreme is the one which causes the heat problem.

To take a "for instance" case, consider a problem of mounting a number of audio distribution amplifiers in a 19-inch rack. In this case we're talking of 30 of these DA's, 10 each to a 5¼-inch rack panel. Power dissipation is about 2 watts per module, a relatively small number, and the manufacturer rates his equipment at 60° C maximum, also specifying cooling requirements as "natural".

The key here is the word "natural". What is natural cooling? Is it cooling by normal convection currents from bottom to top of unit, carrying the heat into the surrounding air? What happens if this natural air flow is blocked?

A better appreciation of this problem may be had by studying Figure 1, a sketch of these modules in their rack frame and the intended air flow. Room temperature air enters through the bottom of the open frame rack and passes up, over and through the vertically oriented circuit cards, removing heat from the circuit components. The warmed air rises from the top of the rack and passes upward and back into the room's environment. This process is called natural convection because of the natural tendency for warm air to rise, creating an up draft or "chimmey" effect in the circuit card slots. It works well when air movement is properly channelled (by the design of the package) and there is free access to the input and output ventilation slots. A good example of efficient use of a natural physical process.

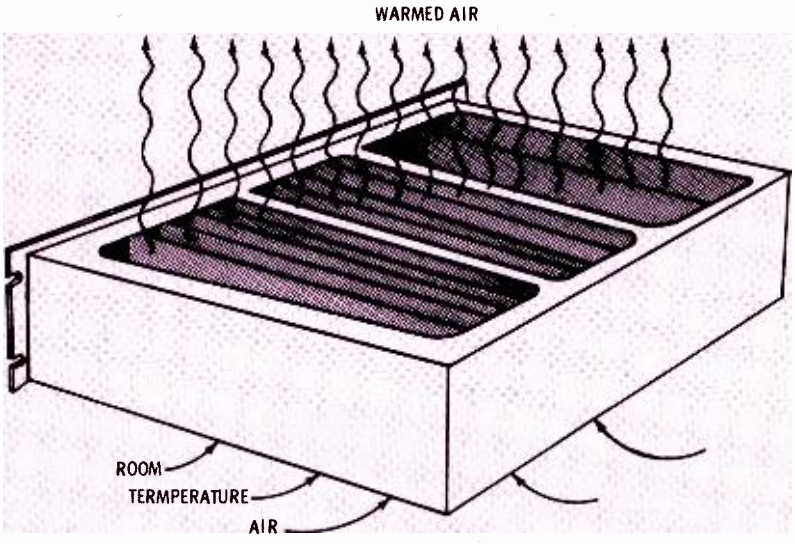


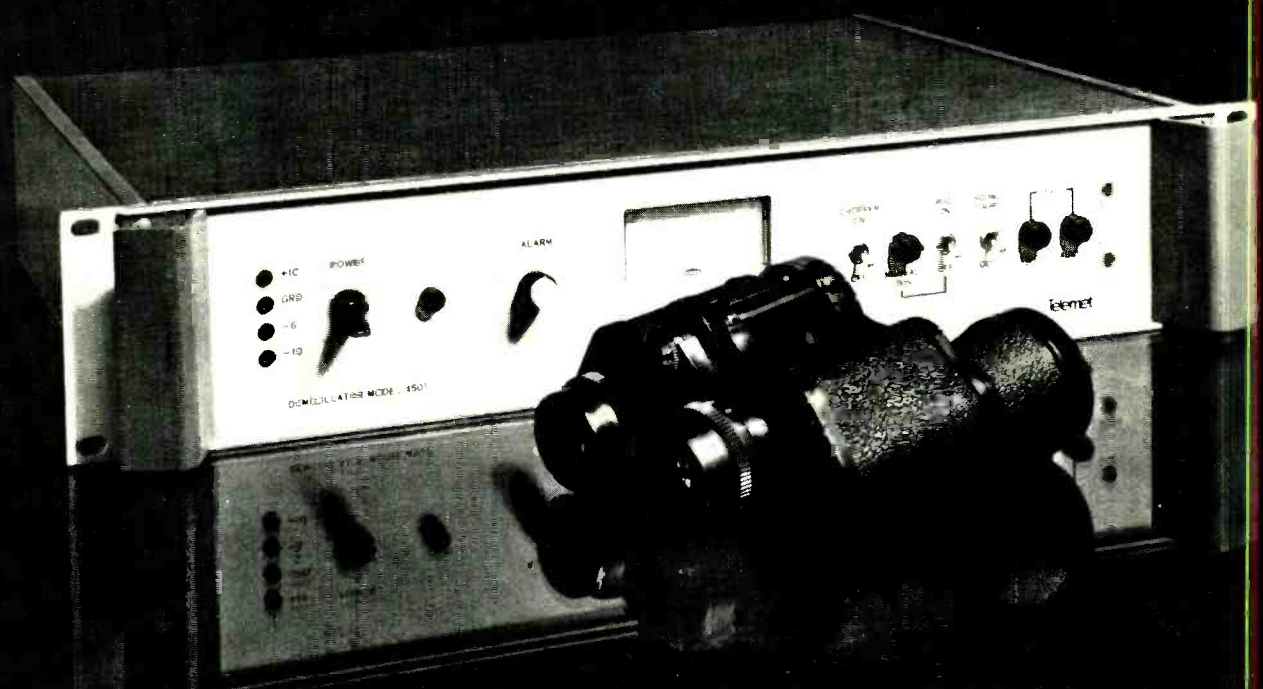
Fig. 1 Illustration of cooling by natural convection in circuit card rack.

Stacking Problems

But what happens when you stack up 3 card frames directly above one another? Now only the bottom unit receives room temperature air at it's lower ventilation port (assuming no additional equipment directly underneath), but the upper two receive the restricted air flow from the unit immediately below it, at progressively higher temperatures. The bottom unit heats the second unit and both of these heat the top unit. So the air inlet temperature for the top unit is raised by the temperature rise of the two units below it, creating the effect of a much higher ambient temperature.

The manufacturer specifies his units for a 60° C max temperature. Now let's assume a 25° C room and a 10° C rise in each unit for purposes of explanation. The bottom unit gets the 25° C air at its inlet and raises it to 35° C, passing it on to the second unit which

Announcing the one Precision Demodulator with the two points of view.



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Five millivolts is practical for almost all remote monitoring applications. Linearity is ±1.0° differential phase, 5% differential gain.

With the sound traps switched **out**, the 4501-A1 goes flat to 4.5 MHz ±0.5dB. Accordingly, envelope delay is flat within ±25 nanoseconds.

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raises it to 45° C. Now the third unit gets the 45° C air, just 15° C below its maximum rating. And within this unit the temperature rises another 10° C, up to 55° C—just 5° C below rating!

Remember, we assumed a 25° C room also. Think of what happens when the room temperature rises. You quickly push the upper unit beyond its rating and quite possibly the second unit also, if the room temperature rise is great enough. And even though the general area may be air conditioned, you've got some nasty hot spots in that top module.

Now to add to the rising tide of disaster, suppose you have similar situations in adjacent racks with pulse and video distribution amps. Maybe even a few miscellaneous power supplies thrown in to add to the confusion. And it's a hot day in August—just 98° F outside with hardly a whisper of a breeze blowing. The remote broadcast of the mayor's speech is about to be aired, just a half hour from now. You have exclusive coverage and your best crew is on the spot to capture every moment of this critical event. What is that crazy squeaking noise coming from the air conditioner? Doesn't it feel sort of warm in here? I don't know maybe it's me, but I'd swear its getting warmer in here . . .

OK, maybe we're being a little dramatic, but you get the picture. Small things overlooked or neglected can cause potential doom. Often they can easily be prevented by careful forethought. In this case the solution is simple: allow ample spacing between units of even moderate power within a single rack. If there is reasonable doubt, question the manufacturer about specifics of an installation.

Why are these things so important? The answer is reliability. Semiconductor failure rate is halved for each 10° C reduction below maximum junction operating temperature. If this doesn't sound like an incentive, look at it pessimistically—failure rate is **doubled** for each 10° C rise in junction temperature. And as far as other components go we all know how electrolytics start popping when their temperature rating is exceeded.

Best To Know The Characteristics

The best thing that can be done is to thoroughly understand solid state equipment and its physical characteristics. This means you will be able to recognize potential temperature problems before they start by spotting weaknesses, either in the equipment itself or the way it is utilized.

First of all you should understand the dissipation and thermal consideration of transistors and IC's. Every solid state device has a maximum rated junction temperature and a thermal resistance. The junction temperature maximum is obvious enough: it's the maximum allowable temperature (in ° C) allowed by the manufacturer of the device. It is the limiting temperature, regardless of whether the device is on (operating temperature) or off (storage temperature).

The thermal resistance of a solid state device (transistor, diode, IC or other) is a measure of its resistance to heat flow from the operating junction (where the heat is generated) to either the case or outside air. In the instance of power transistors and rectifiers, thermal resistance is given from junction to case. For IC's (which are not usually heat sinked) and small transistors it is given from junction to air. In both cases it is measured as "x" number of degrees centrigrade per watt of power.

Example: a 2N3055 power transistor has a 1.5° C/W junction to case thermal resistance. For every watt of power dissipated, the junction will be 1.5° C hotter than the case. For 20 watts of power dissipated, the junction will be 20 x 1.5, or 30° C hotter than the case. But this is not the entire picture: so far we have only talked

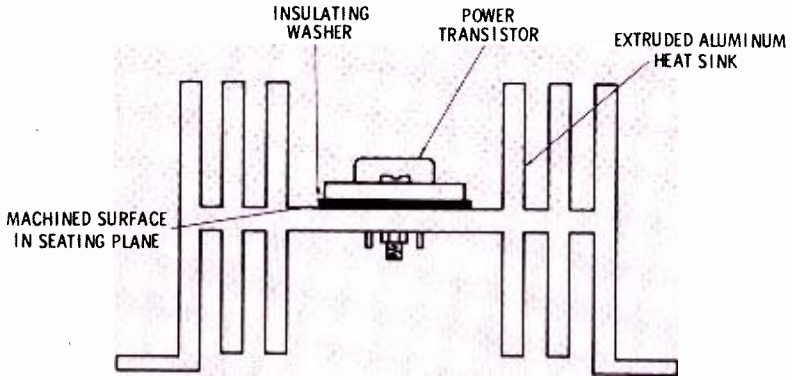

Fig. 2a Power transistor with heat sink and necessary thermal hardware.

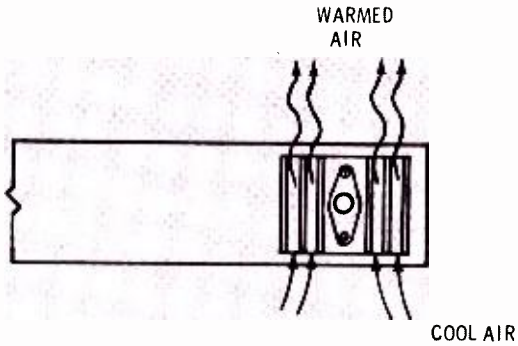

Fig. 2b Heat sink and transistor of Figure 2a in a typical mounting on rear of chassis.

about the difference between the junction and the case.

Heat Sinks

Additional elements are necessary to keep the case temperature below reasonable limits at high power while transferring the heat into the surrounding air. This is a heat sink, necessary because the transistor case by itself cannot dissipate appreciable heat. The overall objective is to achieve a **low** thermal resistance, this means the junction will operate cooler.

A heat sink adds two additional thermal resistances, one from case to heat sink, caused by the interface between the case of the transistor and the heat sink. Since the transistor case is usually electrically above ground, an insulating washer is used between the transistor case and the surface of the heat sink, adding some additional thermal resistance. The final thermal resistance is the heat sink itself, which transfers the heat of the semiconductor to the surrounding air.

Figure 2 shows a transistor mounted to a typical extruded aluminum heat sink; (A) showing the mounting of the transistor to the sink and (B) the heat sink to a chassis. Note in 2 B the orientation of the fins is vertical, to maximize cooling convection currents which flow upwards through the fins.

Now let's go back and see what this means to the transistor.

To see how hot the junction of the transistor gets, we add up all the thermal, resistances from junction to ambient, multiply by the power being dissipated, and add this temperature to the maximum ambient. It's really simpler than it sounds, so let's try it.

The thermal resistance (O) involved here is junction to case, case to sink, and sink to ambient. Assigning typical numbers; Ojc= 1.50° C/w, Oc-s 0.2° C/w and Os-a 2.0° C/w. These add up to 3.7° C per watt. For our 20 watt dissipation, the junction would be 3.7x20=74°C above ambient. For a 50°C ambient the junction would be 124°C, well below the maximum of 200°C. Using this concept of thermal resistance it is easy to work out the maximum expected junction temperature and so get a good feel for the conservativism of a particular design.

Although the example we used was a 2N3055 transistor, the same technique holds true for any power semiconductor. The only necessity is that the thermal resistances be known.

Small Transistors

IC's and small signal transistors are specified in a more simplified manner, as they do not normally use heat sinks. Take a 2N3904 for instance, specified with a 310 mW power dissipation at 25°C, a max junction temperature of 135°C and a thermal resistance of .357°C/mW, junction to ambient. In this case the junction to ambient spec is all that is needed to predict junction temperature given the dissipation. Consider a 100 mW dissipation and an ambient of 50° C for instance. 100 mWx .357° C/mW=35.7°C, 50°C+35.7=85.7°C, the temperature of the junction at 100 mW power and 50°C ambient temperature.

IC's can create potential heat problems also when they are used in appreciable quantity. Digital logic IC's such as flip-flops and gates consume a relatively constant amount of power, 50-100 mW per package. What happens when you have a large number of little 100 mW ovens spread out over a board? If it isn't handled properly it too can cause heat build up.

With 40 or 50 IC packages spread out all over a PC board (or boards), there is little that can be done as far as heat sinking. Heat removal in this case has to be by radiation and convection, and the mechanical package must take advantage of natural air flow through proper ventilation.

High density electronic packaging can be as important a part of the design as the circuitry itself. After all, who wants to nurse a piece of gear that is temperature sensitive because no one thought until the last minute how much power was being dissipated in that little box?

Things To Look For In Equipment

There is no quick and simple answer to proper thermal design; but there are a number of small rules which individually might seem minor, but collectively can make the difference between a marginal unit and a trouble free one. Things like a black heat sink is 25 percent more efficient than an unfinished one, metallic oxide insulating washers have lower thermal resistance than mica, metallized heat sink compound is more efficient than plain silicon grease, a vertical finned heat sink is more efficient than a horizontal one, aluminum is a better heat conductor than steel.

The next time you have a piece of gear for evaluation and are running it through its paces, check into its thermal characteristics. Look (or feel) around for hot spots. Observe the method of cooling used. Are proper convection paths provided? Are the highest operating temperature components well away from other more sensitive ones?

Check over the power supply in particular. Hook it up to a variac and check to see where it drops out of regulation at low line voltage. 100-105 volts is usually a lower limit (117 volts-10 percent). Supplies which go much lower (80-90 volts) are efficient and are dumping excess heat into the unit by way of the series regulators. Stay away from a supply like this unless it has primary taps on the transformer.

You should also run the unit for a few hours at high line voltage and high temperature, if possible, to expose any problems which might develop. In general, be a little skeptical of the unit. Make it prove to you that it is reliable. After all, once you accept it, you are going to have to depend on it.

Solid state components are, by their very nature, temperature sensitive devices. It takes careful design to minimize the effects of environmental changes upon them and heat dissipation cannot be disregarded. Remember that a number of individual small heat sources can add up to the effect of a large one. Stand back and let the thing breathe. ▲

Someone has to take the lead

Miami station updates emergency equipment

By Gene Rider*

When a hurricane swirls off the Southeastern or Gulf states the National Hurricane Warning Center on the University of Miami Campus at Coral Gables becomes the origination point for what is probably radio's most listened to remote broadcasts. Scores of stations in Florida, the Southeast and nationwide get audio from the Hurricane Center and give it a high priority scheduling.

When I started in broadcasting (where have 40 years gone?) Miami had two stations, each of which had a carbon mike and a home made amplifier in the small Weather Bureau office in downtown Miami. The weather man depended on an occasional wireless message from an island or Caribbean ships for hurricane tracking. These messages plus a lot of analytical magic enabled the weather man to broadcast hurricane alerts and release wire service bulletins.

Progress in environmental science accelerated through the years. Hurricane hunter planes with radar, sophisticated instrumentation, computers . . . they all lead up to satellite weather surveillance and photos of any weather disturbance in the world. The Miami Weather Bureau (Weather Service, as of late 1970) kept pace and was the nucleus of the Department of Commerce's ESSA–Environmental Science Services Administrations–National Hurricane Warning Center.

After several moves about town, each time to greatly expanded quarters, this function of the Weather Service, was installed in the Computer Building on the University of Miami Campus at Coral Gables. The center is made up of more than two floors of complexity, glittering chrome, closed circuit TV, banks of TWX machines, radar domes, scopes, facsimile equipment, satellite antennae, multi-racks of intricate weather instrumentation—even an auditorium and a stage for TV broadcasts and media briefing. But most important, a mammoth diesel standby power plant at ground level.

Because of our role in EBS and Florida Defense Network, it was WIOD's lot to service the pooled audio equipment at the Center, and on a day in early 1969, after driving 25 miles in heavy traffic from WIOD, I stood in the middle of this space age complex, in its broadcast booth, changing a 6L6 tube in a Western Electric 124 amplifier, circa 1946.

