A MACTIER PUBLICATION DECEMBER 1969

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BROADCAST MANAGEMENT/ENGINEERING

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PLEASE SEE EDITORIAL PAGE 72

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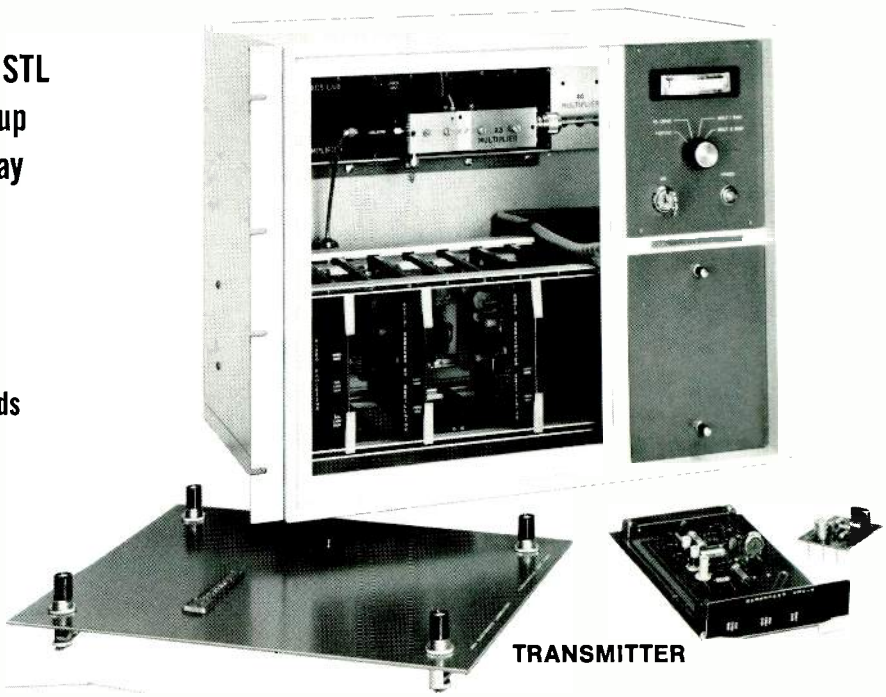

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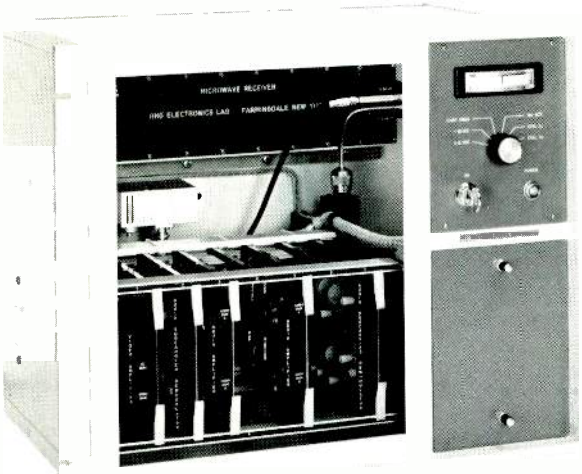

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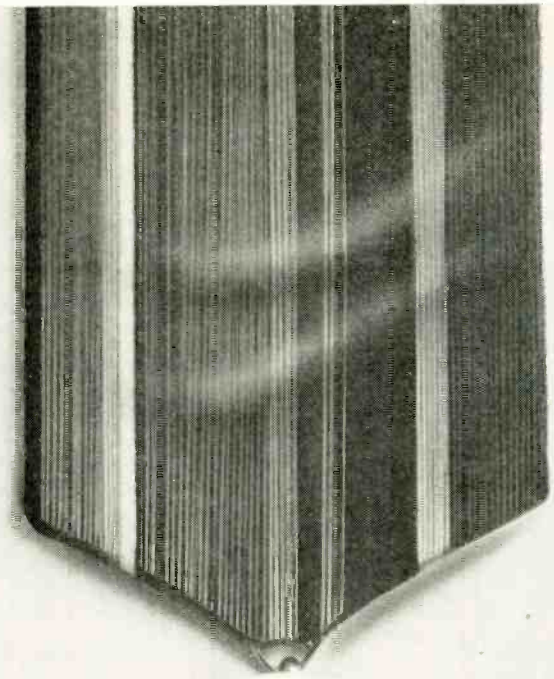

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DECEMBER 1969/VOLUME 5/NUMBER 12

BM/E

BROADCAST MANAGEMENT/ ENGINEERING

This month's cover: Cleaning up your station's signal is pretty important—especially if you're beginning to sound like station KRUD on this month's cover by Art Sudduth. Some important things to consider for both radio and TV are covered in the special section on pages 31-46.

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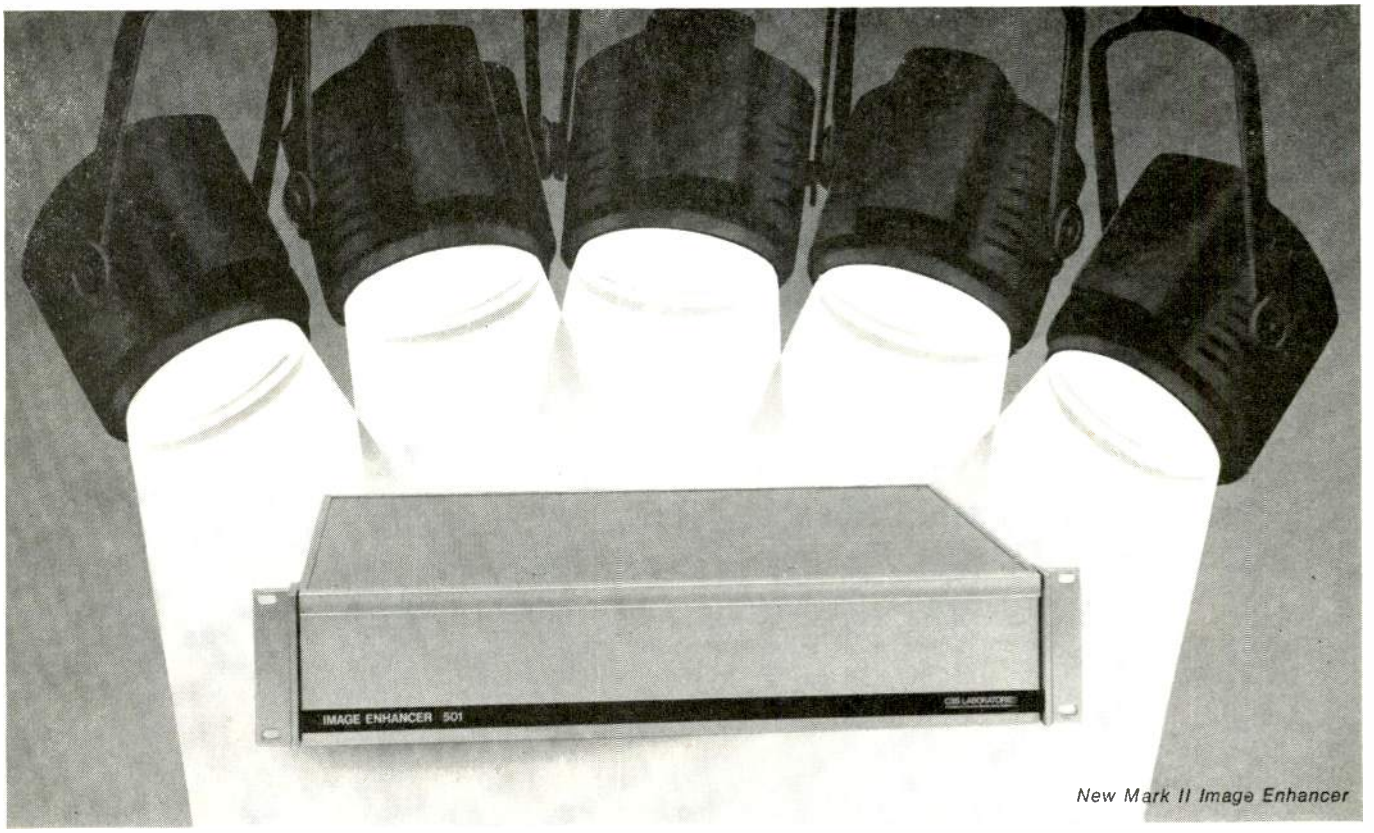

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BROADCAST INDUSTRY NEWS

CBS domestic satellite system plan gets no opposition from Comsat or AT&T

For the first time in four years, the Communications Satellite Corporation and the American Telephone & Telegraph Company have voiced no opposition to a proposal for a single-purpose TV domestic satellite system.

The proposal—that the networks and the Corporation for Public Broadcasting join in severing ties with AT&T and creating the first privately operated domestic satellite system for the U.S. and offshore islands—was made by Frank Stanton, president of CBS, on October 15 at the 37th convention of the Audio Engineering Society.