This single channel 20 watt amplifier (with a standby 124, feeding Miami area radio stations via a splitting pad arrangement) represented 40 years of pooled progress in weather broadcasting by the Miami area radio industry.

The setup looked like the paging amplifier on Noah's Ark and would probably last until the next flood. But who is to blame a broadcast plumber for not tying down a beautiful remote amplifier, needed for football games, for an out of sight, fixed remote? Or a station's one engineer with too much work, for not being overly concerned about pooled equipment at a remote he might possibly not use once a year?

Back at WIOD I had a talk with

*CE, WIOD, and Jerry Pardue, Weather Services Public Relations. Pictures by Charles True, National Hurricane Center.

Fig. 1 When a hurricane hits there is no way to stop this kind of damage. But the regional warning system can save lives if it participates actively in an organized pool.

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Jim Wesley, General Manager.

Result, WIOD would buy new equipment and furnish manpower for the installation, then let it be known to area stations that contributions toward the cost would be acceptable—with prorata refund in event of over subscription.

Jim Rayfield, of WIOD Engineering, and I kicked it around a couple of days. Our first thoughts were in terms of two remote amplifiers, but since the equipment might at times have to feed as many as 30 lines, a remote amplifier would have to, in turn, feed some sort of power amplifier for the multi-line output requirement.

This brought us back to our old approach—a power amplifier with splitting pad as had been used on the unit to be replaced. A solid state dual system, of course. Each amplifier to have a 2 channel mixer, one microphone and one line input. The line input was to be used for routing sub remotes such as Red Cross Emergency HQ and the TV pool audio in the Weather Service auditorium through the radio pooled equipment.

(When a hurricane brews, other remotes of interest to the industry and the public require emergency air time and the best approach to this requirement would be to route the other emergency remotes via the Center, where all stations can be tied together.)

There are many good amplifiers on the market suitable for our requirements. We chose the Altec 361B 2 channel mixer power amplifier with the following options: an Altec 1578A preamplifier for the mike channel and an Altec 15095 transformer for the remote input. Complete duplication for both units.

One refinement required for the new system dictated itself immediately. We'd recently been called upon, as EBS Key, to broadcast a tornado alert on a minute's notice. Coordinating the Weather Service warning via telephone had taken too long. A tornado tone alerting system whereby Weather Center could push a button at their remote amplifier and ring an alarm at those stations who had installed a tone trap amplifier alarm to bridge their Weather line. The alarm to be followed by an official tornado alert message 60 seconds later.

Hurricanes approach relatively slowly, generally speaking, and the Center schedules these broadcasts on a time start basis. Usually the schedule calls for broadcasts every two hours when a hurricane is within 200 miles of land. The tone alert system is not used for hurricane warnings.

Costs (1969), for the entire setup including microphone, headphones and VU meter totalled about $575—surprisingly lower than we'd thought.

Jim Rayfield built a compact, handsome setup and we installed it at the Hurricane Center. A 600 ohm audio takeoff at line level is available for any station that buys a

Fig. 2 Public and Marine forcaster at work in the Center. Note the CRT data terminal to his right.

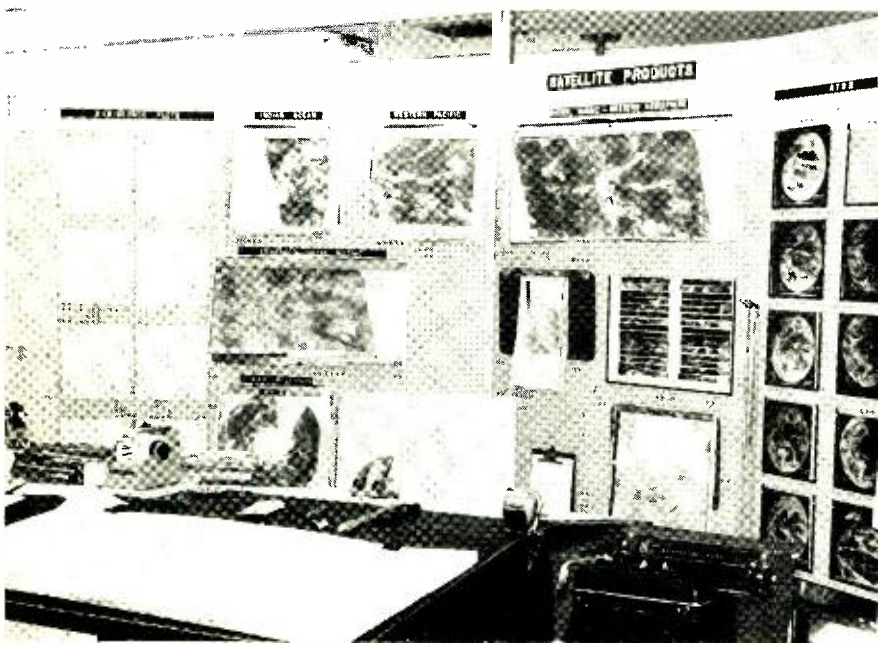


Fig. 3 This is the map analysis area of the Center.

line to the Weather Center. WKAT and WIOD made it easier by sharing costs on a trunking equalized line from Coral Gables to WKAT-FM in downtown Miami. There, dual power amplifiers multi-feed downtown Miami stations and the Miami Police Department via short haul unequalized lines.

The tornado alerting 1 kHz oscillator is composite and is powered off either of the Altec 361B's. WIOD and a few other stations have bridged tone trap alarms across their Weather Bureau lines. We had a tube type 1 kHz trap available as a leftover from an old EBS system. When we find time we'll build a solid state trap, using a tape cartridge 1 kHz trap as a beginning.

During the off-hurricane-season, only a few Miami stations broadcast from the weather center. Most Miami stations have a TWX Weather Wire and the stations' DJs read forecasts. But during the hurricane season the authoritative voice of a U.S. Weather Service—ESSA official direct from the Hurricane Center is used on most area stations. For those stations who don't buy lines, WIOD-FM, WYOR-FM and the Florida Defense Network weather broadcasts are available and are relayed from station to station far upstate.

When the new equipment was installed, provision was made to feed audio from the setup to a Bell System conference call, feeding select FM stations upstate. These stations in turn make the broadcasts available to AM and FM stations within their radius.

When the installation was completed, we mailed out block diagrams of what we'd installed and Jim Wesley mentioned the installation at a meeting of the Greater Miami Broadcasters' Association and we soon had 50 dollar checks from 9 radio stations and one TV station for a total of $500.

WIOD had one week's engineering time and $75 in the new setup.

Summary

After eighteen months of run time of 24 hours a day without a trouble call or a switch to the spare amplifier, we believe low power solid state PA amplifiers fill the bill nicely for broadcast use of this nature. A pool arrangement is a must for such places as Weather Service. Don't struggle with antique equipment. Broadcasters are much quicker to cooperate in such matters than you might think. But someone has to take the lead. It might as well be you. ▲

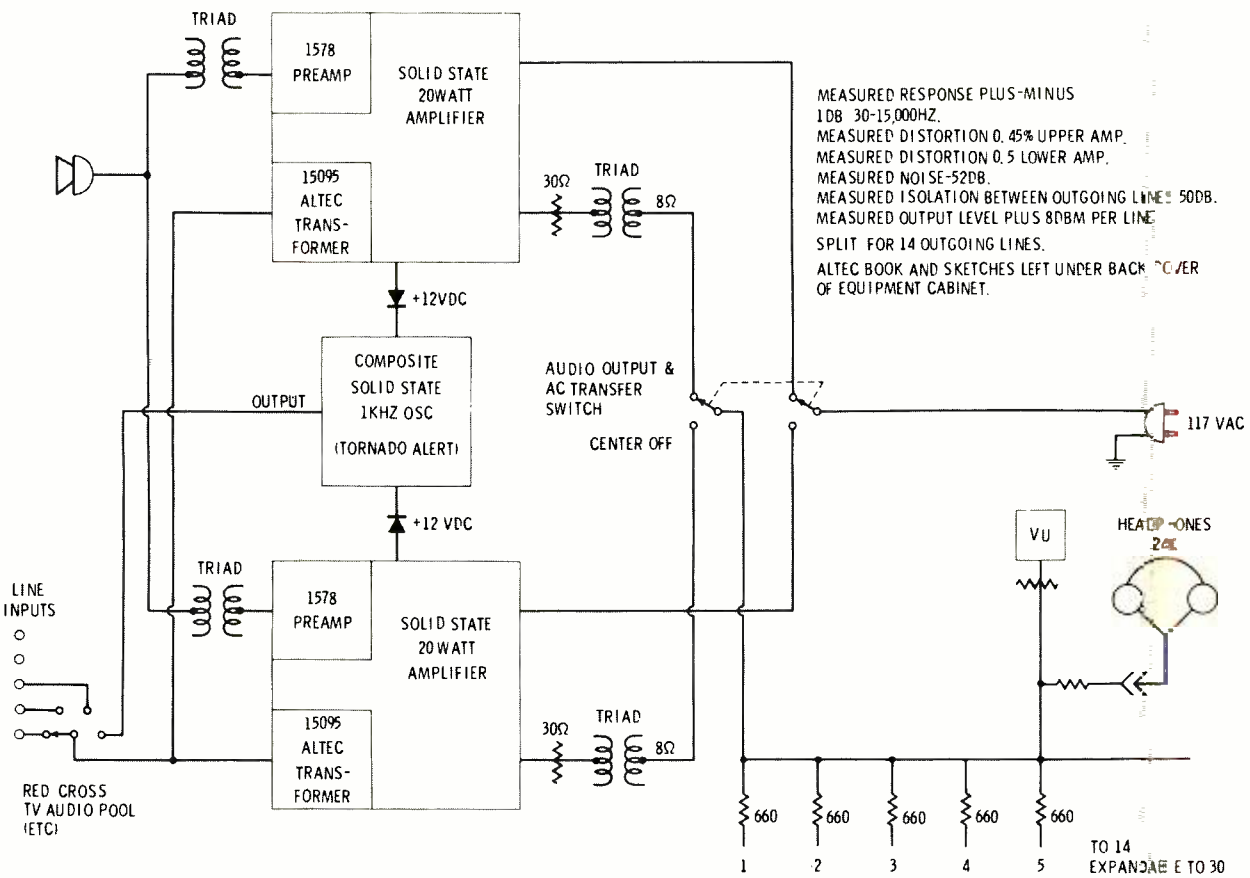


Fig. 4 Weather Bureau audio pool system installed by WIOD.

The Curve Tracer:

Another Method of Testing Transistors, Part 1

By Carl Babcoke
BE Solid State Editor

Characteristics of transistors which can be measured include DC beta, AC beta, shorts, leakage, opens, bandwidth, linearity, polarity (PNP and NPN), internal capacitance, noise level, and maximum permissible operating currents and voltages.

Testing of shorts, leakage and opens is understood best by thinking of the transistor as three interconnected diodes, as shown in Figure 1. Forward and reverse resistance of the three junctions can be measured with an ohmmeter by testing one junction, then reversing the polarity of the leads and measuring again. This method demands some experience in interpretation. And, unfortunately, when applied to nondefective silicon types, infinite resistance is indicated by most of these tests. However, some opens, shorts and most leakage can be detected using this method.

Each diode junction of a transistor also can be dynamically tested for its ability to rectify, by use of the circuit shown in Figure 2. The ideal waveform for a good junction is a right angle. A short produces a vertical line, and an open produces a horizontal line. These tests can be made on in-circuit transistors; however, the accuracy will depend upon the circuit characteristics. Also, collector-emitter tests are not as definite as we might desire, and leakage indications are not very sensitive.

Turn-on and turn-off tests in which the collector-emitter junction is measured with an ohmmeter are true measures of transistor actions. Of course, no accurate calibration is possible. The basic circuit for such tests is shown in Figure 3.

DC beta testers accurately measure the DC (static) gain of a transistor by adjusting the base current to achieve a known collector current. The base current then is measured on a meter calibrated in DC beta. A simplified schematic of this method is shown in Figure 4.

In commercial instruments, only one meter is used, with switching for the various shunts. Other switch functions are used for polarity reversal, leakage, and calibration. Also, provision usually is made for beta tests at various amounts of collector current. This is desirable because transistor beta changes with collector current. For example, a transistor that measured a beta of 180 at 1 milliamp, might jump to a beta reading of 240 at 10 milliamps. Many commercial transistor testers make in-circuit beta measurements by first balancing out the circuit leakage.

Testing Transistors With A Curve Tracer

Dynamic transistor curve tracers are being heralded as the best solution to some of the shortcomings of the preceding tests. Let's take a look at the operation of one curve tracer, the Jud Williams.

This curve tracer applies a "staircase" waveform of current to the base of the transistor. During each step of the staircase, a DC voltage that varies from zero to maximum and back to zero is applied to the collector. Collector current verti-

The Jud Williams curve tracer is shown here. There are at least three commercial tracers currently available.

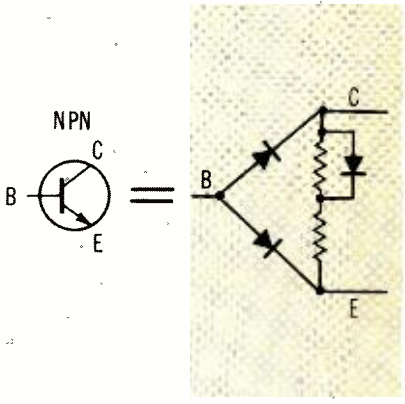
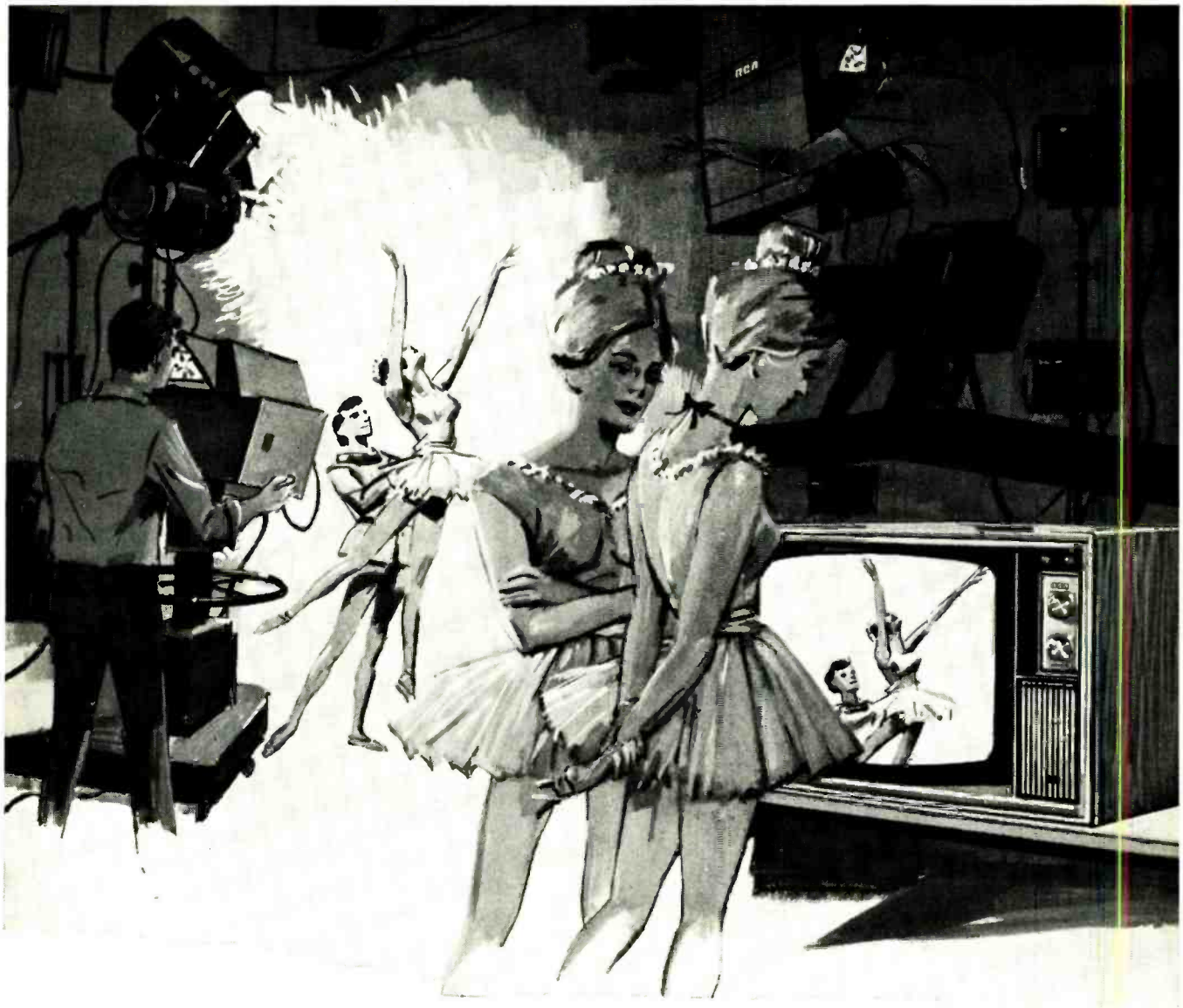


Fig. 1 Equivalent circuit of an NPN transistor shows three interconnected diodes which represent the relationships of the three elements of a transistor—emitter, base, collector. For the PNP type, polarity of the diodes would be reversed.



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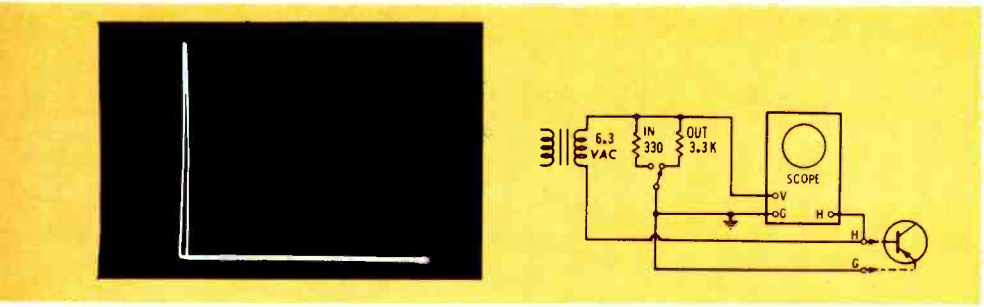

Fig. 2 Schematic of a simple method which permits testing of diode junctions in a transistor. The right angle readout on the scope is the ideal waveform for base-emitter and base collector junctions.

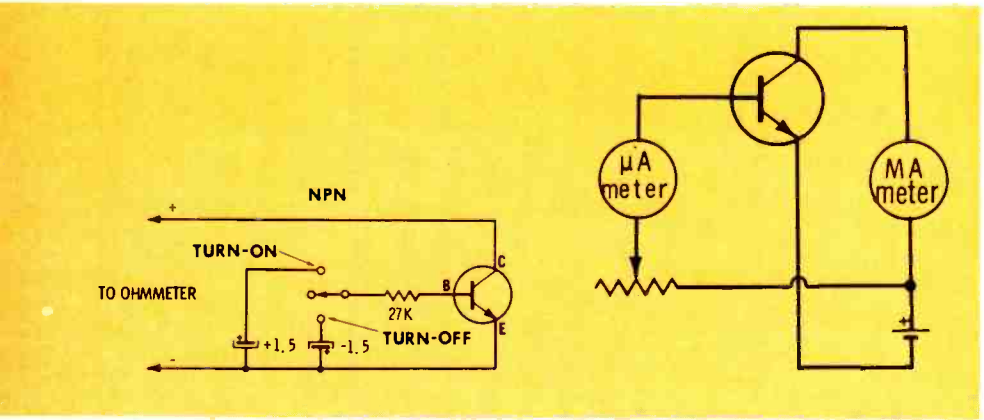

Fig. 3 The ability of the base to control the resistance of the collector-emitter circuit can be tested by using this circuit, which is connected to an ohmmeter.

Fig. 4 DC beta is the ratio of static base current to static collector current.

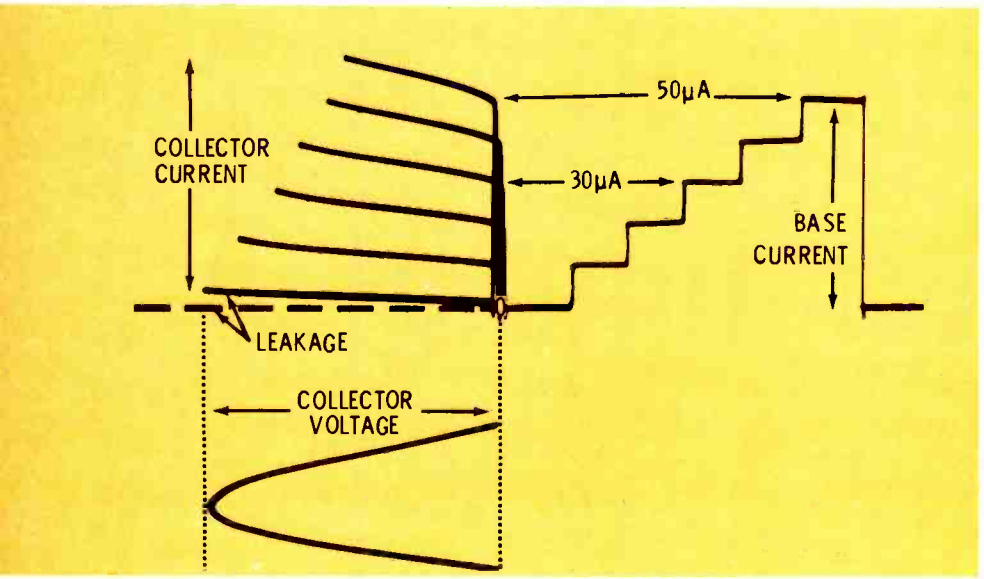

Fig. 5 A typical family of transistor curves (upper left) showing the relationship between the DC staircase base current and the DC parabolic collector voltage (lower lef). Collector-emitter leakage can be read by the tilt of the base current compared to the true zero line on the scope graticule.

cally deflects the scope, and collector voltage provides horizontal deflection.

Figure 5 shows the relationships between the waveforms applied to the transistor and the resultant "family of curves" produced by a normal transistor. These curves show collector voltage and emitter current at zero base current and at five steps of increasing base current. Tilt of the "zero base current" curve (the longest one) is an indication of leakage, i.e. the collector-to-emitter current that is not controlled by the base.

Three wires extend from the rear of the curve tracer cabinet. One lead connects to the ground post of the scope, another to the horizontal input terminal, and the remaining lead to the vertical input. If the scope probe for the vertical input has direct and low-capacitance functions, use the direct position to avoid unnecessary mathematics when measuring transistor beta.

Rotate the horizontal selector knob on the scope panel to the position marked "EXT", "H INPUT" or "HORIZONTAL INPUT". With both the curve tracer and scope turned on and the voltage control of the tracer turned up partially, a horizontal line should be seen on the screen of the scope. The horizontal width of this line should vary when both the VOLTAGE control on the tracer and the horizontal gain control on the scope are adjusted. Scope intensity and focus should be adjusted normally.

No locking adjustments are nec-

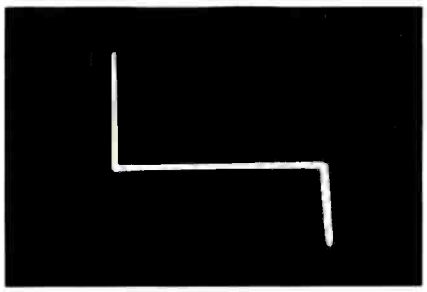

Fig. 6 Curve produced on a solid state scope as a result of protective zener action in the horizontal sweep circuit of the scope. Many scopes will overload when the collector voltage control is set to produce higher voltages. False curves can be the result.

essary, because the scope receives both horizontal and vertical deflection voltages from the curve tracer.

Curves can usually be obtained from normal transistors when tested out-of-circuit by pre-setting the curve tracer controls with the BASE CURRENT switch at 10 μA, the VOLTAGE control at 20 volts and the POLARITY switch to the position which provides a family of curves. This adjustment of the POLARITY switch can be used to identify non-defective PNP or NPN types.

Overload of the horizontal deflection circuit in the scope is often encountered in many scopes when the VOLTAGE control on the tracer is turned to the higher settings. Figure 6 shows the bent ends of the horizontal line caused by the zener protection circuit in one brand of all-solid-state scope. This overload cannot be considered a scope defect, but it must be corrected otherwise false curves will result. A large value resistor or a voltage divider between the tracer lead and the horizontal input connector will easily solve this problem, if it exists.

Normal Variation Of The Curves

Many typical curves of non-defective transistors tested out-of-circuit are shown in Figure 7. The settings of the curve tracer controls are listed for your guidance.

DC beta can be accurately tested with the curve tracer method. The vertical gain of the scope must be calibrated correctly, and the curve tracer controls adjusted to spread

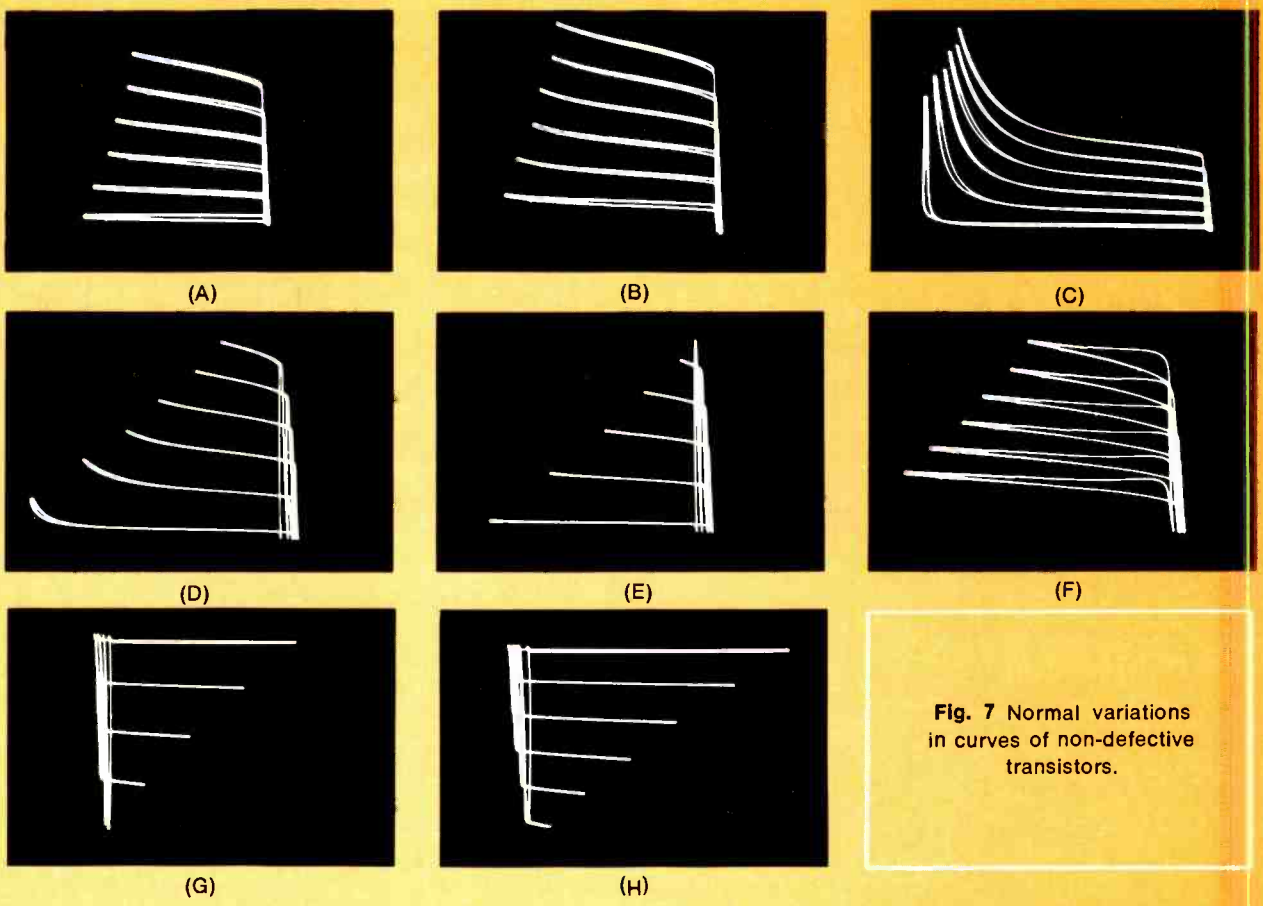

Fig. 7 Normal variations in curves of non-defective transistors.

(A) Family of curves for a 2N411 PNP germanium transistor. BASE CURRENT control set for 10 μA per step of the staircase, and VOLTAGE control set at 20 volts PP.
(B) Curves produced by same transistor, but with BIAS switch erroneously set for silicon instead of germanium.
(C) Curves produced by same transistor, but with VOLTAGE control set at 70. Avalanche leakage occurs at about 50 volts.
(D) Curves produced by same transistor, but with BASE CURRENT control set at 50 μA, VOLTAGE set at 30, and scope vertical gain reduced.
(E) Curves produced by same transistor and conditions as in (D), but, because COLLECTOR VOLTAGE is set at only 20, only 5 curves are produced on scope.
(F) Curves of an old type 2N301A PNP germanium power transistor. Notice how leakage tilts the "zero base current" curve. Also note the loops in each curve, which indicate poor frequency response and internal heating.
(G) Family of curves of a small NPN silicon transistor with BASE control set at 10 μA and COLLECTOR set at 15 volts. This transistor produces about 50 percent more gain than the one in (A).
(H) Curves produced by same silicon transistor, but with VOLTAGE control increased to 25, to produce all 6 curves.

the curves apart for greater reading accuracy. The method and examples will be detailed next month.

Leakages And Open Circuits

An open in any element, a base-emitter short, or no transistor connected to the curve tracer will produce a straight horizontal line on the scope, as shown in Figure 8. A vertical line is caused by a collector-emitter or base-collector short.

Leakage tilts the horizontal lines of the curves. Figure 8 shows the curves produced by transistors with various values of leakage.

Comparing Test Methods

Several dozen defective transistors were tested out-of-circuit using a good meter-type beta tester, the Williams Curve Tracer, and ohmmeter tests. Most of the transistors were either shorted or open. Such obvious defects easily were found by all three methods. However, the curve tracer operation was much faster. The tracer controls were preset, as explained earlier, so it was only necessary to connect the transistor (or plug into a top-mounted socket) and try both positions of the polarity switch. If no curves were obtained, the transistor was defective and no further tests were needed.

Beta Tester

A few transistors with a serious amount of leakage tested slightly low in beta and nearly normal in leakage. Both the tracer and ohmmeter gave more definite indications of a defect in the transistor.

One transistor with a partial open in the base circuit checked perfect on the beta tester, but abnormal on the other two test methods.

Opinion: A beta tester gives an accurate DC beta reading for the voltages and currents supplied by the tester during the test. Accuracy is better if beta readings are taken at several collector currents. Leakage indications are often not sensitive enough. Operation is painfully slow.

Ohmmeter Tests

Ohmmeter tests were the sole method of testing transistors (outside of the laboratory) for several years after solid-state components first appeared in portable radios. Most germanium transistor defects can still be found by using ohmmeter measurements. The tests are less valuable when silicon devices are to be checked.

Correct interpretation of the six basic ohmmeter tests found the defect in every transistor tested, except for those that had avalanche leakage at abnormally low voltages.

Opinion: Ohmmeter tests can locate most defective transistors, if the readings are interpreted correctly, but the tests require quite a bit of time. Ohmmeter tests cannot give any hint of gain.

Curve Tracer Tests

The curve tracer tests also found every defective transistor, in addition to a few that the other two methods were not definite about. Also tests were performed that were impossible for the other methods.

The ability to match the small 3-lead transistors by plugging one in each top-mounted socket and switching back and forth between them with the SELECTOR switch cannot be matched by meter or ohmmeter tests.

Maximum voltage rating between collector and emitter can be established by noticing the point on the VOLTAGE control where avalanche occurs on the zero-base current curve.

Opinion: Curve tracers offer the potential of quick and accurate (or quick and approximate, for faster tests) testing of transistors without the shortcomings of other methods (except for expense of purchase).

Next Month

Next month we will explore the abilities of the Jud Williams Curve Tracer to test transistors in-circuit, and to test diodes, zeners, SCR's and other solid-state devices.

The method of curve tracing featured by Eico in their Solid State Semiconductor Curve Tracer model 443 will be analyzed. ▲

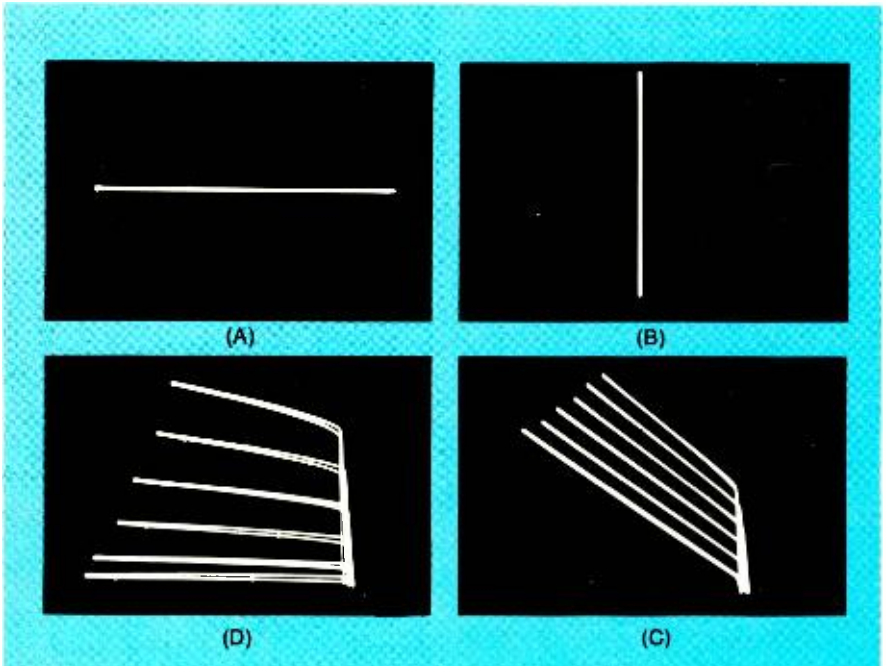

Fig. 8 Curves produced by defective transistors.
(A) A single horizontal line is caused by a base-emitter short or an open element.
(B) A single vertical line is caused by a base-collector or collector-emitter short.
(C) Curves of a 2N408 PNP germanium transistor with a 1.8K-ohm short between collector and emitter, or a 180K-ohm short between base and collector. Notice the tilt of all the curves.
(D) Non-linearity near the "zero base current" curve of a 2N408 caused by a base-emitter short of 10K ohms.