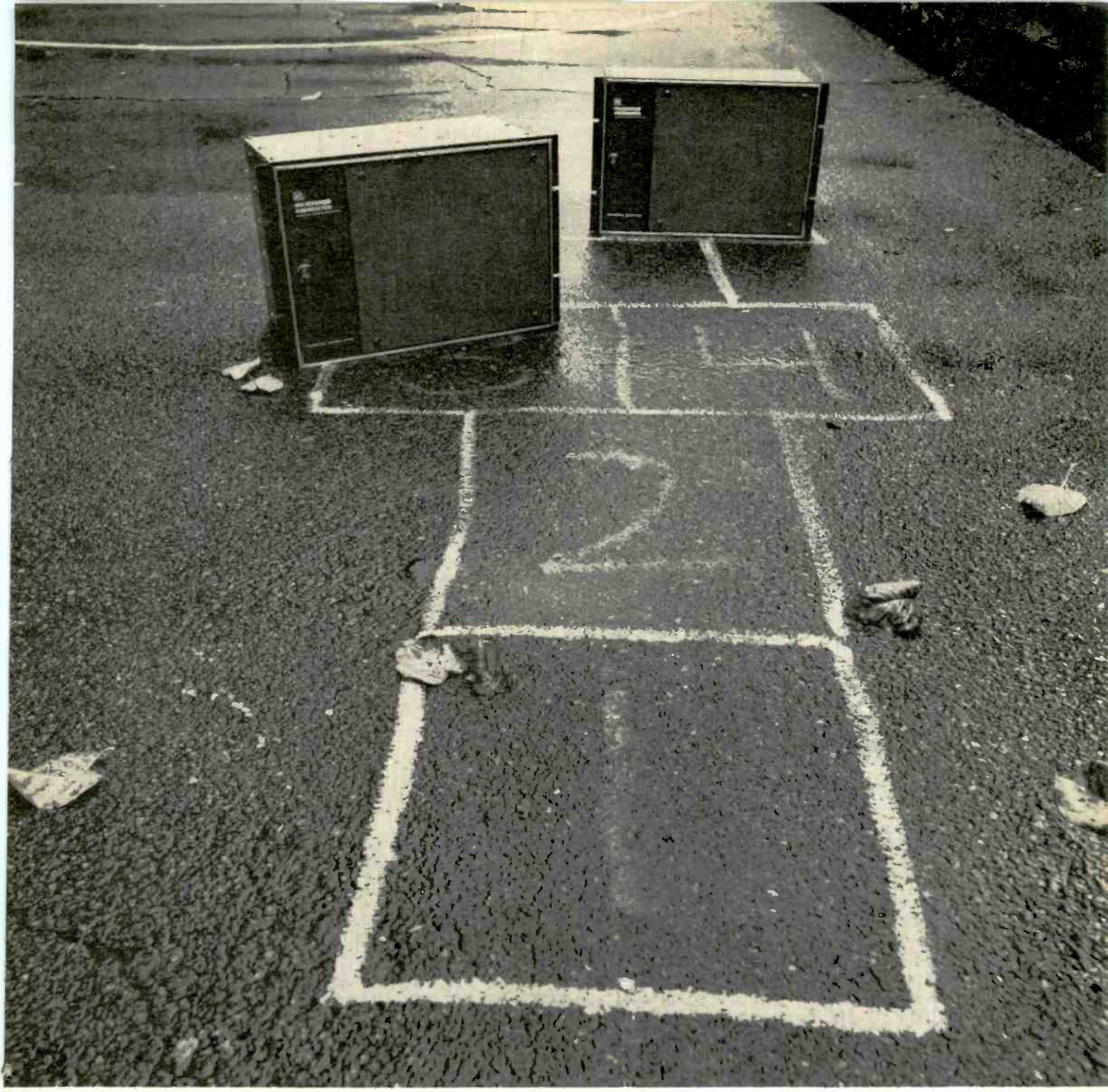
CBS' Dr. Frank Stanton addressing AES. BM/E Photo

Stanton presented the CBS proposal in the context of AT&T's $20 million increase a year in network charges (which brings the three networks' total AT&T charges per year to $65 million) for about 45,000 miles of AT&T relay facilities, and against the background of what he called "a national waste"—nearly five years of industry discussion and "bureaucratic inaction."

If the federal government gives the plan the go-ahead, said Stanton, the system could be operational as early as 1972 for an initial cost of $100 million. The plan calls for the networks to pay the National Aeronautics and Space Administration for launching the satellites—about $3 million per launch. ABC, NBC and CBS would each pay one-third of the total cost; noncommercial television, which presently pays reduced rates on a temporary basis to the public utility, would have an equal voice in directing the consortium and would not be charged for channels. About 500 ground stations connected to broadcasting outlets would transmit live TV and radio programming throughout the U.S., Alaska, Hawaii, Puerto Rico and the Virgin Islands on an around-the-clock basis. Stanton said that "because of the costs levied on the networks," CBS leases AT&T lines only for 14 to 18 hours a day and that the offshore islands "now have to settle for delayed programming."

Comsat and AT&T reactions were positive—far from their traditional responses. To date, Comsat has been meeting with the networks in efforts to land the job of building and operating its own system which it believes could satisfy the networks' needs. Predating the talks was Comsat Chairman James McCormack's urging Presidential Special Assistant Clay T. Whitehead to declassify for the talks a Comsat plan submitted last September. This plan would make the utility a full carrier that could offer its domestic service to CATV and press associations as well as to television; for the plan calls for the elimination of commercial carriers now required by the FCC to work between the networks and international satellite services. In proposing direct access to the system for users, the Comsat plan would thus relieve the networks from paying the initial $100 million and the cost of maintenance crews. The system could carry up to 14 TV channels, any of which could handle simultaneously as many 1800 telephone calls if AT&T ground facilities should become overcrowded, according to the plan. Comsat said that for the sake of efficiency it should own ground stations that would deal with satellite signals.

AT&T's new position was that any organization or group should be allowed to set up a domestic communications satellite system; it also indicated that the satellite system's economics may not be as favorable as has been thought. Although it hadn't studied the CBS proposal before saying, "It would appear to merit consideration in the context of a careful appraisal of the most efficient use of the frequency spectrum and orbit space, as well as other relevant technical and economic factors," AT&T said it believed "this approach would allow flexibility and incentive for creative private initiative and would provide the most



The big jump in short hops

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appropriate means for an orderly development of domestic satellites." The public utility said, too, that its "recent studies indicate that satellite costs currently may be less favorable compared to terrestrial costs than appeared to be the case some years ago."

Reacting to a proposal that TV networks operate their own communications satellites is nothing new for either utility. Their earliest such confrontation was in 1965, when ABC and the Ford Foundation proposed setting up domestic communications particularly for TV. Comsat and AT&T consequently argued for a Comsat owned-and-operated, multi-purpose domestic satellite system that would relay telephone as well as television communications. The utilities differed, however, on whether Comsat or carriers like AT&T and Western Union should own the ground stations. It is said that under its new policy, AT&T believes it could own its satellites.

House takes surprise action on pay TV bill

For the second time during the present session, the House Commerce Committee has voted to send an anti-pay TV bill to its Communications Subcommittee, which is said to be less against pay television than the full committee. Of 23 anti-toll TV bills introduced this session, one—the initial measure presented by Representative John D. Dingell (D-Mich.)—is on record as having been referred to the subcommittee.

The vote on anti-pay TV bill H.R. 420, it is said, was taken in the absence of about one-third of the committee members at a meeting called routinely in late October to finalize an airport facilities bill. According to reports, Communications Subcommittee Chairman Torbert H. Macdonald (D-Mass.) moved that anti-toll TV bills should go to his committee after Commerce Committee Chairman Harley O. Staggers (D-W. Va.) mentioned pay television in reviewing the committee's calender. It is said that the committee passed Macdonald's motion on a 12-9 vote in the face of Staggers' ruling Macdonald out of order and after the committee voted 10-10 to kill a motion to table Macdonald's motion. Macdonald has said that his subcommittee will hold public hearings on the bill.

Numerous pay TV proponents have interpreted the Commerce Committee action as another boost for their cause, in pointing to the recent FCC and Court of Appeals authorization of pay television (see *BM/E,* November, 1969, p. 8) and to Staggers' early October letter to the FCC urging delay of pay TV application grants until at least after January 31 for the sake of "orderly congressional consideration of the matter."

The National Association of Theater Owners, for whom the FCC may also be holding up pay TV application grants, has asked the Appeals Court for a stay of its decision upholding the Commission's pay TV authorization.

WCBS-FM de-automates

WCBS-FM, the CBS-owned fm station in New York, dropped the "Young Sound" tape service and went "live" with six air personalities on October 20.

When the FCC forced split programming for commonly owned a-m and fm stations in major markets three years ago, WCBS-FM elected the least costly separate programming route—automation. Now, Herbert W. McCord, WCBS-FM station manager, says it wishes to become a *full-service* radio station.

The six WCBS-FM air personalities are: Tom Clay, K.O. Bailey, Steve O'Shea, Bobby Wayne, Bill Brown and Gus Gossert. Gossert, who's also the station's program director, emphasized that WCBS-FM's playlist will contain music from albums and hit singles on the basis of quality, taste and compatibility with the station's total sound.

McCord says this means a much broader range of music and less repetition of selections than is the practice at WOR-FM, New York's top ranked fm station (See *BM/E*, October, 1969, page 8). Commercials should be restricted to eight per hour. The news operation is to draw from the all-news sister a-m station, WCBS Radio 88, but the delivery should be modified to be compatible with the station's overall image.

Educasting tries its thing with TV

Fm stations may become visual as well as audio instructional outlets. Educasting Systems Inc., which has already developed the use of SCA subcarriers for audio programmed learning systems (see *BM/E*, February, 1969, pp. 26-27), has recently received an okay from the FCC to go ahead with feasibility tests for sending still and moving television pictures on fm stations' subcarriers.