New FCC standard patterns explained

By Robert A. Jones*

On January 18, 1971 the FCC released their findings in Docket Number 16,222; the proceedings to specify a so-called "Standard Method" for calculating radiation patterns. This new method replaces the old system of calculating a theoretical pattern and adding the MEOV values to it.

The new Standard Radiation Pattern incorporates the old MEOV plus some new factors. I might point out here that this amendment of Part 73 of the Rules will apply only to new assignments and to major changes (as defined by Section 1.571 (a) (1).)

Like any new method, this will take getting used to, and may take some time for the average station engineer to understand. First let's see what the FCC was trying to accomplish with this new Standard Method of Calculating Patterns. They were trying to establish for every directional station just one pattern, not two as we presently have. This new standard pattern would replace your theoretical pattern plus your measured pattern.

This new standard pattern would be used to determine both service rendered as well as interference considerations to another station. As you probably know, in the past the theoretical pattern was used to compute service areas, but the MEOV was for computing interference contours. In reality, the use of this new standard pattern to compute service areas will be misleading, since any given station will not, in practice, occupy all the area up to the maximum radiation in all directions. In other words, the use of this new method will result in computed service areas of directional stations being greater than they really are in practice. However, these new service area showings are good in that they will define the **maximum** service area for any given station.

The new standard pattern consists of really the old theoretical pattern plus the addition of two new factors. These factors are a value of 2.5 percent of the root sum square of the fields of the individual towers, or 6.0 MV/M; whichever is the greater value. This would be added in quadrature to the old theoretical radiation pattern. Then this would be multiplied by a factor of 1.05 times to achieve the new standard pattern. If this all sounds confusing, it is. I didn't understand it either the first time I read it.

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

Comparing Methods

But let's see how one would go about designing a pattern by the old method and the new method. This I trust will help you comprehend more quickly the basics of the new method. Figure 1 is a basic two tower five kilowatt pattern calculated by the old method. The solid line represents the theoretical pattern. The dashed line represents the MEOV limits. The formula used in computing this pattern is as follows.

$E_0 = K\ [(1 + M^2 + \text{Cos}\ (\Psi + S\text{cos}\ \Phi)]\ ½$

Where terms are defined as:

E_0 = Field intensity in any given bearing.

M = Current ratio between two towers.

Ψ = Phase angle between two towers.

S = Electrical spacing between towers.

Φ = Clockwise angle measured from the tower line.

Table I shows how an engineer might compute this pattern, using this formula, to arrive at the final theoretical pattern. As I said before, this is the old way of making patterns.

Figure 2 is a graph of the same two tower 5 kW pattern, but by the new method. As you can see there is only one line on this graph, not a solid line plus a dashed (MEOV) line. As you can see these two patterns are quite similar. The basis for computing this new pattern actually begins with the same theoretical formula proposed in the former method. In other words we take the data and computations in Table I and add to this information certain additional factors.

At this point I quote in part from the new Rules, Section 73.150(a) "For each station employing a directional antenna, all determining of service provided and interference caused shall be based on the inverse fields shown on the 'standard radiation pattern' for that station."

TABLE I
BASIC THEORETICAL PATTERN

A	B	C	D	E	F	G
Bearing	70 cosA	B-110°	CosC	1 + D	E½	F × 447
0	70.0	-40.0	0.766	1.766	1.330	595 MV/M
10-350	68.9	-41.1	0.754	1.754	1.326	593 "
20-340	65.8	-44.2	0.717	1.717	1.310	585 "
30-330	60.6	-49.4	0.650	1.650	1.286	574 "
40-320	53.6	-56.4	0.553	1.553	1.246	556 "
50-310	45.0	-65.0	0.423	1.423	1.193	533 "
60-300	35.0	-75.0	0.259	1.259	1.124	501 "
70-290	23.9	-86.1	0.068	1.068	1.034	462 "
80-280	12.2	-97.8	-.136	0.864	0.931	416 "
90-270	0	-110.0	-.342	0.658	0.812	362 "
100-260	-12.2	-122.2	-.533	0.467	0.684	305 "
110-250	-23.9	-133.9	-.689	0.311	0.558	250 "
120-240	-35.0	-145.0	-.819	0.181	0.426	190 "
130-230	-45.0	-155.0	-.906	0.094	0.307	137 "
140-220	-53.6	-163.6	-.960	0.040	0.200	89 "
150-210	-60.6	-170.6	-.985	0.015	0.123	55 "
160-200	-65.8	-175.8	-.995	0.005	0.071	31.7 "
170-190	-68.9	-178.9	-.999	0.001	0.031	13.8 "
180	-70.0	-180.0	-1.000	0.000	0.000	0 "

(b) The following data shall be submitted with an application for authority to install a directional antenna.

(1) (i) The standard radiation pattern shall be constructed in accordance with the following mathematical expression:

$$E_{std} = 1.05\ [E_{theo} + Q^2]\ ½$$

Now to explain: The E_{std} stands for the field intensity in a given direction, in the final form or Standard Radiation Pattern Form. These values are those plotted in Figure 2. The Etheo represents the "basic" theoretical pattern for the particular array in question. In our case this is the old theoretical pattern shown in Figure 1 and tabulated in column G of Table I. The two factors that the FCC now introduces are the term Q, and the fact that the theoretical pattern, after being modified by Q, is then enlarged by a factor of 1.05 times.

Computing Q

The factor Q is stated by the new Rules to be an orthogonal component. This is a factor which for any given antenna pattern will represent a constant. It is calculated in one of two ways, the larger of which you must use. One way to figure the value for Q is to multiply the value of 6.0 times the square root of the power in kilowatts. This is written as:

$$6.0\ (P_{kw})\ ½$$

If the power of your pattern is one kilowatt, this works out to 6.0. If 5 kW it is 13.4; 10 kW it is 19.0, and so forth. For powers lower than one kilowatt, the new Rules say you must use a value of one. Thus the constant 6.0 is the lowest value you can obtain, regardless of power employed.

The second method of computing this factor Q, is by multiplying 0.025 times the RSS of the unit fields. This RSS term is not to be confused with the RMS of a pattern. The individual towers of any

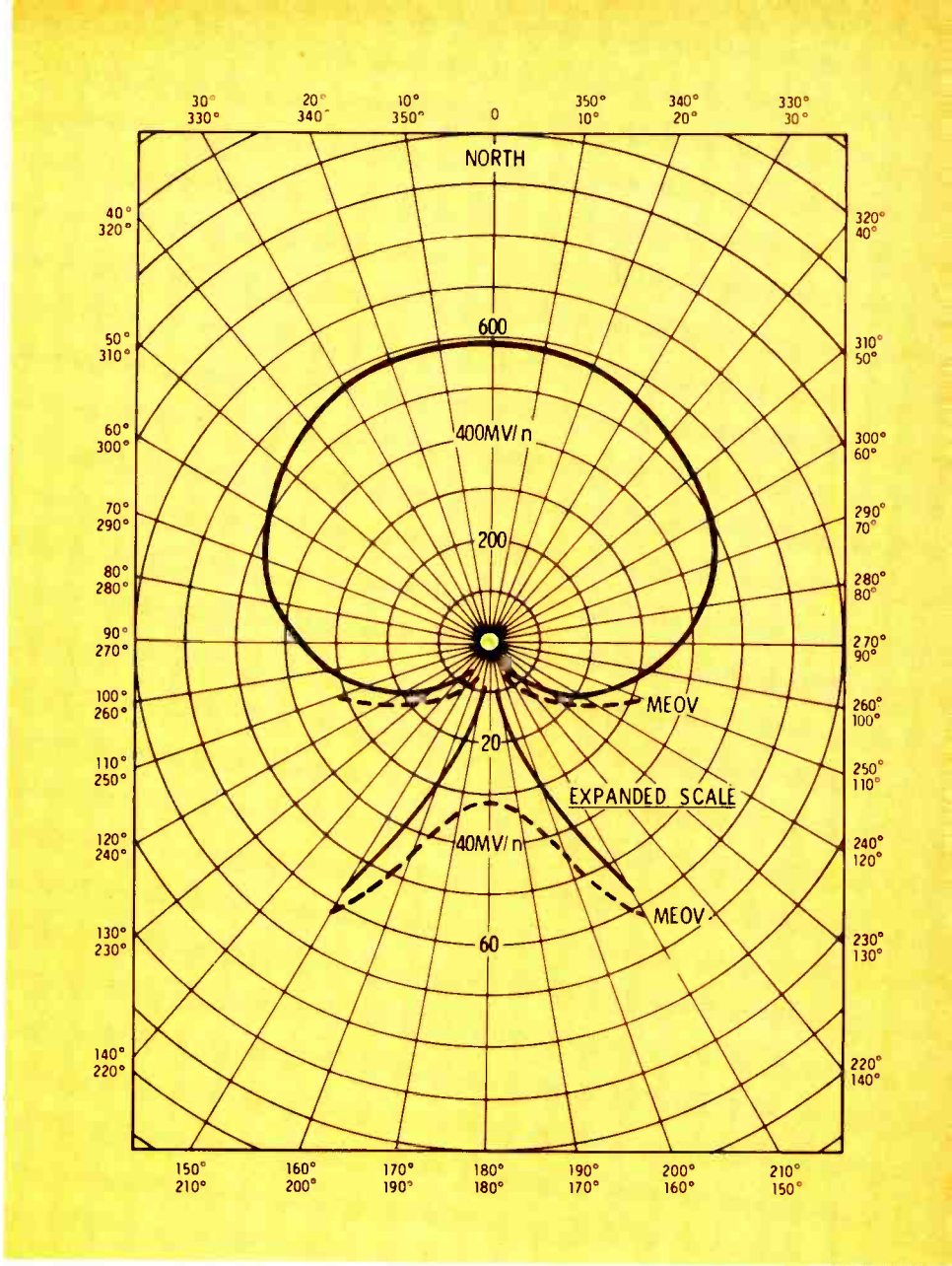

Fig. 1 Old way of calculating patterns.

pattern will each radiate their own field intensity signals. Thus each and every tower in any pattern, if it could be measured alone, produces an unattenuated signal at one mile of the "X" MV/M.

In our two tower example, we have two signals, one generated and radiated by each of the two towers. Had we used three towers, we would have three signals, and so forth. In computing RSS we take the individual signals from each tower and square them. This is followed by adding up each of the individual squares. And then finally taking the square root of this total.

To show you how this works, we take the individual fields for the two towers. In our 5 kW two tower, these are 316 MV/M and 316 MV/M respectively. Each of these fields is squared which gives us 100,000 and 100,000; and then added, to produce a total of 200,000. The square root of this total is then computed to be 447 MV/M. You now have the RSS for this particular pattern.

Having finally arrived at this RSS value, we then multiply it by 0.025. Again referring to our example, we have an answer of 11.2 MV/M.

At this point we must stop and see whether this 2.5 percent of the RSS is greater or less than the constant based upon six times the power in kW. We then find that 11.2 MV/M is less than the 13.4 MV/M; hence, we must use this higher value to represent Q in our new Standard Radiation Pattern. This seems like a lot of extra work, but remember that for any given

pattern Q is always a constant.

I might point out that these calculations are all based upon a daytime pattern. That is, one where only the horizontal plane pattern need be determined. Had we been interested in a nighttime pattern, we would have had to apply the vertical form factor to the above computations of "Q".

To those who are unfamiliar with the vertical form factor, usually expressed as $f(\Theta)$, it is a term that takes into account the radiation characteristics of a given electrical height tower at skywave radiation angles, above the ground plane.

Having now computed this orthogonal factor Q, we apply it in quadrature to our old theoretical pattern. Referring to the FCC's equation in Section 73.150 (B) (1) (i) we find that the original field intensity at any given bearing is squared, then added to the square of "Q"; and the square root of the total then taken.

On Table II, I have shown how the design engineer will then take the old values from Table I and combine them to come up with a new pattern representing both linear and orthogonal components. This end result is then multiplied by 1.05, and you finally have the new Standard Radiation Pattern. This I have shown in the extreme right hand column of Table II and, of course, it is the value plotted on Figure 2.

TABLE II

STANDARD RADIATION PATTERN

A Bearing	B Theo. Pat.	C B^2	D $C + Q^2$	E $D^{1/2}$	F 1.05 x E
0	595	354,000	354,180	595	624 MV/M
10-350	593	352,000	352,180	593	622 "
20-340	585	342,000	342,180	585	614 "
30-330	574	333,000	333,180	574	602 "
40-320	556	309,000	309,180	556	584 "
50-310	533	285,000	285,180	533	560 "
60-300	501	251,000	251,180	501	525 "
70-290	462	213,500	213,680	462	485 "
80-280	416	173,000	173,180	416	436 "
90-270	362	131,100	131,280	362	380 "
100-260	305	93,000	93,180	305	320 "
110-250	250	62,500	62,680	250	262 "
120-240	190	36,100	36,280	191	201 "
130-230	137	18,770	18,950	138	145 "
140-220	89	7,920	8,100	90	94.5 "
150-210	55	3,030	3,210	56.6	59.4 "
160-200	31.7	1,005	1,185	34.4	36.2 "
170-190	13.8	190	370	19.3	20.3 "
180	0	0	180	13.4	14.1 "

Pattern Considerations

There are two more areas to be considered in using this new Standard Radiation Pattern. The first consideration is how to treat those directional patterns where the degree of radiation suppression must be greater than our factor Q will allow. Some allocations do require new stations to suppress their signal, to avoid prohibited overlap, to very low values of field intensity. The fact that many of these stations have been built and do work exemplifies the fact that under good engineering practice, such patterns can be granted.

Possibly your station is one that is so licensed. There are numerous examples of stations with power of 1 kW or less who have nulls suppressed to under the 6.0 MV/M limit imposed by the new "Q" factor. In their decision in Docket 16,222, the FCC has recognized this fact of life. Several of the parties filing comments on Docket 16,222 urged the FCC to establish new rules governing the acceptability of standard radiation patterns incorporating radiation minimums lower than those which the general rule would require. If the FCC had done this, it would avoid the necessity for each such application having to request a waiver of the rules—an action which the FCC only takes reluctantly, if past experience is any criterion.

FCC Position

The Commission states the reason they did not incorporate these new lower limit procedures, is that they fear it would be an open invitation to bypass the newly established radiation floor. The FCC further points out that if a lower floor of radiation is to be achieved and maintained in actual operations, something more than normal attention must be given to all details of design, construction, and operation. The FCC states they are willing to consider such proposals, but only on an undivided basis and will act only when the applicant can convince the FCC, by a suitable showing, that the proposed operation is susceptible to practical achievement.

As a guideline, the FCC outlines the nature of this special showing. I do not wish to interpret what these five points are, since you must seek such interpretation from your stations legal or engineering council. Paraphrased here are my own words for points (A) thru (E) in the FCC order, and no interpretation is implied.

(A) The first area one must make a showing in, is with respect to the proposed antenna site. You must prove it is suitable in all respects for the establishment of the proposed antenna system. You must show that scattering or residual reradiation from structures on or near this proposed site will be of an insufficient magnitude to preclude the adjustment of the measured field intensity within the standard radiation pattern. One approach may be for the FCC to permit partial or temporary constructions to show by use of measurements the suitability of this site.

(B) A showing also will have to be made to prove that the electrical and physical design of the array will insure a stable operation.

(C) A showing as to the proposed phase sampling system to be installed to measure phase angles and remote base currents. This showing will have to include a description of the electrical and physical design details of the phase sampling system, along with a specific evaluation of ultimate accuracy of the system in detecting changes in current amplitude or phase angle relationships.

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with respect to the departures in relative current amplitudes and phase angles, smaller than those which the monitoring system is capable of accurately indicating. This showing must prove that these changes, if they occurred, would not result in a positive radiation deviation of a magnitude which could result in objectionable interference to other stations.

(E) And the fifth point you need to submit a showing on is with respect to the operators, normally manning the directional installation, being able to correct any phase or current deviation.

These points, if convincingly submitted, set forth the criterion upon which a waiver will be granted of the new minimum radiation limits imposed by the Standard Radiation Pattern method.

Built-in Alternative

In establishing these new Rules the FCC points out that the measured pattern cannot exceed the Standard Radiation Pattern in any direction. Nevertheless, they have built into these new rules an alternative procedure, in the event you fail to meet this Standard Radiation Pattern limit, when you measure your new DA. A new Paragraph 73.152 is employed to take care of situations where, due to measurements, a Standard Radiation Pattern must be modified.

If, after construction and final adjustment of a directional antenna, a measured inverse field intensity at one mile in any direction exceeds the field intensity shown on the Standard Radiation Pattern, for that pertinent mode of directional operation, the station must file for a modification of Construction Permit. It will then be necessary to specify a modified Standard Radiation Pattern. In some cases it may be necessary to change the operating parameters, so that all measured effective field intensities will be contained.

This modified Standard Radiation Pattern must encompass all measured fields, and it shall supersede the previously submitted Standard Radiation Pattern for that station in the pertinent mode of directional operation.

If this be your case, you will proceed as follows. First be certain that the excessive measured field

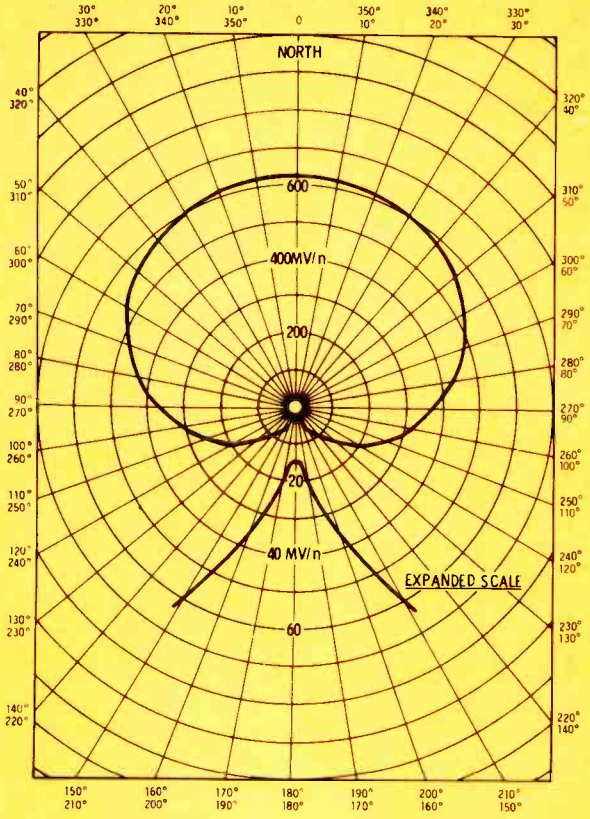


Fig. 2 New FCC method for calculating patterns.

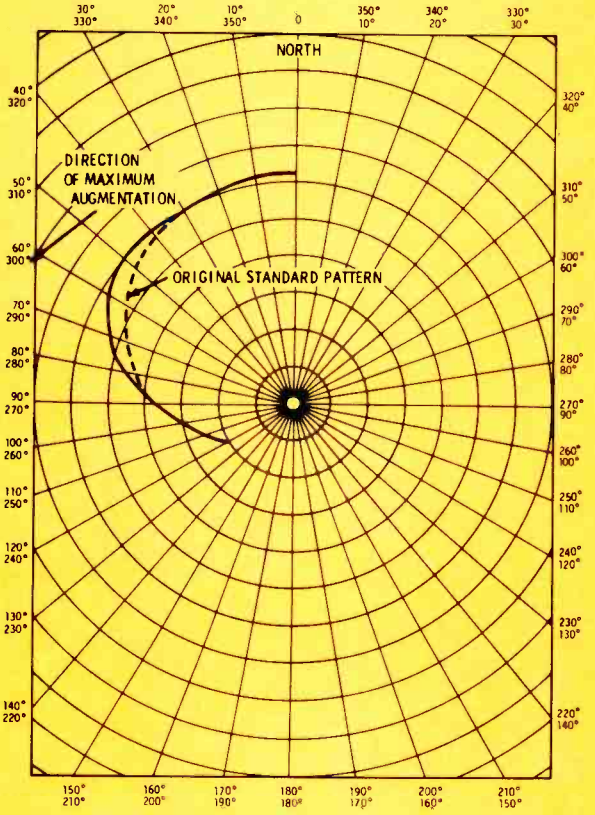


Fig. 3 Augmented Pattern.

does not result in objectionable interference to another station.

If no interference results, it may be simplest to modify the pattern to a larger than original pattern size. If the measured fields systematically exceed the confines of the original pattern, a simple increase in the pattern RMS, may correct the problem.

More than likely the case will be where the measured field exceeds the Standard Radiation Pattern in just one discrete direction. If this be the case, it will be necessary to expand the Standard Radiation Pattern only over a limited sector. This latter procedure the FCC will now call "augmentation". It will be accomplished by still another new formula. This is as follows:

$$E_2 = [E_1^2 + (Q \cos\frac{(180\ D_a)}{S})^2]^{1/2}$$

These terms are defined as E_1 being the original Standard Radiation Pattern calculated for a particular angle before augmentation. E_2 will represent the field in the augmental direction after it is modified. The factor Q is not the same Q we used in the Standard Radiation Pattern, but a new factor based upon the square root of $E_2^2 - E_1^2$. (It certainly would be a help if the FCC had chosen some letter besides Q in these two formulas. It no doubt will result in some confusion.) The value S represents the angular "span" over which augmentation is applied.

At each end of this span the augmented pattern will blend back into the original Standard Radiation Pattern. And Da is the absolute angle between the azimuth at which the augmented pattern value is being computed, and azimuth at which the maximum augmentation occurs. In no event can Da exceed one half of S.

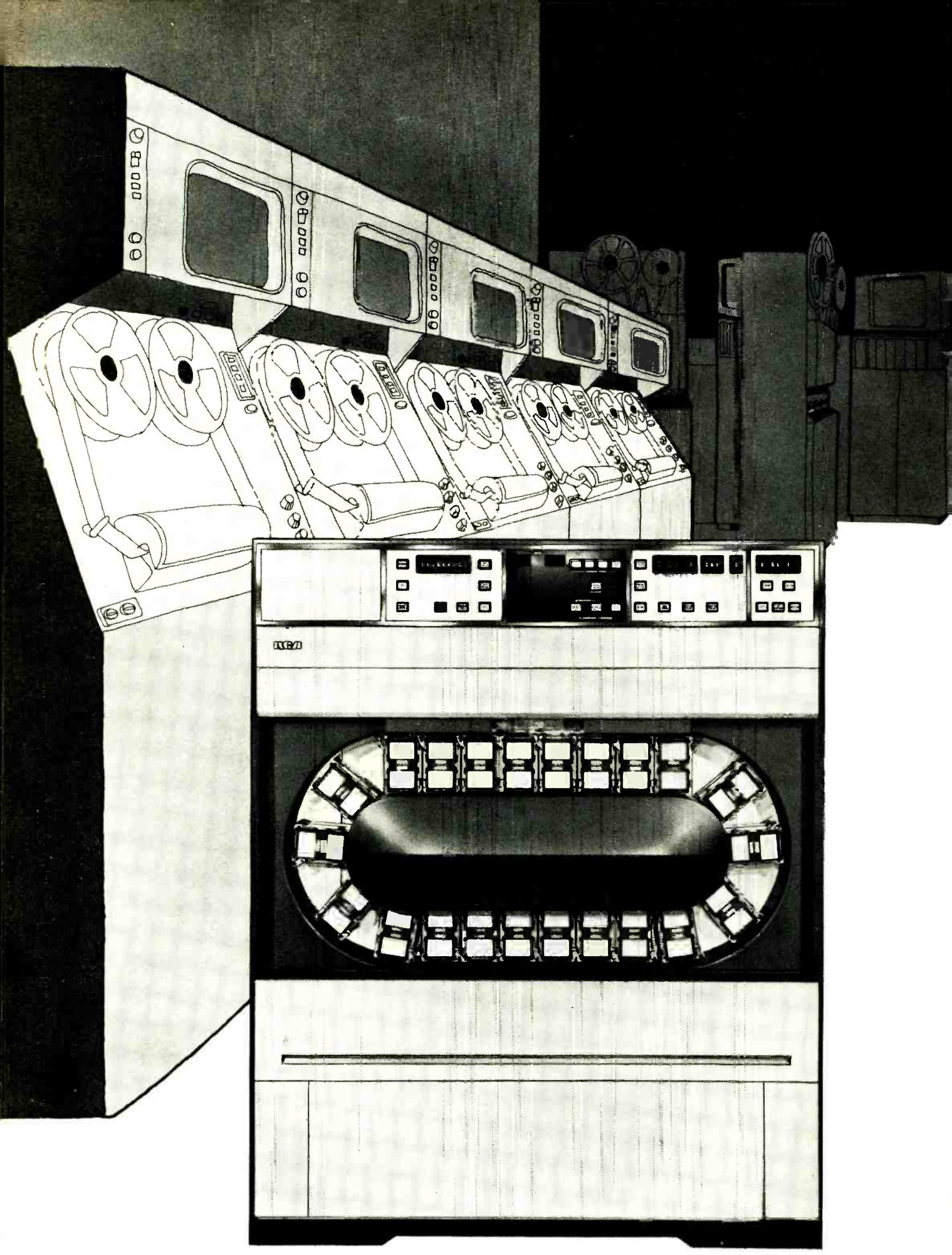
Figure 3 is a polar plot of our Standard Radiation Pattern in Figure 2, incorporating an augmented section. I've assumed that the measured field at 300° exceeds the Standard Radiation Pattern by 10 percent. Applying the augmentation formula, we obtain our Modified Pattern. The dashed line on Figure 3 depicts the original Standard Radiation Pattern fields computed prior to augmentation.

Future Outlook

This, I trust, explains the new method of computing Standard Radiation Patterns, and to some small degree explains the thinking behind this change in the Rules.

The FCC points out that they will make every effort to persuade Canada and Mexico to adopt this new method, for new assignments. They believe this kind of understanding can be reached under the provisions of existing agreements, and no major legal impediment to their accomplishment should exist.

If the FCC is successful, it will mean we can use the same pattern for both domestic and foreign interference determination. And at some time in the future, the FCC says, they may require all existing stations to go to this new method. If so, a public notice to this effect will then be issued ▲



Should you put the 'cart' before the reels?

When a new piece of equipment creates as much excitement in today's cost-conscious broadcast industry as our "cart" machine has done, you know it's got a big potential for both saving and making money. The big question is how much can it do to make your operation more efficient, and what new profit opportunities will it bring? We suggest you take this little quiz and see for yourself what the "cart" machine can do, compared to the tape system you're now using.

1. How long does it take an operator to load, optimize and cue a tape commercial on a "cart" machine?
   a. ☐ 3 sec. b. ☐ 30 sec. c. ☐ 3 min.
2. If you schedule 4 tape commercials during a break, how many "cart" machines would be needed to play them back?
   a. ☐ four b. ☐ two c. ☐ one
3. How many cartridges can be loaded into the TCR-100 at one time?
   a. ☐ 12 b. ☐ 22 c. ☐ 100
4. How many times can a cartridge message be replayed before it starts to deteriorate?
   a. ☐ 25 b. ☐ 50 c. ☐ 100 d. ☐ 200 or more
5. What about tape costs, compared to a reel-to-reel video tape recorder?
   a. ☐ about twice as much
   b. ☐ about half as much
   c. ☐ about the same
6. The "cart" machine can free up your reel VTR's for which of the following tasks?
   a. ☐ teleproduction b. ☐ promos
   c. ☐ previews
7. What can the "cart" machine do about rebates?
   a. ☐ virtually eliminate them
   b. ☐ cut down on them drastically
   c. ☐ nothing much

As you'll see when you've got all the right answers (upside-down, below), the "cart" machine is more than just a piece of hardware. It's a whole new system for saving time and money when you're airing commercials, promos, and ID's. And it opens up new avenues for making additional profits.

If you got more than five answers wrong, we'd say you need a "cart" machine right now. If you got them all right, you probably just ordered one.

And if you haven't already ordered one, ask yourself why not.

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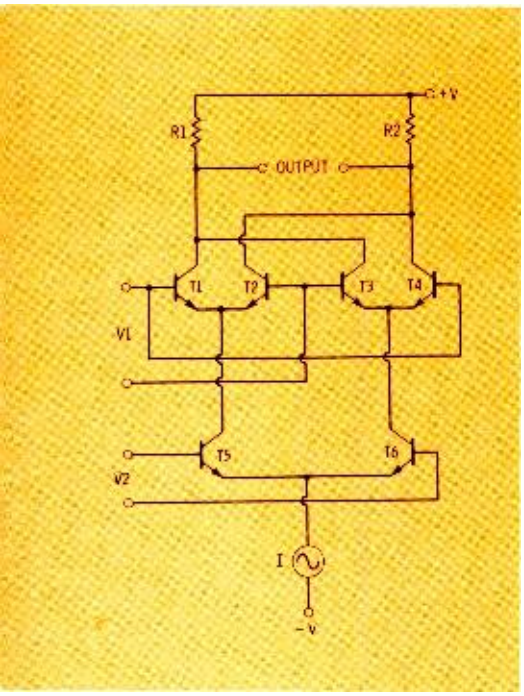

Fig. 1 A doubly balanced modulator.

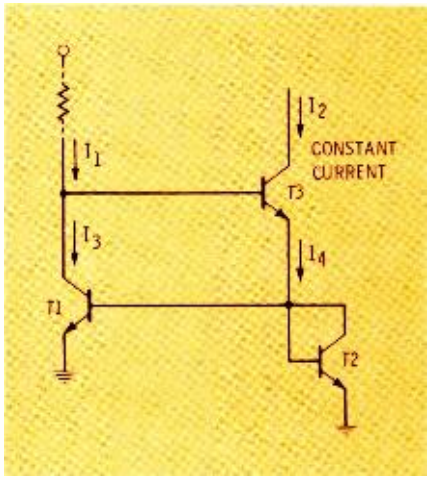

Fig. 2 Such a current source as is shown here is useful to bias other circuitry, and it has led to new circuits for timing, waveform generation, and integration.

By Hans R. Camenzind*

The integrated circuit industry is certainly one of the most spectacular ones ever to appear. It has risen fast and furious to a half billion dollar level in a few short years. Few companies have been put together in a more flamboyant way or have received as much public attention.

Yet the integrated circuit is a curiously lop-sided innovation. The overwhelming portion of all IC's made, some 85 percent, are destined for a rather narrow segment of the electronics industry: digital logic circuitry. In this segment, mostly represented by computers, discrete components have now been replaced by integrated circuits to the level of approximately 65 percent.

In the remainder of the industry, which is roughly three times the size of that represented by computers, integrated circuits are being used in less than 5 percent of all applications!

The reason for the quick acceptance of integrated logic circuits is easy to understand: the same components that were used for discrete logic stages—diodes, transistors and resistors—are again available in IC's. In addition, the larger parameter variation of integrated elements (due to the fact that they cannot be selected) is of little consequence in circuits which are only either "on" or "off".

This, of course, is not the case with the majority of circuits for non-computer applications. (Usually called analog or linear, both rather misleading terms). More often than not we find large capacitors, inductors, transformers, or precision components intimately involved in the functioning of a circuit. It is mainly for this reason that only a relatively small number of non-computer circuits have so far been integrated.

*General manager of Interdesign, Santa Clara, Calif.

The Building Block Paradox

There is more to this story. In order to manufacture an integrated circuit at low cost, very large numbers need to be processed. It is not at all surprising that IC manufacturers have first focused on the circuits which are used by the millions: gates, flip-flops, operational amplifiers.

Gradually, as the competition for these standard building blocks has assumed almost vicious proportions, the product scope has widened into more complex functions and less common circuits.

But let's consider some rather fundamental questions at this point: will standard integrated circuits really do the job? Can we expect to build our instruments and systems from a number of standard off-the-shelf integrated building blocks?

To find the answer, consider this: the transistor is a fairly simple, three terminal device. Yet the proliferation of different types is staggering (more than 4000 2N numbers alone). With an integrated circuit, which allows countless combinations and permutations of as many as 500 transistors in one package, will we ever be able to satisfy even a small portion of all the requirements with a manageable number of standard IC's?

There is another factor. An operational amplifier is meant to be a

universal building block. You would think that it could be used in just about any application where a certain amount of gain is required. Yet to make an operational amplifier truly "universal", serious compromises are necessary. The high input impedance, for example, is opposed to low noise figure. The high loop gain causes the frequency response to be low, etc.

For these reasons IC technology has done little in such areas as communications. The breathtaking promises of huge cost reduction, increased reliability, reduction in size and weight are largely unfulfilled.

Changes Coming

This need not be so much longer. There are some significant changes on the horizon. A number of new tools are now available which, if used imaginatively, can bring the benefits of IC technology into the communications industry.

The first change of significance concerns the available elements in integrated circuits. Although the performance of integrated components is in many respects still somewhat inferior to that of discrete ones (and will most likely remain so), integrated circuit designers have managed to come up with a number of fascinating combinations of elements which provide performance and present possibilities unheard of with discrete components.

To illustrate this let me describe two examples. The first one is the doubly-balanced modulator, illustrated in Figure 1. A current source (I) feeds the emitters of transistors T_5 and T_6. Depending on the polarity and the magnitude of the lower input signal, V_2, T_5 or T_6 receive a portion (or all) of the current I.

Each of the resulting currents is then fed to two or more transistor pairs (T_1/T_2 and T_3/T_4) and again divided according to an input signal (V_1). Finally, in the load resistors R_1 and R_2, the resulting four currents are paired again.

This component arrangement is useful for many applications. First of all, it's a multiplier. If both input signals are sufficiently positive, the entire current flows through R_1. If one of the two is negative, the current flows through R_2. If they are both negative, the current flows again through R1.

A second application is gain control. With a signal applied to one input, the other input controls the gain. If this second input is zero, no signal is passed through. The most remarkable feature of this circuit in gain control application is that no DC shift is created at the output.

A third application is mixing; here the current-steering mode allows high frequency operation.