Joining with Educasting in testing the feasibility of broadcasting slow-scan television on subchannels of the Flint, Michigan, educational fm station, is the Department of Education of the State of Michigan. The fm subcarrier system, assembling a 525-line-picture in 16 seconds, uses a 5-kHz bandwidth for the picture channel. Picture and sound for the programs are prerecorded on cartridge tapes.

The other test—using a regular TV station—involves New York City's municipally owned uhf channel 31, WNYC-TV. Action on the screen stops periodically and up to four multiple-choice answers flash on the screen in four quadrants; the student chooses the answer by pressing a numbered button. The selected answer stays on the screen, while the other answers disappear. Whether and why the answer is correct is explained by the audio subcarrier.

NAB and Hollywood ask new flick law

After more than four months of discussing CATV regulation and copyright matters with and without the NCTA—before and after the NCTA walked out of a negotiating session in September—the NAB and film copyright owners have formalized their respective recommendations and have presented them to Senator John L. McClellan's Subcommittee on Copyright.

To date, the only word from the subcommittee is that it's most likely that the long-awaited, revised general copyright bill will be presented to the full Senate by the end of the month. Unlike the copyright bill passed by the House of Representatives last year, this bill would specifically deal with copyrights and cable television.

Signed by Willard E. Walbridge, chairman of the joint NAB boards, the NAB letter to the Senator said that copyright and regulatory legislation are "inexorably intertwined" and thus must be passed simultaneously. Copyright proposals of the group of film producers and

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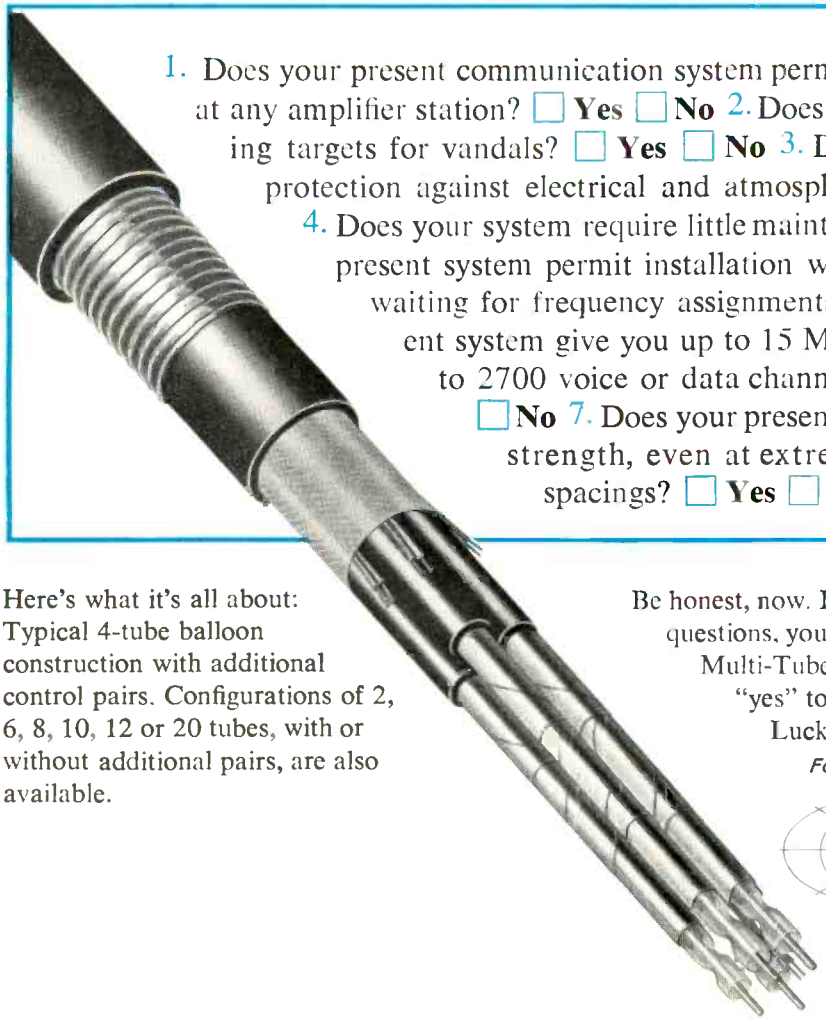

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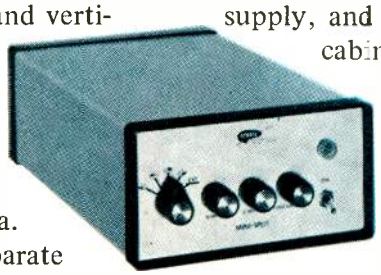

The **MINI-SPLIT** can be used as a separate unit with standard program switchers, or easily custom-installed into program switcher panels. The wide bandwidth allows it to be used in high-resolution CCTV systems, including those operating with EIA standard RS-343 and CCIR standard scan rates. It accepts either synchronous composite or non-composite monochrome or color signals.

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syndicators were submitted to the Senator by New York attorney Louis Nizer as a draft of a revised Section III of the pending copyright revision bill.

The only proposal not presented previously by the NAB was its suggestion that a CATV system get an FCC license—like the broadcaster—if it wants to originate entertainment programming. Not meant for CATV automated programs like weather, time and news, the NAB recommendation said that like broadcasters who cannot own more than one station in a community, cable television operators originating nonautomated programs should be barred from operating more than one origination channel. Other recommendations in the NAB proposal were that:

- CATVs more than 45 miles from any top-100 TV market or 60 miles from any other TV market, shouldn't have any restrictions on the number of distant signals they can carry.
- CATV systems within 45 miles of the top-25 markets should carry three network signals, three independents and one ETV.
- The formula for markets 26-50 would be three-two-one, and would be three-one-one for markets 51-100.
- CATV systems should substitute any new, closer stations for distant stations they were carrying.
- Leap-frogging, advertising and interconnection should be prohibited.
- CPs should be counted as "stations" for three years and would then be discounted if the stations weren't built.
- Special charges—per program or per channel—shouldn't be permitted.
- Except where the FCC granted waivers, CATV should be grandfathered regarding signals they have carried since December 20, 1968.
- As to copyright liability, systems should pay "reasonable compensation; very small systems should be exempted from copyright payments, based on a specified number of subscribers; station exclusivity should be provided throughout their service areas; station live originations should be fully copyrightable; sports blackouts—including nonprofessional and nonteam events—must be observed by systems; translators within Grade B contours should be exempt, but fully liable if outside Grade B contours.

Among the film distributors' legislative proposals were recommendations that:

- CATV systems with 500 or less subscribers should be exempt from liability for copyright infringement.
- Exclusivity periods should be established to protect contracts with TV stations in markets where the CATV system uses distant signals. Starting with the date that the off-network show is offered to stations, a two-year protection period for network programs put into syndication should be instituted.
- CATVs in the top-75 markets should carry only Grade B signals; if they overlap, they shouldn't even carry these.
- CATVs should carry up to three network signals and one independent in markets smaller than the 75th.
- Compulsory licensing should be asked only of local signals in the top 75 markets.
- Leap-frogging should be prohibited.
- Copyright owners should get a percentage of CATVs' gross as determined and distributed by the Register of Copyrights.

NCTA reaction? Editors of the *NCTA Membership Bulletin* wrote on October 7: "Both groups are to be congratulated for the great expense and effort they have put forth together to see that CATV keeps its place . . . boy."

Uhf gets $500,000 color mobile unit

As part of station plans to develop as a local TV facility and telecast in color next year, Kaiser Broadcasting's KBSC-TV, channel 52, Corona-Los Angeles, has invested half-a-million dollars in a color mobile unit.

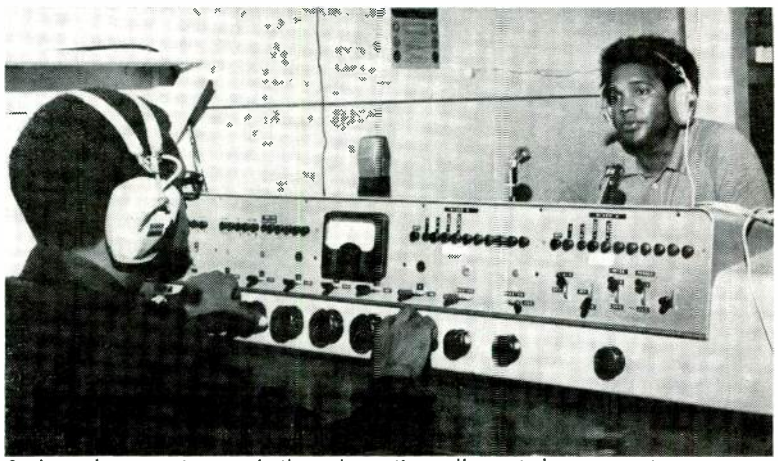
The September "acquisition of this unit is evidence of Kaiser Broadcasting's commitment to develop channel 52 as a local television service and facility," said General Manager Richard Jolliffe.

Equipment in the $500,000 mobile unit includes: three RCA TK-44A cameras with 10-1 zoom lenses; RCA switcher with 12 inputs, mix, preview, clean feed buses, Ball special effects; 10-input audio console, RCA cartridge tape; RCA TR-4HB TV tape machine; RCA PK-310 camera with Kodak Carousel projector with 75 slide capacity; and a three-channel intercom system.