A circuit of this kind would not have been feasible with discrete components due to the relatively large number of components required and the fact that the transistors have to match well. In IC's, matching to a high degree is automatic and components can be added in rather large numbers without increasing the cost of any measurable way.

Our second example in this category is an element which was hardly known before IC's: the current source. There are many configurations available; we will discuss only one, shown in Figure 2.

First, locate T_1 and T_2. The base and collector terminals of T_2 are connected together, which point is also connected to the base of T_1. If the two transistors are made of identical size, then their character-

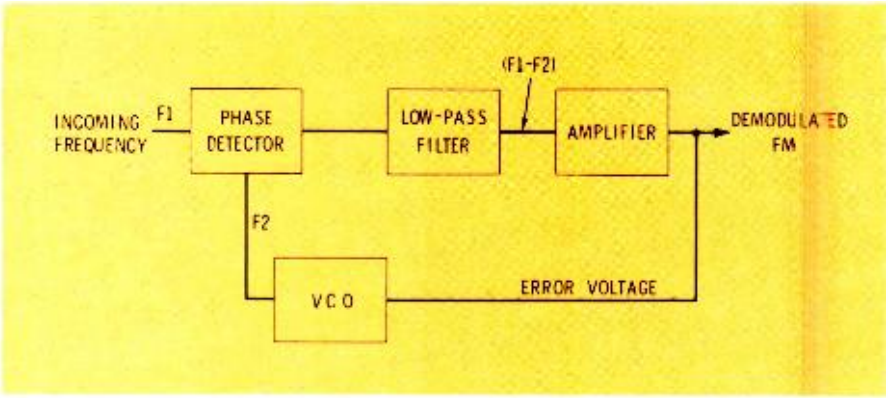

Fig. 3 Block diagram for a simple phase-locked loop.

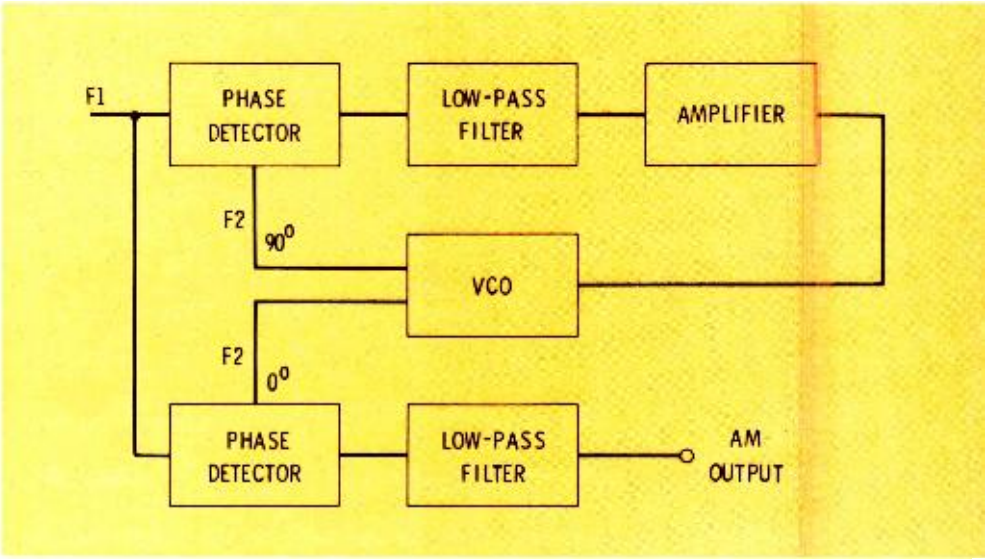

Fig. 4 Special circuit designed to demodulate AM with a phase-locked loop.

istics should match precisely. Thus, when a current flows into the base of T_2 and creates a collector-current in T_2, an identical current must flow into the base of T_1 and create the same collector current in T_1.

The currents I_3 and I_4 are therefore identical, save for a small error due to the lost base currents. This error can be eliminated with the addition of T_3. Now T_1 sinks just enough current to match I_1 and I_2, no matter what voltage (below breakdown) is applied to the collector of T_3.

The only requirement for this current source is that T_1 and T_2 match well. The absolute magnitudes of the device parameters are unimportant. With the process variation normally encountered, I_2 can be held within ½ percent over the military temperature range.

Such a current source is not only useful to bias other circuitry (such as the circuit in Figure 1), but also it has led to a host of new circuits for timing, waveform generation, or integration.

Again we see that a combination of integrated components can produce a highly useful and precise new circuit element!

The Danger of Traditional Approaches

Even with these new circuit elements the value of integrated technology for communications is not assured. More is required.

The major stumbling block is the fact that all of our electronic systems in existence today are very much based on what kind of components were available at the time of their conception. If we devise a new technology and some of the traditional components—inductors for example—are missing, many of the concepts so far used are automatically excluded.

There are, however, almost always alternate approaches. Naturally they look less familiar to us and we are therefore tempted to ignore or even reject them at first. But let me illustrate how the integrated circuit can become a powerful tool, if we accept the fact that there may be other ways of performing a function, even though the traditional method has been in use for more than 50 years.

Our example concerns the replacement of the conventional L-C tuned circuit to perform frequency selection and demodulation. We shall use a concept called the phase-locked loop, which itself is some 30 years old, but has never been used directly for this purpose.

A block diagram of a simple phase-locked loop is shown in Figure 3. An incoming frequency, f_1, is compared with that of the local voltage-controlled oscillator (VCo) in the phase-detector (or mixer). If the two frequencies are identical, their difference is zero and the output of the phase-detector is a DC voltage with a magnitude depending on the relative phase of the two frequencies.

If the incoming frequency is higher or lower than that of the VCo, then the frequency **difference** will appear at the output of the phase detector (along with a large number of higher frequency products). If this difference frequency is low enough so it can pass through the lowpass filter, it will be amplified and fed back to the VCo, causing the VCo frequency to move toward the incoming signal until they

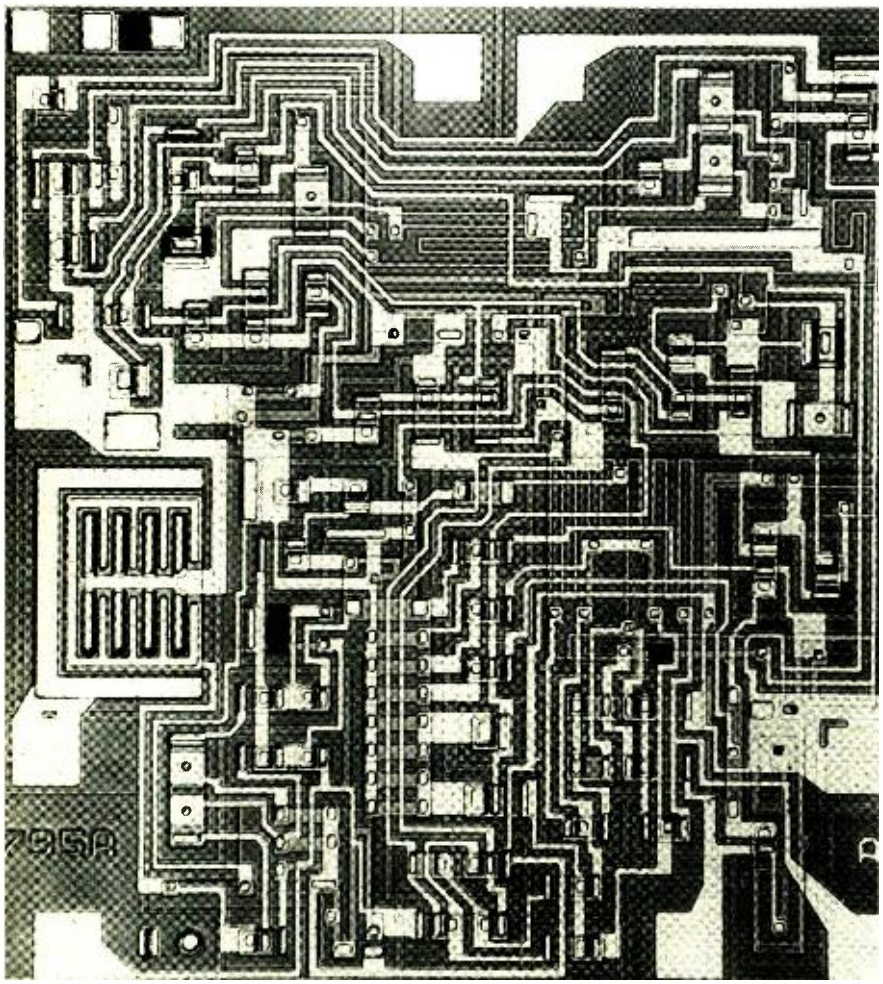

Fig. 5 An example of a phase-locked loop integrated circuit. This one, Signetics NE567, is a tone decoder which, over a frequency range of 1 Hz to 500 Hz, replaces a resonant reed relay directly. (Photo courtesy of Signetics)

READER SERVICE CARD

Broadcast Engineering

FOR ISSUE OF APRIL, 1971

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6	21	36	51	66	81	96	111	126	141	156	171	186
7	22	37	52	67	82	97	112	127	142	157	172	187
8	23	38	53	68	83	98	113	128	143	158	173	188
9	24	39	54	69	84	99	114	129	144	159	174	189
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are identical.

If the two frequencies are too far apart, the difference frequency will be strongly attenuated by the low-pass filter, leaving the VCo unchanged.

Thus, the phase-locked loop is an **adaptive** filter. Once we tune the VCo sufficiently close to the desired signal, it will "grab" it and latch on to it. This is a valuable feature for IC's, since no great precision is required. In addition, a great deal of bandpass-type filtering is achieved with a single low-pass filter; no coils are required.

The phase-locked loop is also at the same time an FM demodulator. As the incoming frequency is shifted, the error voltage fed to the VCo must shift to keep the loop locked. Thus this point is directly the demodulated signal for FM.

It is also possible to demodulate AM with the phase-locked loop. Figure 4 shows such a scheme.

A second phase-detector is added, controlled by the same VCo signal, but shifted 90° in phase. This signal is therefore directly in-phase with the incoming signal if the loop is locked. Thus the second phase detector switches the signal through only during the positive cycles, producing an average voltage proportioned to the amplitude.

Custom Circuits

We have touched on two new developments in noncomputer IC's: the availability of novel design elements and the successful use of alternate systems approaches.

The third development taking place in this area is the emergence of custom designs. It has now become feasible to produce specialized circuits even for small production runs and with a reasonable initial investment. This is primarily due to the use of well controlled, standard processes. A number of companies specialize in the processing of custom circuits; in addition there are companies (such as Interdesign) offering design assistance for custom integrated circuits. ▲

Texas A&M offers CATV technician course

Texas A&M has started an engineering course for CATV technicians and engineers.

This laboratory type school was developed to fill the training needs of the CATV Industry for short course education.

The philosophy of the Engineering Extension Service, Texas A&M University is to educate the man that does the work. This is to help the man on the job to better himself and in turn help the industry as a whole to be improved.

The Engineering Extension Service has been working with the Telephone and Power Utility companies along these same lines, for several years.

Mr. C. E. Swehla of Continental Transmission Corp. attended one of the Telephone Training Management Courses. While there, he noted that a school such as had been set up for the telephone people would be of great benefit to the CATV industry. He, in turn, contacted the Texas CATV Association and the school was born.

The school is sponsored by the Texas CATV Association, and an advisory committee has been set up by them to develop the school. In this way we stay in close contact with the needs of the CATV industry.

Under the guide lines of the advisory committee, an instructor was selected, and the course was set up. The material used was developed under close scrutiny of the committee.

The first course offered by the CATV school is for the Installer. This is a two week course developed to give maximum instruction to the installer of what he needs on the job. He studies: The CATV System as a whole, Basic AC-DC Theory, Basic Math, CATV Section of National Electrical Code, Frequency Spectrum, Reading System Drawings, Coaxial Cable, How to Install Connectors, How to Choose Proper Tap and Install it, Making a House Drop, Trouble-Shooting a Hookup, Basic Television Receiver, Test Equipment, Public Relations, First Aid, Climbing Procedures and Safety.

Classes are set up for a maximum of 10 men, with each man having a full set of tools and equipment for the job to be performed. In this way close personal attention can be given to each student. The school is situated on the Old Bryan Airfield and we have a complete operating system for the student to work on. House drop installations are made inside of a large airplane hanger so weather does not affect the school operation. The facilities include a local origination studio, Head end, 2.5 miles of plant and

Fig. 1 Inside training area at Texas A&M showing poles and strand ready for practice installation. Hanger is shared with telephone and power lineman training schools.

Fig. 2 Victor Miranda of National Trans Video, Los Angeles, practices installing drop cable.

Fig. 3 Pole farm at Texas A&M is maintained for pole climbing practice.

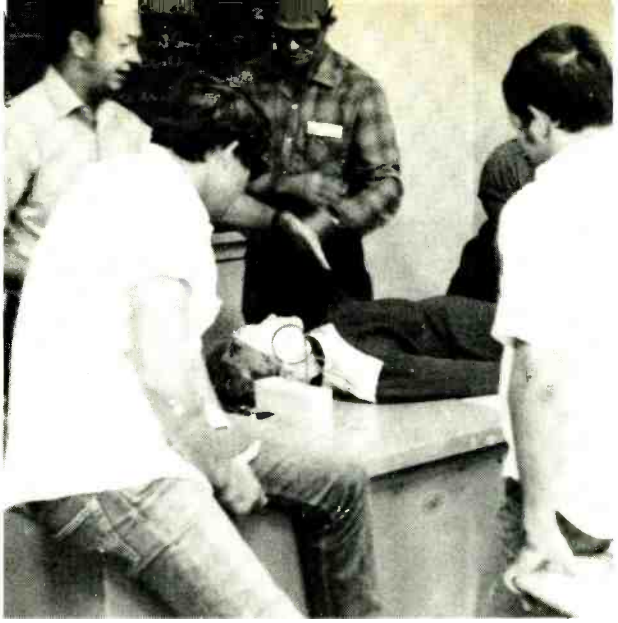


Fig. 4 Valuable first aid training also is given the cable technician students.

the airplane hanger for indoor work.

The student is instructed in proper climbing procedures and safety on poles set up for this purpose.

The classroom building contains three spacious rooms and the head end. Also due to the construction of the plant, there is a distribution run back to this building for drop purposes. By having this long run between the head end and the tap off (2 miles) we can show in the same building what happens to the signal if it is not properly handled.

Public relations is stressed heavily due to the fact, to the customer, the installer is "the CATV Company." Our future plans call for keeping close contact with the CATV industry and develop courses that will meet the total training needs of the Industry.

Equipment being used has all been donated by systems and manufacturers. By this fact the price of the course has been held down to a very reasonable price of $160.00 tuition. We have facilities here on campus for lodging and food service. So a minimum of $212.71 will put a man through our school, plus transportation, to and from the Bryan/College Station area.

There is bus and airplane transportation available, connecting through Dallas and Houston.

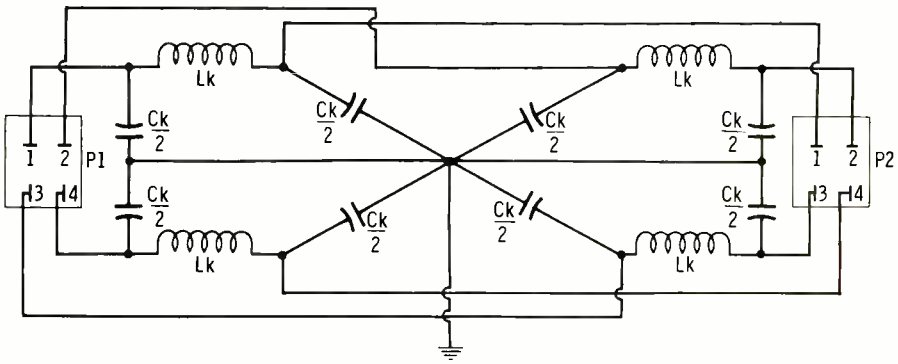
ENGINEER'S EXCHANGE

Telephone RF Filtering

The March 1970 issue contained an Engineer's Exchange item titled "Telephone RF Filter Unit". The circuit shown will work, but some of the information given to arrive at the proper component values should be corrected.

The filter unit in its original form, with the information supplied, indicates a Ck value of 10 kHz and an Lk value of 100 kHz. The article states Fc is the desired frequency to attenuate. Fc is always the cutoff frequency in filter design as shown in Figure 2. If an Fc of 109 kHz as stated was used, the values of the components arrived at by the formulas $Ck = \frac{1}{\pi fcR1}$ and $Lk = \frac{R1}{\pi fc}$ would have been approximately 480 pf and 170 uh respectively.

Constant K low pass filters are easy to design and use. With the assistance of Sams Passive Audio Network Design manual, I designed and used constant K filters shown in Figure 3a and 3b in many places at WJBC-WBNQ. Since most of the RF problems originate from the AM transmitter, the design is quite simple. It is not necessary to use the transmitter frequency in any of the calculations. I select an Fc of approximately 100 kHz. 100 kHz is a compromise to achieve reasonable values of L and C. The curve of attenuation progresses rapidly for each octave from Fc, so that in the broadcast band attenuation is maximum.