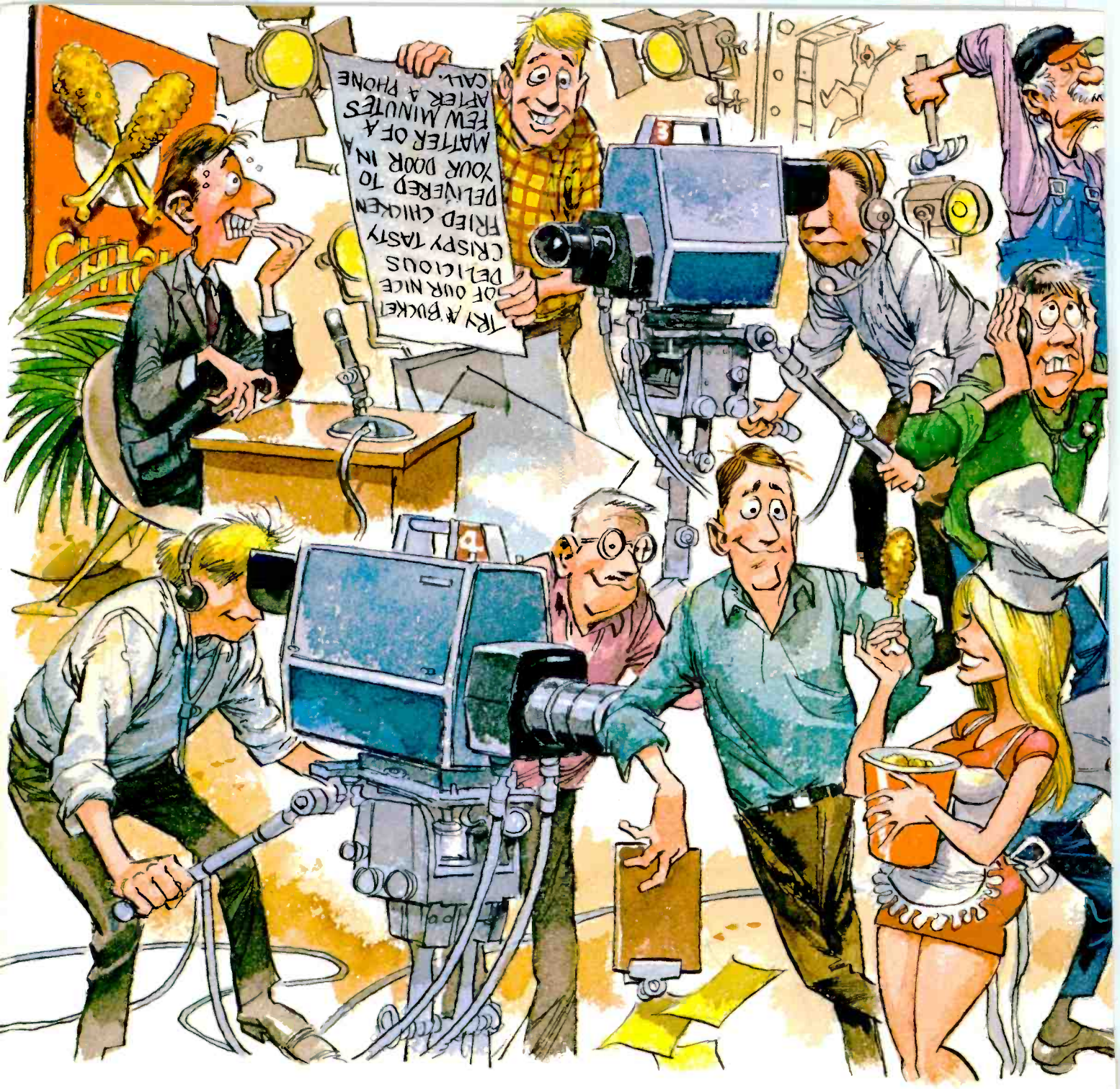
FCC amends SCA filing

To simplify the filing procedures for assignment or transfer of an existing Subsidiary Communications Authorization, (SCA), the Commission has amended sections of the rules by deleting requirements for filing FCC Form 318.

Student fmer tackles communication blackout



Strike and occupation aren't the only tactics college students are using to create minority community within communities. University of Buffalo's WBFO-FM, for instance, has been trying for it with a minority-originated-oriented Saturday format financed through a $30,000 CPB grant. Above, satellite studio manager Earl Sinclair prepares for 18 hours of programming. Part of the motivation, says WBFO-FM manager, is offering whit "something besides the sound of a brick shattering a plate-glass window.



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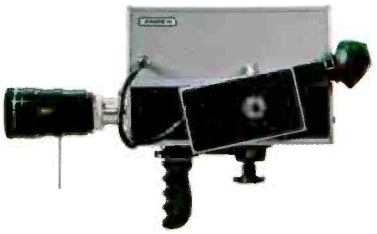

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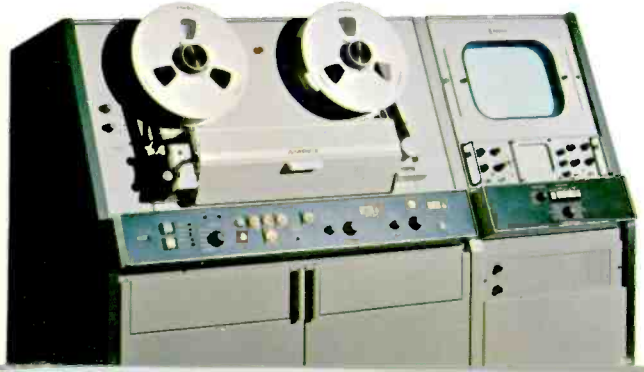

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The Ball Brothers Research Corporation TE-9 general purpose monitor is designed to prevent eyestrain and a bad case of the "up-tights."

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The CRT is driven with 12 kV to provide the necessary brightness. The drive plus the specially-selected CRT phosphors produce high contrast ratios. You get 600-line resolution at 40 ft.-Lamberts—more than you need for close viewing of broadcast or closed circuit TV pictures—even in high ambient light.

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BB9/16

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INTERPRETING THE FCC RULES & REGULATIONS

New Developments in Pay-TV

IN DECEMBER, 1968, the FCC issued its *Fourth Report & Order,* 15 F.C.C. 2nd 466 (1968), authorizing virtual nationwide subscription (pay) television (see *BM/E,* February, 1969, p. 14).

Soon afterwards, the National Association of Theater Owners petitioned the FCC for a stay in the effective date (June 12, 1969) of the non-technical rules. When this was denied, the petitioners went to the U.S. Court of Appeals for the District of Columbia[1] where the Commission's *Fourth Report* was upheld without reservation.

To petitioner's allegations that the Communications Act precluded the FCC from approving STV, the Court answered: "The Act seems designed to foster diversity in the financial organization and *modus operandi* of broadcasting stations as well as in the content of programs."

The Court also dealt swiftly and succinctly with the petitioners' other allegations: that the FCC lacked authority to regulate STV rates, that its failure to give adequate reasons for the decisions in the *Fourth Report* was artibtrary and capricious, and that it acted in restraint of free speech. The Court then cautioned the Commission that "regulations which are vague and overbroad, create a risk of chilling free speech, while rules which are too finely drawn will arouse judicial suspicion that they are designed to suppress uncongenial ideas."

The Court felt convinced, however, that the FCC had acted within proper limits in promulgating rules for STV and, without dissent, affirmed the *Fourth Report* in its entirety on September 30, 1969.

Fifth Report and Order

Pending the Court of Appeals decision, the Commission adopted the first technical standards for STV and also specified procedural requirements for STV applicants *(Fifth Report and Order,* FCC 69-950, Docket No. 11279; released September 11, 1969). In this *Report* the Commission declared that no applications for STV authorizations would be granted until 60 days after the Court's decision, although they would be accepted for filing immediately.

Technical Considerations

As noted in its *Fourth Report,* the Commission had originally intended to issue technical rules before the effective date of June 12, 1969.

But in denying the petition to stay the effective date of the non-technical rules and to withhold grants of new authorizations until the Court rendered its opinion, the Commission decided to issue technical standards "as soon as possible but not necessarily before June 12, 1969." Thus, the initial standards discussed below were adopted September 4, 1969.

Voluminous comments had been filed with the Commission by various manufacturers (e.g. Zenith, Teco, Inc.). At least one manufacturer (Motorola, Inc.) was concerned over the additional power STV transmission would need so that the STV signal would be identical to conventional TV signals reaching the television receiver.[2] To this, the Commission declared:

> "We expect to ascertain the relative amount of extra power, if any, to be transmitted in the STV systems for the encoding information. We anticipate that, in STV stations, the authorized values of peak power for the visual signal, average power for the aural signal, and the effective radiated powers of each, as based on these values, will not be increased above values which would be authorized for the conventional transmission."

If higher average power is actually transmitted by the applicant, the Commission will consider that fact in evaluating the system for approval. Because exact judgments concerning relative interference-causing capability and interference susceptibility of STV systems may not be practicable in type-acceptance applications, the Commission modified the proposed rule on type-acceptance (§73.644) to permit FCC evaluation of actual STV-system performance.

The Commission held that the type-acceptance rules provide authority to request field test information, if necessary, as a prerequisite to approval.

Interim procedures were also adopted for advance approval for STV *systems*—the schemes for generating and decoding STV signals. *But such approvals will not apply to specific items of encoding or decoding equipment.* The Commission will require use of type-accepted TV broadcast transmitters. However, just as type acceptance of conventional synchronizing signal generators or color input signal generating equipment need not now be obtained, no type acceptance will be required for encoding or decoding STV equipment.

Thus, engineering showings in STV authorization applications must identify the STV system to be used, which must have been approved pursuant to §73.644. For STV systems not already approved, the applicant must submit information

1. **National Association of Theatre Owners v. F.C.C.,** F. 2d (Case No. 22,623 [1969]).

2. The STV encoding information (which "scrambles" the video and aural signals so ordinary TV sets cannot receive them) requires additional power which might increase signal-to-interference ratios with possible co-channel or adjacent channel interference.

The new Sony DXC-5000 video camera is a marvel of simplicity.

To begin with, it uses two tubes instead of four to produce a high-quality picture: one tube for luminance, the other to generate all three color signals, red, green, and blue.

This saving in tubes alone might simplify the operating problems, but the matter doesn't end there. The DXC-5000 has completely automatic color temperature compensation and gain control, which does away with all the endless set-up procedures and readjustments called for by changes in light levels and color temperature. Because of these automatic controls, any one can learn how to operate the camera in about three minutes (as opposed to six months for a conventional color camera). And because this camera has relatively few parts, it's reasonably priced, extremely compact, and weighs a mere 29 pounds.

VIDEO CAMERAS HAVE SOME 30 CONTROLS. OURS HAS 3.

And what *are* the DXC-5000's three controls? Vertical registration, horizontal registration, and electronic focusing. As many controls, it so happens, as it takes minutes to learn to operate the camera.

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necessary for approval under the pertinent provisions of §73.644. Applications must also specify, by manufacturer and type number, the proposed STV equipment (encoders and decoders).

General Application Information

STV authorizations will be granted only to licensees or permittees of television broadcast stations. If the licensee grants a franchise (for example, to install and maintain the decoding equipment in the STV subscribers' homes) to a business entity which is connected with the operation but is nonetheless a separate and distinct entity from the licensee or permittee, authorization goes to the licensee or permittee, and not to the franchise holder—even if the entities are commonly owned.

The Commission does not plan to adopt a specific FCC Form for STV applications. Qualified broadcast licensees or permittees must therefore file a separate STV application, in letter form, in triplicate, with a $150 filing fee. STV applicants without appropriate broadcast authorizations (see *BM/E,* Feb. 1969) must file an FCC Form 301 for construction permit, also, in triplicate with a filing fee of $150.

The Commission will give public notice of acceptance for filing and will make no grants earlier than thirty days after the issuance of this public notice.

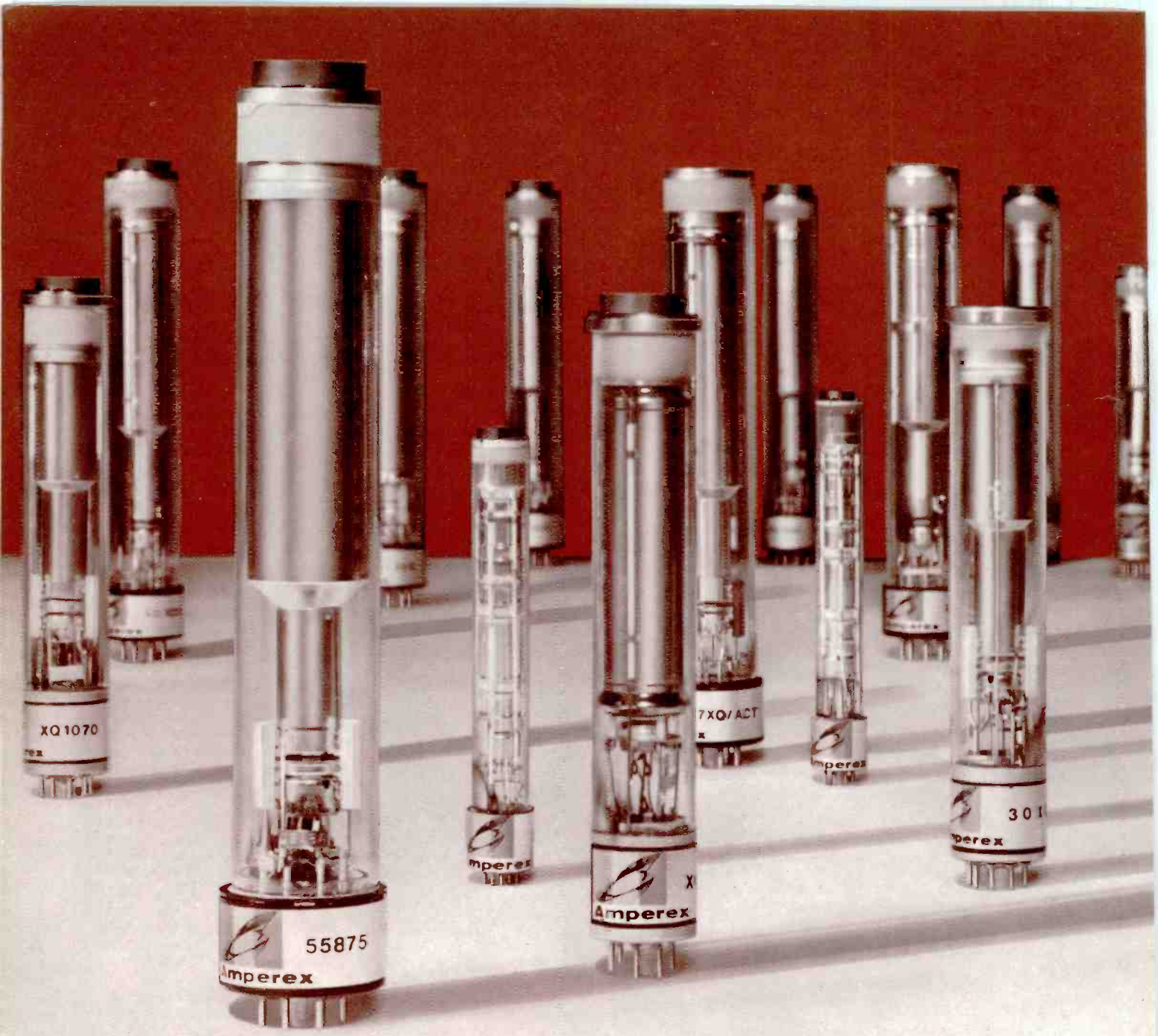
STV applicants must follow rules applicable to local notice of filing set forth in §1.580.

The application must describe definitively the STV's proposed operations, including:

> (1) the methods for disseminating and decoding information needed by subscribers, and for billing and collecting charges, including installation charges, monthly charges, per-program charges, or any other charges payable by subscribers;
>
> (2) the terms and conditions under which contracts will be entered into with subscribers; and
>
> (3) the approproximate number of subscribers it is estimated will be served during the period of authorization. It shall also state whether a franchise holder, which is a separate business entity from the applicant, is to be involved in the proposed operation, and, if so, whether and to what extent the franchise holder and applicant are commonly owned. If a separate entity is a franchise holder, the application shall show exactly what the responsibilities and functions of the applicant and the franchise holder will be: e.g., who will install the scrambling equipment; who will install the unscrambling equipment attached to sets of subscribers; who will service and maintain that equipment; who will provide information to subscribers so that they will know how to adjust the unscrambling equipment to obtain desired programs; who will collect and disburse revenues obtained from subscribers; who will be charged with the responsibility of obtaining programming; and who will be responsible for promotion and soliciting subscribers. An executed copy of any agreement, arrangement, or unerstanding between the applicant and the franchise holder concerning their respective functions shall be submitted with the application.

Programming

The *Fourth Report* contains an exhaustive study of programming requirements, one of which is that stations engaged in STV operations must



Now there are 14 different Plumbicon* TV Camera Tubes.

The Plumbicon family, which made its commercial debut only three years ago with the "Emmy-winning 55875," has grown to include many new and needed types for the expanding TV industry.

The line, now in production or development, includes tubes for both conventional and 'miniature' TV Plumbicon cameras, for retrofitting in Vidicon cameras and for image-intensification and other specialized requirements for medical, industrial and educational Closed Circuit Television applications.

55875: The original, Emmy-award winning TV camera tube; magnetic deflection and focus; integral mesh; 1.25 inch diameter.

XQ1020: Separate mesh version of 55875.

XQ1023: Extended-red-spectral-response version of XQ1020.

XQ1025: Similar to XQ1023 with addition of infra-red cutoff-filter.

7XQ: Fiber-optics faceplate version of XQ1020, for use with image intensifier in low light level television.

7XQ/ACT: Same as 7XQ but with "anti-comet-tail" gun to eliminate "blooming" of super-highlight images.

16XQ/XQ1070: One inch retrofit for most vidicon cameras.

19XQ: "Anti-comet-tail" gun version of 16XQ/XQ1070.

30XQ: Fiber-optics faceplate version of 16XQ/XQ1070.

31XQ: Ruggedized version of 16XQ/XQ1070.

3XQ: 30mm. tube with electrostatic focus and magnetic deflection.

15XQ: 30mm., all-electrostatic tube for cameras of reduced size and weight.

12XQ: ⅝ inch tube with electrostatic focus and magnetic deflection...for miniature cameras.

21XQ: Extended-red-spectral-response version of 12XQ.

Selected versions of several of the fourteen types shown above are available for educational, industrial and medical closed circuit TV systems. To learn more, contact us by mail or by phone:

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broadcast a minimum schedule of non-STV programs *(BM/E,* February 1969) in addition to the STV programs.