An example of filter design for Figure 3a is as follows; Fc = 100 kHz, Ro = Line Z (assume 600 ohms):

$Lk = \frac{Ro}{\pi fc}$, $Lk = \frac{600}{3.14 \times 10^5} = 1.9 MH$

$Ck = \frac{1}{\pi fcRo}$, $Ck = \frac{1}{3.14 \times 10^5 \times 600} = 530$ Pf

For the specific application here, the closest commercial values of components could be used without affecting the filter's performance. High quality components should be used in all filters. The capacitors should have low internal dissipation and the inductors should exhibit high Q at Fc. Surplus toroids are a low cost source of high Q coils.

If carefully constructed, the filter in Figure 3a will have attenuation of 20 dB/octave or better. A sharper attenuation rate can be achieved by joining individual constant K sections. To add sections it is only necessary to make the center inductor the sum of the individual section inductors. A better impedance match over the filters passband is another benefit of join-

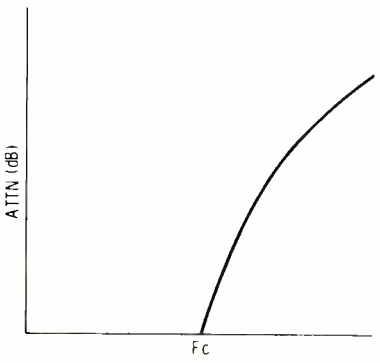


Fig. 2

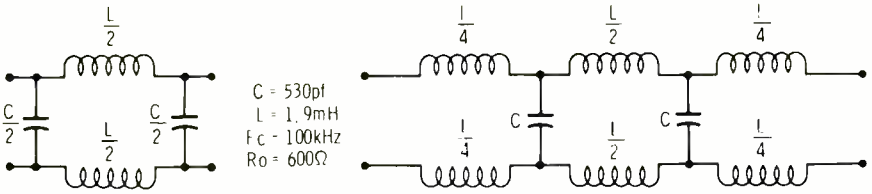


Fig. 3a, 3b

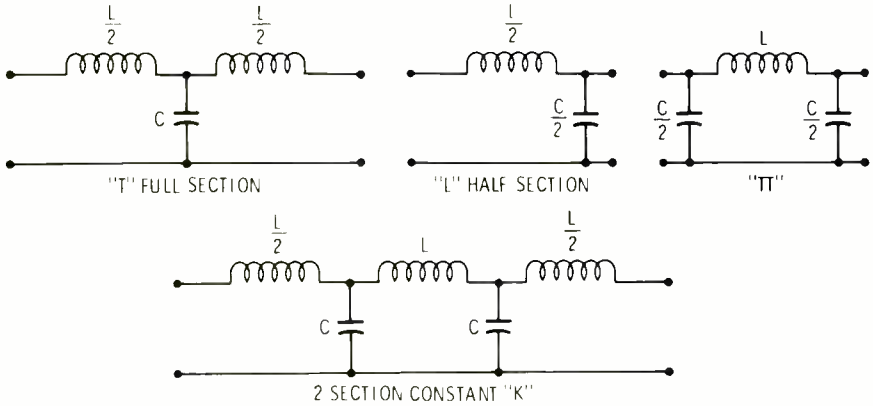


Fig. 4

ing sections.

Figure 4 shows how the same filter can be used in several unbalanced configurations. Ck should not be split and grounded as shown in Figure 1. Hum can be reintroduced if the capacitors do not exhibit equal Xc over the passband.

I am not an expert in filter design, but I feel my experience might benefit others with similar problems.

Marvin J. Beasley
WJBC/WBNQ
Bloomington, Ill.

Videotape Braking Problem

We were being plagued with intermittent braking action on one of our video tape recorders. Every once in a while when you stopped the tape deck the brakes would hesitate about one third of a second before operating. This would result in the tape going slack, which was annoying when cuing up tapes.

This problem would show up for part of a day then go away for a few days. Then it stopped going away and we found the brake solenoides were staying magnitized. Degousing them did not help at all.

Then we noticed one solenoid on the deck giving us the problem. It was running hotter than normal. A current check indicated it was drawing more power than the other solenoids and a resistance check showed some shorted turns which were not stopping it from working, but were enough to prevent adequate back EMF, when the power was removed to cancel the magnetic field and cause immediate release. Therefore, it would take part of a second for the solenoides magnetic field to die, releasing the solenoid.

A quick check with the scope showed a counter EMF of only about 10 percent the applied voltage with the bad solenoid in the circuit. A good solenoid produced approximately 100 percent of applied voltage which quickly cancelled the magnetic field. Most tape deck brake systems use two solenoids wired in parallel. One for each hub. Even if only one developed a short, it would affect both solenoids.

So if you have any DC solenoids that are slow in releasing, check for shorted turns on the solenoid.

D. Khalil Jones
Studio Engineer
KID-TV
Idaho Falls, Idaho

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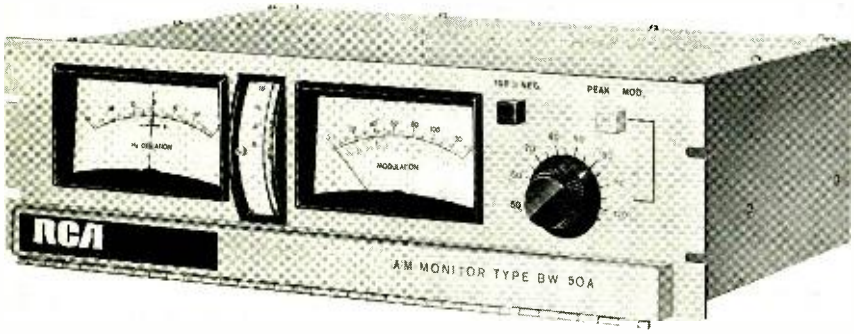
NEW PRODUCTS

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

Modulation/Frequency Monitor



A combination modulation and frequency monitor for AM transmitters, designated the BW-50, has been announced by **RCA Broadcast Systems** along with the companion BW-60 RF amplifying unit.

The BW-50 is described as a new approach to accurate AM transmitter monitoring and is the first combination unit of all solid state design. It features a 100 percent negative peak indicator which is independent of any calibration procedures.

The companion amplifier permits the monitor unit to be used at a remote point, usually the broadcast studio. It amplifies an off-air signal without modifying the signal's other characteristics.

Circle Number 60 on Reader Reply Card

Character Generator

TeleMation introduced the TCG-1425 Electronic Character Generator at the NAB Convention.

The TCG-1425 incorporates a number of features to facilitate composition and editing, including automatic line-by-line centering; a unique hop function to shift a group of characters or words 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.

The unit functions in a static page display, in horizontal crawl and in vertical roll. 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.

Circle Number 61 on Reader Reply Card

Boom Mount Assembly

A complete boom mount assembly that makes possible support, control, and mechanical isolation for the Shure Model SM53 Microphone has been announced by **Shure Brothers Inc.,** Evanston, Illinois.

The assembly is made up of four accessories, starting with the A53M isolation mount. Designed exclusively for the SM53, it cuts mechanical shock and vibration to virtual insignificance. It can be used with desk stands, floor stands, and lecture podiums in addition to booms.

To reduce noise from wind gusts caused by swift boom swings and air gusts indoors and out, the assembly provides an A53WS windscreen. Both front and rear windscreens are included.

The rugged A53E extension pipe makes it possible to lower the actual microphone mounting assembly an additional 20 inches below the boom to minimize difficult shadow problems.

And to isolate vibrations reaching the microphone through the cable, Shure offers the A53C isolation cable. The 18-inch A53C is designed for use with the A53M mount. A longer version of the same cable is built into the A53E extension pipe assembly.

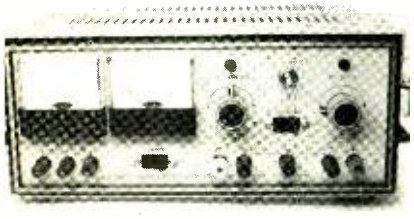
Circle Number 62 on Reader Reply Card

Regulated Power Supply

An addition to the **Heath** line of power supplies is their IP-17, a variable 0 to 400 VDC regulated kit.

It does offer several other voltage possibilities: 0 to −100 VDC and 6 or 12 VAC. The higher range voltages are variable, and measured continuously by a voltmeter and a

milampmeter. When both high voltages are in use, the voltmeter can be switched to show the + or − voltage. And so there will be no confusion as to which voltage is being indicated, a pilot light comes on over the pot control that is being read.



The AC and DC outputs are isolated from ground and from each other. The unit uses circuit board construction and a wiring harness is supplied.

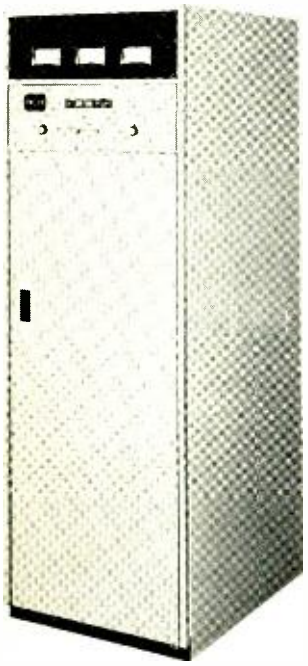
Output variation is less than 1 percent from no load to full load, and output variation is less than 1 percent when a 10 percent or less line voltage change occurs. Jitter and noise free. The IP-17 is $110 wired, $69 in kit form.

Circle Number 63 on Reader Reply Card

Translator Amplifier

Emcee Broadcast Products has introduced the new TOA-100A 100-watt UHF linear amplifier for color television translator service. The amplifier is designed for operation in NTSC and European CCIR systems.

According to the company, this unit can also be supplied as an ultra linear amplifier or, with the addition of its own driver, can be supplied as a complete 100-watt translator. In translator form it may be used as the driver for Emcee's 1 kW UHF translator amplifier.



The TOA-100A utilizes a long-life ceramic planer triode, type TH-328. The 750 watt plate dissipation of this tube insures long life and linearity for use as a 100-watt amplifier. The unit covers channels 14-83 and CCIR bands IV and V.

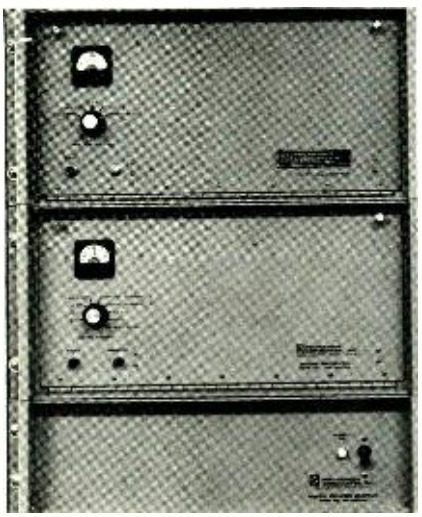
Like the recently-developed 1 kW, the TOA-100A is extremely economical to operate. Typical hourly cost figures are: .05¢ per hour for the electricity.

Front panel metering is provided and includes plate current and plate voltage, filament voltage, bias voltage, peak visual power, aural power, and reverse power.

Circle Number 64 on Reader Reply Card

Relay System

The MA2H total solid state television relay system by **Microwave Associates** has been developed for high power intercity color or monaural television relay broadcast applications. All solid state power output of the MA2H transmitter is



10 watts (5 watts or 20 watts optional). Receiver IF frequency is 70 MHz. Noise figure is 10 dB or 6 dB with low noise preamplifier included.

According to the manufacturer, S/N (EIA weighted) exceeds 72 dB per hop, and differential gain is less than ±0.3 dB, differential phase is less than ±0.5 degrees and frequency response is ±0.3 dB maximum over 3 hops.

Ten-hop performance exceeds 62 dB video signal to noise.

No klystron or TWT amplifiers are used for cost savings in elimination of spare tubes. The MA2H is priced at $9,000 per basic repeater system.

Multiple audio program subcarriers are available for use with the MA2H system.

A complete repeater including transmitter, receiver and power supply occupies only 22¾ inches of vertical rack space in a standard 19-inch EIA rack. Power consumption is 120 watts.

Circle Number 65 on Reader Reply Card

Coaxial 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 ½", ⅞" and 1⅝" 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

(Continued on page 60)

New Products

(Continued from page 59)

of high power, low attenuation, good frequency 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 ½" and ⅞" cable sizes and a hollow copper inner conductor in the 1⅝" cable size. The dielectric is a foamed polyethylene. A Habirlene jacket can be supplied over the outer conductor of corrugated copper for added protection.

Copper corrugated Cuflex coaxial cable in ½" diameter size carries catalog number FXCC 12-50; ⅞" diameter, catalog number FXCC 78-50; and, 1⅝" diameter, catalog number FXCC 158-50.

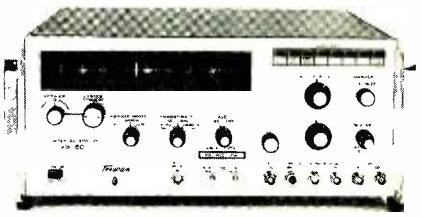
Circle Number 66 on Reader Reply Card

Sweep Signal Generator

Texscan Corporation announces the Model VS-60 sweep signal generator. The VS-60 covers the 5 MHz range in one hand. The VS-60 can be swept up to its full width while having sufficient stability for narrow band circuit testing.

One of the highlights of the VS-60 is the versatile marker system. The instrument has provisions for both single frequency and harmonic type frequency markers with crystal accuracies of 0.005%. The unit also has provisions for accepting CW frequencies from external sources to provide additional marker capabilities.

The VS-60 provides a full 10 mw of output power in both the CW and sweep modes. This instrument has a 0 to 3 dB vernier output control, a 0 to 10 dB in 1 dB step rotary attenuator, and a 0 to 60 dB in 10 dB step rotary attenuator.



Other standard features include sweep rate that is variable from 20 seconds per sweep to 16 m.sec. per sweep (60 Hz), built-in kHz square wave modulation, and an external input to the automatic leveling circuitry for externally leveling at the device under test.

Circle Number 67 on Reader Reply Card

Automatic Color Corrector

An advanced solid-state system that automatically senses and balances color variations in television programs while they are on the air was shown for the first time to the nation's broadcasters by **CBS Laboratories,** a division of Columbia Broadcasting System, Inc., at the National Association of Broadcasters annual meeting in Chicago March 28-31.

The Automatic Color Corrector Model 6000 is the first system of its kind to operate in real time unattended to maintain consistent color balance for live or recorded program material.

The new system, which has been under an intensive evaluation program at the CBS Television Network, will be integrated into broadcast operations for on-line use as soon as possible, according to Joseph A. Flaherty, General Manager of Engineering and Development for the network.

The Automatic Color Corrector 6000 will be marketed for less than $5,000 under an exclusive franchise distribution by the CBS Laboratories Professional Products Department.

In operation, the Color Corrector eliminates the problem of color matching when a studio program, for example, is succeeded by tape

or film, or by a segment made outdoors under varying lighting conditions.

The system also makes it possible to adjust color program balance a videotape playback. In addition, program segments and television commercials shot at different times under varying light conditions can be previewed with the unit and their color tones balanced automatically to match the overall program. As a result, corrections are made in real time without the viewer sensing any variation.

The automatic color corrector—which was invented by Renville H. McMann, Jr., CBS Laboratories Vice President for Engineering, and Clyde W. Smith, a senior engineer with the Electronic Systems Department—balances the color tones by generating a correction signal. This signal is added to the incoming signal only when required. The system closely simulates operating controls used to balance one camera or videotape against another.

Circle Number 68 on Reader Reply Card

Video Switcher

Ball Brothers is introducing a video Production Center VPC-8 with combined switching, effects, signal generation and video processing to allow the production of television program information in a compact package suitable for monochrome or color remote van operation.

The VPC-8 has 8 video inputs, self-generated black and the following effects: mix, external key, 3 wipes, and mat, 4 busses with complete preview facilities, A and B mix. The above allows complete production flexibility. Vertical interval switching is performed with lighted push-buttons designating switch selection. Standard EIA rack mounting of 10½″ for the electronics, 5¼″ rack for the separate power supply. Prices are: 4 input, $3240; six input, $3840; eight input, $4450.

Circle Number 70 on Reader Reply Card

Film Chain

Until a suitable and economical programming pattern emerges, CATV operators must look to existing sources for material. The most readily available is the vast library of 16mm films from governmental, educational and industrial sources, as well as from commercial film rental libraries. Most are available to CATV operators and can be

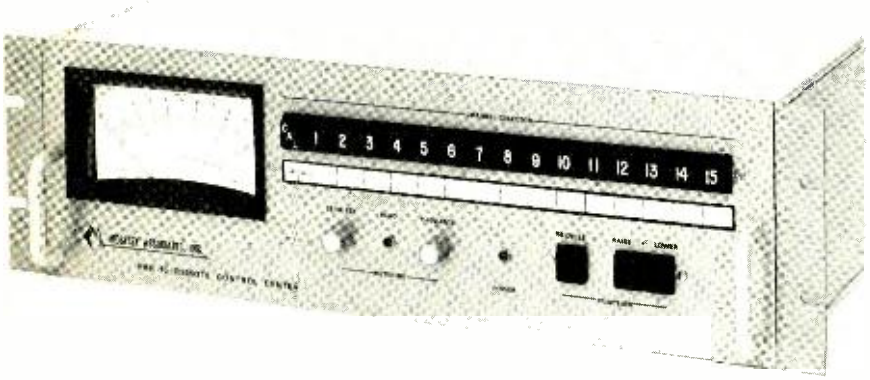
(Continued on page 62)

Remote Control System

A new all solid-state, 15-channel remote control system has been announced by **Moseley Associates, Inc.,** of Santa Barbara, California.

The system, designated Model PBR-15A, has 15 metering positions plus calibration, and will handle up to 30 individual control functions. Three basic versions of the system are available utilizing plug-in printed circuit modules for field convertibility to fulfill future requirements without rewiring. These versions are the PBR-15AD for operation over a single DC telephone line.

The PBR-15AW operates over a single voice-grade telephone circuit, and the PBR-15AR is for radio (STL) or wireless applications. The standard radio version includes a control subcarrier generator and detector for use with the firm's aural STL's. An optional alarm system is available.



Circle Number 69 on Reader Reply Card

(Continued from page 61)

cleared for use on commercial television.

16mm motion pictures are put on television by the use of special projectors whose shutter is synchronized with the scanning rate of the TV camera. The projector and camera are close-coupled to eliminate stray reflections, and the audio is amplified directly from the sound track of the film. More sophisticated equipment now includes up to three audio-visual inputs which can include a 16mm film, 35mm filmstrip and 2 x 2 slides.

A new maxi-media Multiplex Film Chain of this type is announced by **Kalart Victor** of Plainville, Connecticut. It features extremely fast image transfer so media changes can be made while the camera is on line. Such equipment is a boon to CATV operators whose need for low priced studio equipment encompasses many forms of local program origination.

Circle Number 71 on Reader Reply Card

Audio Control Center

A unique "Audio Control Center," combining complete program audio and monitoring amplifiers has recently been introduced to broadcasters by **Gates Radio Company.**

Although intended primarily for controlling audio in program automation systems, the Gates Audio Control Centers will find applications in many other broadcast audio installations.

Available in mono or stereo versions, the Audio Control Center combines VU metering, program output, and audio monitoring in one compact 5½ inch rack-mount unit. The stereo version also has a provision for the L+R, sum channel, output module.

The Gates ACC-1 monophonic audio control center is fully self-contained in a 5½ inch rack mounted unit while the ACC-2 stereophonic package includes a separate 3½ inch power supply panel which may be mounted adjacent to the ACC-2 control center or separated up to ten feet.

Solid-Statesman modular amplifiers, as used in Gates' broadcast audio consoles, provide high performance with program amplifier output capability up to +26 dBm (+8 dBm nominal) and plug-in monitoring amplifiers at 10 watts (+40 dBm) per channel.

Circle Number 73 on Reader Reply Card

Sync Generator

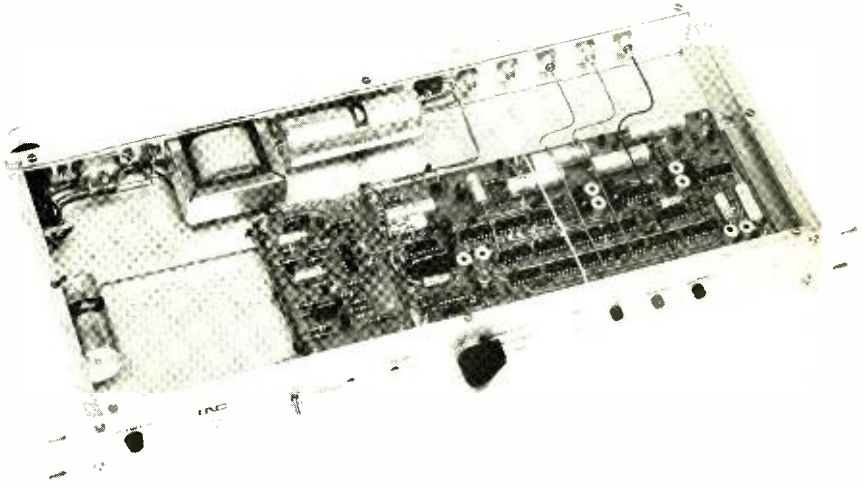
The **International Nuclear** Model #TSG-502-L sync generator is a professional quality monochrome sync generator designed for Broadcast, CATV, CCTV and ETV small studio video origination systems.

The INC Model TSG-502-L sync generator is a solid-state unit, using integrated circuit binary elements for both the countdown from the 31.5 KHz and for the generation of the vertical timing intervals. This system insures that these intervals are exactly controlled by the 31.5 KHz timing pips generated by the crystal and provides horizontal drive, vertical drive, composite sync and composite blanking signals in accordance with EIA-RS-170 and Broadcast television standards.

The AC line lock module number ±52-683 provides sync output with the vertical component phase locked to the AC power line.

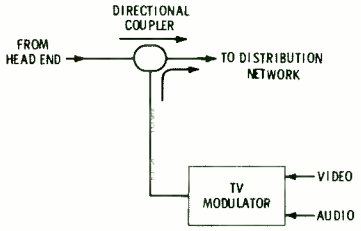
Front panel controls and switch provide 180° phase shift and approximately ±80 degrees of continuously variable phase shift adjustment of vertical sync relative to the 60 cycle power.

A three position switch selects the Internal 31.5 KHz crystal, external 31.5 KHz drive or drive from INC Model TCS2 Color Standard, or AC Line Lock.



Circle Number 72 on Reader Reply Card

(Continued from page 20)



dual-oscillator system (Figure 7).

Since a TV station transmits a vestigial sideband AM visual signal, and a double sideband visual AM signal is produced when using either of the above techniques, the unwanted (lower) visual signal sideband should be tapered off to avoid interfering with an adjacent channel. This can be accomplished by including a vestigial sideband filter or by tuning the visual signal RF amplifier so that the band occupancy will be as shown in Figure 8.

As stated earlier, the aural and visual RF signals are fed to the cable through a combining network (diplexer) of which a circuitry example is given in Figure 9.

Much wider use of TV modulators will be made as more CATV systems start originating their own programs. The TV modulators and off-the-air TV signal processing equipment are usually installed at the head end. This is convenient when the LOP studio is at or very near the head end.

The studio, however, can be downstream alongside the trunk cable, when more convenient. In this case the TV modulator for the LOP channel can be at the studio and its output can be fed into the trunk cable through a directional coupler, as shown in Figure 10. The LOP signal injection point, however, must be ahead of the first bridger. ▲

TECHNICAL DATA

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

100. ATLAS SOUND—Compact, high-audibility Model EC-10 loundspeaker is described in a new literature sheet from Atlas Sound. The double re-entrant type EC-10 is designed for use in sound systems or in conjunction with mobile and citizen band transceivers. Also, its frequency response range makes it particularly suitable as a highly sensitive microphone for intercom talk-back applications. The sturdy, weatherproof, 6-watt unit is designed for indoor or outdoor installation and for applications requiring small size, low weight and modern appearance.

101. BELL P/A PRODUCTS CORP. — A new six-page catalog from Bell P/A Products Corp. gives detailed specifications and descriptions of the company's broad line of commercial sound components and special purpose sound system products. Designed for insertion into standard catalog binders, the double-fold catalog covers a wide array of Bell P/A sound system products including amplifiers, tuners, boosters, mixers, turntables and record changers, carrying cases and cabinetry. Highlighted are the various families of Bell P/A amplifiers. Complete specifications and photographed configurations are included for the Bell P/A Mod Series; the Carillon Series; the TPA (Transistorized Power Amplifier) Series, and the SLA Series of automatic limiting amplifiers. The Mod Series amplifiers feature one to eight modular input preamps. The unique packaging makes possible a virtually unlimited number of applications for output power requirements from 20 watts to 200 watts at 5 percent, total harmonic distortion.

102. CHIRON TELESYSTEMS—A two-page brochure describing the Model D-1500, a totally self-contained, compact, low-cost key-

board/memory/display character generator is now available. The generator offers 15 rows of display and features capabilities found in more expensive titling systems. The Model D-1500 Television Character Generator is priced at $4,000.

103. CHRONO-LOG CORPORATION—The Chrono-log Series 3000 Oscillographic Time Code Generator is described in a new bulletin. This new instrument records real time or elapsed time on a recording oscillograph and provides the actual time of occurrence of phenomena recorded on other channels. Recordings from different oscillographs can be precisely correlated on a time basis. It is possible to read the exact time to one second resolution at any point in a trace without having to search back over long chart rolls. The bulletin gives complete technical data and describes the operation in detail.

104. CLEVELAND INSTITUTE OF ELECTRONICS — A new 24-page, full-color brochure describes "a practical approach" for training of employees in industry. The brochure describes how unique method teaches workers quickly and economically the specific electronics knowledge they need. It explains how full-time employees can be trained on their own time, at home, or on company time.

105. COHU ELECTRONICS, INC.—A new color sync generator for broadcast television stations that provides jitter-free sync from a digitally-generated time base is described in data sheet 6-534 published by Cohu. The data sheet includes a complete description of the sync generator and its options including BNC or UHF connectors.

106. HEWLETT PACKARD CO.—Finding the right power supply is simple using the tables in a new Hewlett-Packard "DC Power Supply Selection Guide". General purpose and special purpose power supplies are listed by voltage and current output in this new 36-page booklet. Either the voltage range or current output desired are selected from the tables, and specifications of appropriate supplies are given in columns below. The easy-to-read specifications include ratings performance and special features.

For More Information on Products advertised or described in this issue use Free Reader Service Card. Be Sure to include your name and address.

bookreview

Electric Generating Systems is the kind of handbook you need if you have any kind of standby or emergency generating system in your plant. It's written by Loren Mages.

While the author does not show a variety of manufacturers' equipment, he does go into detail on everything from the selection of systems to their maintenance. In this connection, there is a lengthy chapter on trouble shooting generating systems.

Of special interest to broadcasters who maintain emergency power systems or are thinking in that direction is a chapter on system installation. In many cases the emergency power plant fails because of improper installation. The author has (and this editor, too) seen installations that look good, but are destined for troubles of their own.

This book is available by book number 23179, AUDEL BOOK DIVISION, Howard W. Sams & Co., 4300 West 62nd Street, Indianapolis, Ind. 46206.

Closed-Circuit Television Production Techniques is concerned with the production principles that are involved in closed-circuit television presentations. The authors, Larry G. Goodwin and Thomas Koehring cover the technical aspects, studio layout, camera operations, audio, lighting, graphics and sets, scripts, and presentation techniques of the field.

The final chapter is devoted to the broad scope of the applications of closed-circuit television. Many of the actual applications in the fields of education, medicine, sports, business and industry, and others are described.

This book goes a long way to offer closed-circuit television users simple, but thorough, production principles that can be used in day-to-day operations.

This book is available through HOWARD W. SAMS & CO., INC., The Bobbs-Merrill Co., Inc., 4300 W. 62nd Street, Indianapolis, Ind. 46206.

FET Applications Handbook is one of the most current and comprehensive guides available for anyone needing practical design data on FET circuits. Now containing nearly 25 percent more material than before, the updated and expanded second edition contains six new chapters.

The content covers FET types, parameters and characteristics, and operational modes. Emphasis is on applications from linear circuits to switching circuits and IC's.

The in-depth information provided in this book will be of value to anyone looking for new ideas and unique circuit applications, including many basic circuit descriptions.

Illustrated with over 250 circuit drawings and graphs, the content includes practical mathematical analyses to explain operation and design detail. Appendices contain often-needed design data and charts arranged to serve as a convenient quick-reference source.

This book is available through TAB BOOKS, Blue Ridge Summit, Pa. 17214.

FCC Invites Comments On Program Identification Ruling

The FCC has invited comments in a further rule making notice (Docket 18877) in an action that would amend Part 73 of the Rules.

This action deals with rules authorizing the use of coded information in the aural transmissions of radio and TV stations for automatic program identification. It also questions whether the rules should be based on proposals by Audicom Corporation or International Digisonics Corporation (IDC), or some modification of their two proposals.

The Commission also invited comments on a proposal by Storer Broadcasting Company for possible licensing and regulation by the Commission of those furnishing encoded material to broadcasters.

The Commission authorized Audicom and IDC to conduct on-the-air tests of their systems and to file reports of the results by June 1, 1971.

In a rule making notice of June 10, 1970, the Commission had invited comments on possible adoption of a rule based on an aural program identification system developed by Audicom. IDC, author of a visual identification code system on which the Commission based its amended rules permitting TV stations to transmit a visual code for program identification (FCC 69-765), petitioned the Commission to expand its rule making to consider an aural identification system it had devised that is substantially different from Audicom's. IDC's petition was supported by Audicom.

The Commission found IDC's request in the public interest. It stated that since the IDC and Audicom systems are alleged to differ in the degree to which the identification information affects programming, and in the level of reliability at which the identification function will be performed under practical operating conditions, both parties are expected, in the tests they will make, to thoroughly investigate these aspects of their respective systems, and to present the results in a form permitting comparative evaluation.

Audicom had proposed a system using a frequency modulated identification signal, placed in a "window" 60 c/s in width, cut in the program material for the duration of the signal transmission (two seconds) at a frequency of about 3000 c/s, with a maximum signal intensity limited to a level not in excess of minus 50 dB with respect to 100 percent modulation.

IDC proposed the use of a coded identification signal centered on the frequency 100 c/s, with an occupied bandwidth of 20 c/s. Information in this band would be carried by pulse duration modulation at a level not exceeding minus 12 dB with respect to the level for 100 percent modulation. Transmission time for any single identification code would not exceed four seconds.

Interested parties may file comments on the Commission proposals on or before July 1, 1971, and reply comments on or before August 2, 1971.

Action by the Commission February 10, 1971, by Notice of Proposed Rule Making. Commissioners Burch (Chairman), Bartley, Robert E. Lee, Johnson, H. Rex Lee, Wells and Houser.

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Equipment Wanted

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

WANTED IMMEDIATELY. One KW AM Transmitter, good condition. Also interested all AM, FM Transmitters. Geleco Electronics, Thorncliffe Dr., Unit 28, Toronto 17, Canada. Phone 416-421-5631. 4-71-1t

TEST EQUIPMENT wanted: field intensity meter, RF bridge, frequency measuring, etc. Dept. 253, Broadcast Engineering. 4-71-1t

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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. Broacast 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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For Sale—two Gates model SA-39 limiters, excellent condition—$225 each. One Hewlett-Packard model 335 FM frequency modulation monitor — $275. WSOM, Salem, Ohio 44460—Phone 222-1011, area code 216. 4-71-2t

Sound level meters, General Radio 1551C, $285 each. New-never used, F.O.B., S. Mieth, P. O. Box 456, Santa Ynez, Calif. 93460. 4-71-1t

RCA COLOR TELEMURAL PROJECTOR. Projects color TV picture for auditorium or classroom. 800 people can easily view 6'x8' picture. TLS-50 takes standard NTSC video input w/separate or composite sync. and is complete w/portable cabinet, speakers and instruction manual. Good condition. Make offer over $1000. Alan Gordon Enterprises, 5362 Cahuenga, North Hollywood, Calif. 91601. (213) 985-5500. 4-71-1t

AMPEX VR-1002, allenized with Amtec; 2 GPL 16mm film chain projectors, much other used television equipment. Call or write: Marquette University, Radio and Television, 625 North 15 Street, Milwaukee, Wisconsin 53233. 224-7467. 4-71-1t

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

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

Surplus audio and video patch panels and patch cords. 500 to 500 ohm repeat coils flat to 20,000 cycles. Send for list. Gulf Electro-Sales, Inc., 6325 Beverly Hill, Houston, Texas 77027. 9-70-tf

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2	TK20C Icon Cameras	each 200.00
12	580D power supplies	each 50.00
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1	General Electric master monitor	200.00
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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	2000.00
1	Ampex VR1000B tape recorder with 3 Mark III heads	$500.00

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 6⅛" line breakaway ass'y $225.00. ea. Andrew No. 23187 adaptor section w/O ring and hardware $10.00 ea. Bird No. 461000 line section 50KW, 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. 3-71-2t

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P17X30B2

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This lens is most suitable for telecasting in dim light conditions, providing ideal pictures for field events in huge open areas like race tracks and athletic fields.

Here are a few examples of the whole Canon line.

	Manual	Servorized/Motorized
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1" plumbicon	PV10X16 PV10X15B	
1" vidicon	V10X15 V6X16 V5X20 V4X25	V10X15R(DC) V6X16R(AC/DC) V4X25R (AC/DC, EE)
⅔" vidicon	J10X13 J6X13 J5X15 J4X12	

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V10X15R

Sound Scoopic 200

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Canon

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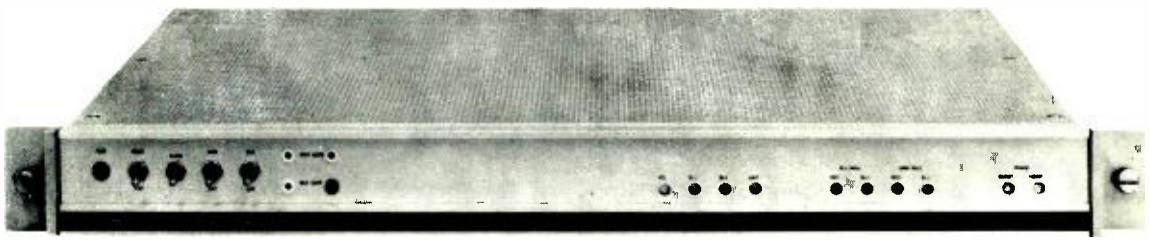

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