An applicant simultaneously filing FCC form 301 (construction permit), 303 (renewal), 314 (assignment), or 315 (transfer), must complete Section IV-B of the required Form as to non-STV programming. *Proposed* STV programming must be included (and segregated from non-STV programming) in Part III, *Proposed Programming, Section IV-B.*

Applicants seeking STV authorization for an existing station, but not in conjunction with FCC Form 301, 303, 314 or 315, must similarly respond, but need not complete that portion of IV-B relating to Ascertainment of Community Needs *unless* the *non*-STV programming (i.e., news, public affairs and other fare) will be reduced to a substantial degree.

The new or existing station applicant "shall state the methods used to ascertain the [STV programming] needs and interests of the community . . . [and it] shall also show how the proposed STV programming will fulfill these needs and interests."

The applicant must also show what percentage of STV time per year will be devoted to each type of STV programming (e.g., ballet, sports, opera, feature films) including a breakdown, by type, of programming shown from the hours of 8:00 a.m. to 6:00 p.m., from 6:00 p.m. to 11:00 p.m., and of programs shown during all other hours devoted to STV programming in a typical week.

Records supporting the representations of proposed STV programming must be kept on file at the station and be open for inspection by the Commission for at least 3 years from the date of filing.

Financial Showing

The Commission has ordered the Ultravision standards applicable to STV applicants.[3] Thus, an STV application must show information sufficient for the Commission to decide that the applicant and franchise holder, whether or not commonly owned, have the financial capacity to operate for one year following construction.

The application must also contain:

(1) An estimate of costs for installation of STV transmitting facilities, in place and ready for service. This estimate should include labor, supplies, etc.
(2) A separate notation of installation costs for decoding equipment in the subscriber's home, as well as advertising and promotion costs.
(3) Estimated costs of operation, on a month-by-month basis during the first year.
(4) A showing of enough cash and/or liquid assets in excess of current liabilities for any construction of STV transmitting equipment for which it may be responsible (as well as additional expenses). The funds must be sufficient for operation for one year.

Furthermore:

"If the proposed STV operation involves a franchise holder (whether under common ownership

Continued on page 74

3. Ultravision Broadcasting Co., 1 FCC 2d 544, 5 RR 2d 343 [1965].

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enough to send the very best.

We could tell you that our microwave systems are the world's greatest. But you'd expect us to be partial.

So we'll just give you some facts and let you judge for yourself.

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Or our 75C and new 78J for government applications. They're the only heterodyne and baseband systems of their kind that can handle 600 DCS circuits with 100% data loading.

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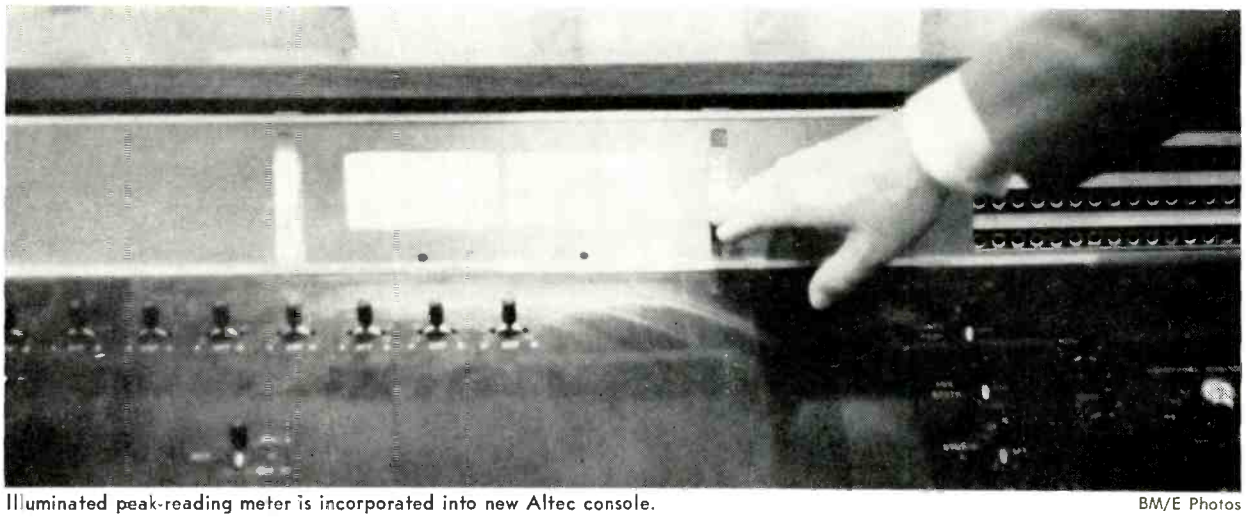
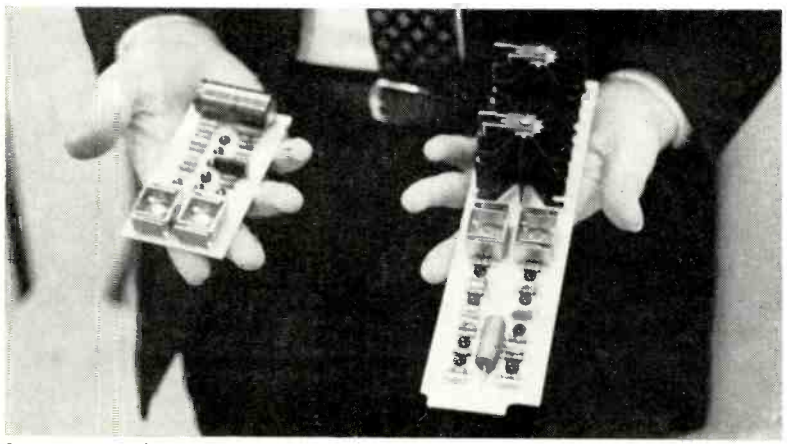


Illuminated peak-reading meter is incorporated into new Altec console. BM/E Photos



Spectra Sonics line amp module (left) and 30 watt amp (right).

For tape duplicators only—Ampex BLM-200 (above). New Melcor module (below) is model CSM channel select.

Heard at the AES

Here's a thumbnail rundown on some significant papers read at this year's AES Convention.

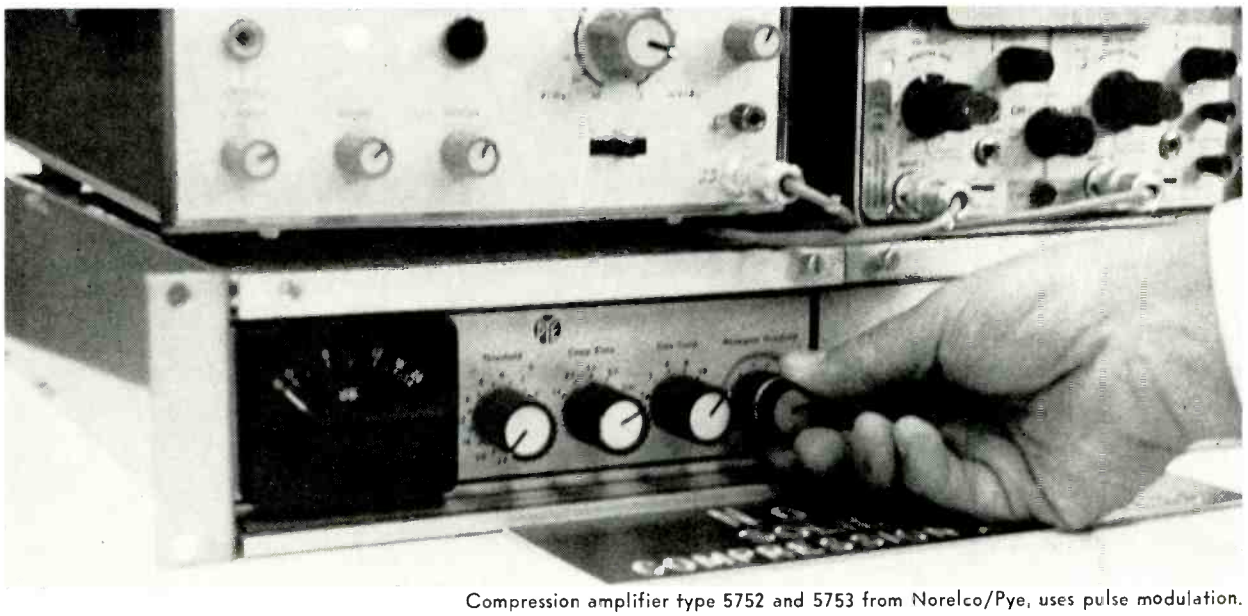
Dynamic Presence Equalizer. This paper describes the work of Richard G. Allen, Emil L. Torick and Benjamin B. Bauer of CBS Laboratories. They have made a new device to overcome the deficiencies of poor audio transmission, wherein midrange and high frequency information is lost. Typical examples include the tiny speaker in a transistor portable radio, the noisy interior of a radio-equipped car, and the head misalignment of a tape reproducer. In each case, speech becomes less intelligible and listeners must strain to understand words.

The dynamic presence equalizer either expands or compresses midrange and high-frequency audio, depending on the incoming response as measured by the equalizer. A speech-music discriminator disables the device for music and recognizes speech by its staccato nature and short-term wide dynamic range.

The equalizer overcomes loss of high frequencies in speech by a corresponding boost, so that the overall presence enhances intelligibility. The equalization is inhibited for music, where it is not needed.

A New Method of Automatically Controlling Audio Levels. Presented by Arno M. Meyer of Belar Electronics Laboratory, this paper describes the Mod Minder, a new type of level-control device. It monitors the number of audio peaks per unit time interval. Then it adjusts the gain according to a preset number. The idea behind this device is to permit a certain number of peaks to get through in order to increase the dynamic range in broadcasting while having some control over the overall level.

Loudness Measurement and Control in Sound Broadcasting. Prepared by R. A. Hackley, H. F. Olson and J. A. Wissner of RCA, this paper described the development of a loudness meter and controller. In the equipment, subjective loudness is measured by splitting it into octave bands, taking note of the equal-loudness contours of the human ear. When the sound pressure level in each



Compression amplifier type 5752 and 5753 from Norelco/Pye, uses pulse modulation.

band is determined, the bands are summed and a total measurement is obtained. The device also gives suitable weighting to the duration of sound impulses, for time also affects loudness.

The development of the loudness meter led to a further refinement known as the loudness controller. It is basically an AGC amplifier which controls—and is controlled by—loudness rather than volume.

The Harmonic Compressor, a System for Doubling Information Rates of Speech. This paper described work done by John W. Breuel and Leo M. Levens of the American Foundation for the Blind. The Foundation supplies recorded books to blind persons, some of whom have expressed a desire for an aural equivalent of speed-reading. The equipment demonstrated enables speed-hearing by doubling the rate of speech of the person recording the book. The harmonic compressor is entirely electronic, and works by chopping the incoming waveform in half and synthesizing the omitted half waves from the remaining ones. If input material is presented at twice the normal speed, the frequency divider restores the original pitch while the speech rate is retained at double the original. A filter bank is used to remove transients introduced by the splitting and synthesizing.

Several demonstration tapes were played. The harmonic compressor is still experimental and generates an appreciable amount of distortion.

Shotgun dynamic mike from AKG sells for $149.

BM/E Photos

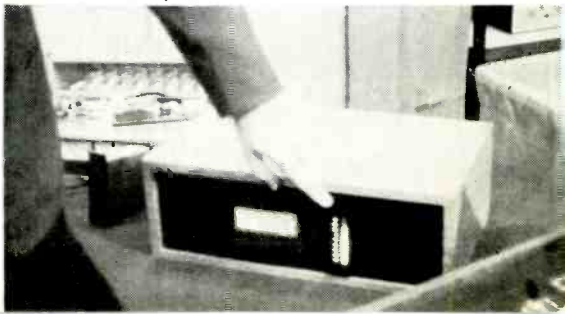
AES: More Stereo

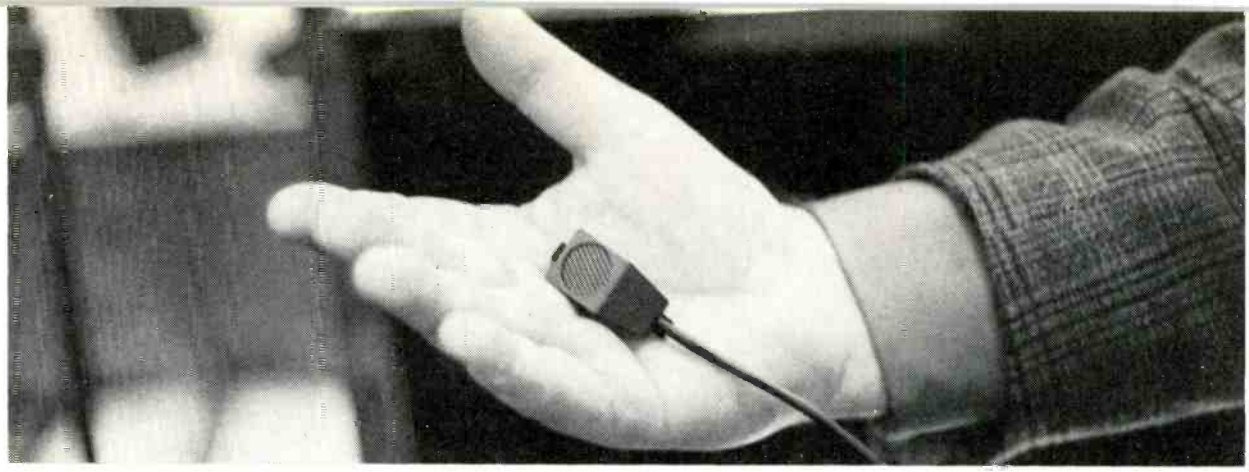
THE NEW YORK Audio Engineering Society Convention was again an unqualified success with some 2300 visitors viewing products shown by some 60 exhibitors occupying far more floor space than ever before. AES officials feel that next year's convention will require even more space as the convention grows in size, interest and complexity.

Professional interest in new equipment and techniques at the convention reached a new high, with concern for the Mets/Orioles World Series running a close second. Indeed, some exhibitors went to great lengths to pipe in the games in their display areas, de-

Three-in-one Weigand console has 14 inputs for 8-track recording. Unit also has remix capability.

Unveiled by Electrodyne, lighted level indicator comes as separate unit, can be added to most systems.



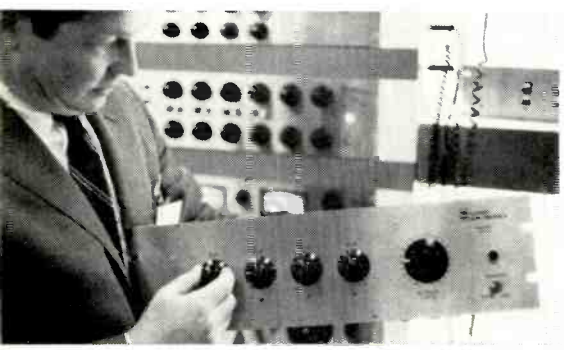


New head for Neumann KMA mike was shown by Gotham Audio.

BM/E Photos

Dynamic, cartridge type mike model BK-14A, was shown by RCA.

Super-professional Koss phones, type ESP-6, contain self-energizing polarizing source.



Four-channel panpot rack mountable unit was introduced by Gately.

spite the Society's ban on loudspeakers on the exhibit floor.

Multi-Track Burgeons

Even more than last year, multitrack recording stood out as a front-runner. There were the Ampexes, 3Ms and Scullys, but there were also newcomers—names like Gauss Electrophysics, Creatronics and United Research Laboratory. There were consoles, big and small, with many emphasizing multitrack. Big boards were shown by Electrodyne, Audio Designs, Weigand, Gotham Audio, Automated Processes and RCA. Smaller consolettes and mixers highlighted displays by Shure, Gately, Fairchild and Gotham. Building-block modules were displayed by Moser, Spectra Sonics, Quad-Eight and Melcor.

Equipment by Ampex included the MM-1000 two-inch recorder with capacity up to 24 tracks. This recorder was shown at last year's AES, but until recently, was not in actual production. Also in the Ampex booth was an endless-loop master tape bin for cassette and 8-track cart duplication. The bin, model BLM-200, uses a one-inch master at 60 or 120 ips. Bin capacity is 1200 feet.

Scully showed current versions of its multitrack equipment, with the added feature of cleaning gauze automatically dispensed during recording. Also re-exhibiting its multitrack gear was 3M. New this year was a redesigned remote control panel for the recorder.

Multitrack consoles made up of discrete modules and building blocks were shown by Weigand, Fairchild (with a new portable console), Electrodyne, Audio Designs, RCA, Automated Processes and Gotham Audio. Mini-mixers were shown by Shure and Gately.

Variations on the theme—non-multitrack recorders were shown by: Nagra—the Mark IV, shown last year, but not available until now; Philips with multi-channel loggers as well as last year's two-channel ¼-inch machine; Tandberg with its portable which offers a film-sync option; Stellavox—not that new but with a homegrown DIN/Cannon plug converter; and Lang with a new transport mechanism for studio recording.

New peak indicators using graduated lights were shown for the first time by both Altec Lansing (as part of its console) and Electrodyne. Console modules were displayed by Moser, Spectra Sonics, Quad-Eight and Melcor.

More companies were involved with instrumentation. On display was measuring equipment from Hewlett-Packard, General Radio, Philips (Pye), Crown International and Creatronics.

Microphones were featured by Shure, RCA, AKG (Philips), Electro-Voice, Neumann (Gotham) and Sennheiser. New tape formulations were talked about at 3M, Ampex and BASF. Unusual performers were a disc-calibrating phono pickup by Stanton Magnetics and a stereo synthesizer from Parasound. **BM/E**

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CONVENTION LOG

Broadcast Engineers Hear Ideas on Cleaning up Signals

PRESENTATIONS at IEEE 19th Annual Broadcast Symposium could generally be classed one of two ways: how-to-do-it-easier or how-to-do-it-better. There was no central theme and coverage of radio, TV and CATV was balanced. Since *BM/E's* theme this issue is cleaning up signals, we'll review the how-to-do-it-better ideas first.

The need to do *a lot* better is necessary judging from the results of an experiment reported by Wendell C. Morrison of RCA for the JCIC Ad Hoc Committee on Color TV. Morrision described hue and saturation differences transmitted by three different Chicago stations which were getting identical feeds. The differences were analyzed on eight receivers at three different receiving sites. Phase shifts of as much as 19.9 degrees and saturation variations of 27.3 percent between stations were logged at the eight different receivers. Morrison drew these conclusions:

- Transmitter performance and monitoring techniques are inadequate.
- Portions of the system affect the signal significantly.
- The transmission system alone does not account for the changes frequently observed—the propagation path is a factor.

Morrison pointed out that when receivers incorporate automatic chroma control circuits the saturation changes are not as pronounced as those observed in the test.

Measurements were collected at four test points within the system: output of signal sources, input to the station's live and distribution amplifiers, output of transmitter (as detected by diode demodulators), input to receiver (after antenna, 10-dB pad and demodulator). The stations did not follow identical practices during their setup procedures, Morrison reported, hence variations were to be expected.

Observations and advice that emerged from the panel discussion, "How Can We Improve Our Color Image?" included these points:

- Studio and Field: Standardize on methods of matching camera characteristics and lining up equipment to eliminate differences that occur due to varying operator and technician styles. Do a better job of lining up the video system. Permit no picture painting for studio conditions—Blair Benson, CBS.
- Transmitter Equipment: Transmitters are more stable than in earlier years. New transmitters will have tighter specs. Progress in improving correction equipment, demodulators and measuring equipment is expected. Short-term and long-term variations depend on operating procedures. Do VITS testing. Continuous monitoring is a must. Old transmitters can be adjusted, holding the adjustment is the challenge.—Frank Bias, GE
- Long Lines. Since there are 4000 repeaters in use throughout the U.S.A., it is difficult to specify standard network performance except on a statistical basis. Objectives contained in NTC Report No. 5 call for differential gain shifts of no more than 15 percent and differential phase variations of no more than 5 degrees. Most repeaters do better and none do worse (each repeater is serviced once every four months). There's a good cooperation between the networks and the telco, but networks never sit still (for example, a football program has local, regional and national inputs).—Charles Carter, AT&T
- Receivers. Receiver manufacturers tinker with circuitry until the picture looks good. Engineers don't design according to standards, but to get a true flesh tone. But, standards shouldn't be abandoned. Prior to 1953, receivers were broad band and had I.Q. decoders, but these were abandoned because of their high cost. Soon a true I.Q. receiver will again be possible at a low cost due to advances in integrated circuits. Thus, transmitter engineers should observe NTSC standards even though set designers haven't. Good liaison between broadcasters and receiver manufacturers can improve the picture—Norman Parker, Motorola.
- Telecine: Color variability in 16mm commercial film is wide and it's impossible to anticipate what correction should be applied to piggy-backed commercials. However, if the telecine is set up to accurately reproduce the film, then film standards on color balance, etc., could be established and observed.—Roger J. Ross, CBC

BM/E Photo

John H. DeWitt, Jr. shows his power line noise source locator, available from International Nuclear Corp.

Ben Wolfe, moderator of the panel, recommended that TV stations periodically do a proof-of-performance check even though not required by the FCC. In a discussion of color standards, CBS and CBC reported better control by setting color monitors to 6500K.

Other sessions in the how-to-do-it-better category covered use of the flashing light programming modulation monitor (see *BM/E*, June 1969, page 50) and a new way to detect sources of power line interference. John DeWitt, Jr. described how to use a portable noise source locator to detect noise emanating from faulty power lines. Using a combination loop and dipole antenna, the noise locator identifies the direction from which the noise is coming. The superhet receiver feeds both a dB meter and a loudspeaker. Weighing only 5½

Continued on page 66


RCA IS SPARKING
A REVOLUTION
IN COLOR
ORIGINATION
PEOPLE
JUST NATURALLY
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WITH THE
HIGH COST
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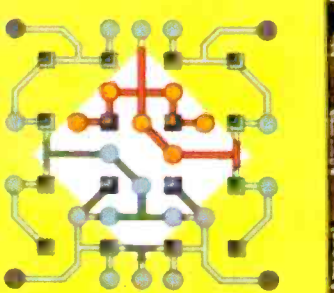
The PK-730—smaller, lighter, less expensive than any color studio camera yet available. Unique single tube, solid-state design features full-fidelity color, unsurpassed operating ease. Unskilled operators can handle this camera with ease since only five controls are needed. It weighs less than 50 pounds and is no bigger than conventional monochrome cameras.

Price includes: Camera, Viewfinder 6:1 Zoom Lens for smooth transitions from wide-angle shots to extreme close-ups, NTSC Compatible Encoder, 50' Camera Cable, Remote Control Panel and Cable.



CIRCUIT 'D'

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color camera systems, live and film.

Now, even the low-budget CATV user can afford to switch from the "gray" world of monochrome to the high-impact, attention-grabbing, "real" world of color! RCA has created color cameras capable of achieving superb color TV performance with non-professional personnel... at the lowest price ever!

Since color is now the accepted means of viewing television, colorful CATV is the trend of the times. And now it's ever-so-easy to be a pacesetter with RCA's new color cameras that topple the cost barriers for local programming in color. Now's the time to join the color revolution. You can "tell it like it is" and save thousands!

The PFS-710, a complete system made especially for color presentations of 16mm sound films and 35mm slides. It includes everything you need—camera, projectors and multiplexer—in a mobile cart just 4 feet long and 2 feet deep.
And it's about as easy to use as showing home movies.

Price includes: Camera, Optical System, NTSC Compatible Encoder, PFP-1600 16mm Film Projector, Slide Projector, Camera Control Panel, Projector Control Panel, Mobile Cart.

NEW COLOR TV FILM SYSTEM

ONLY $9.850

RCA 800 Series VTRs have both record and playback capability and produce pleasing high-resolution color pictures. Pushbutton controls and simple threading enhance ease of operation. Use as a portable or rack-mount unit. Can be remote-controlled. Stop motion is standard. Slow motion and electronic editing are also available. One hour of continuous recording can be made on an 8-inch NAB reel, using 1-inch tape.

Price includes tape recorder, complete with color module.

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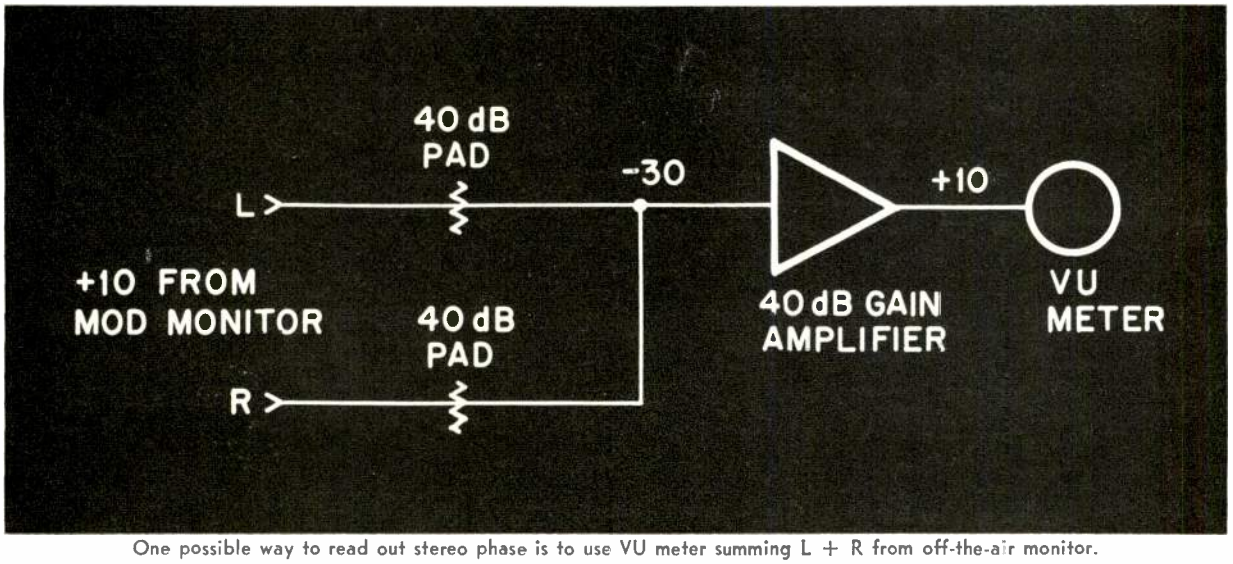
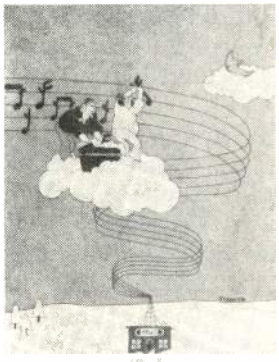


One possible way to read out stereo phase is to use VU meter summing L + R from off-the-air monitor.

Keep Your Stereo Phased

Fazed by stereo phasing? Erase those costly phase differences with sound engineering practices and with motivated combo men.



THE STEREO FM BROADCASTER is constantly plagued by the vagaries of proper phasing. Even bigger than this problem is the fact that many fm-ers are completely unaware that the problem exists. So says Robert Richer, vice president and general manager of Quality Media, Inc., a supplier of packaged programs to broadcast stations.

There are phase difficulties in varying degrees —from five degrees to as much as 180 degrees. If your station's signal should go as far as 180° out of phase, the result is murder for monophonic listeners—by far the biggest segment of today's fm audience. The received mono signal in such cases is not a full L+R program, but in fact is missing key elements that have been cancelled out. The effect is the same as if your transmitter power had suddenly dropped. There's also distortion, the music sounds thin and unappealing and announcers sound as if they have a speech impediment.

No Time for Phasing

Richer caught a very prominent phasing problem while listening recently to a station in a major market. He called the station owner to tell him about it, and was told, "Yes, I know. The station's been out of phase for about a week now, but I've just been so darned busy, I haven't had a chance to get to it." Richer wonders how much of its audience that station has held onto. We're wondering, too.

Actually, correcting a serious phase outage can be quick, simple and painless, if the outage is 180°. Simply reverse the patch plug (if you're using standard dual-prong audio plugs) in either the left or right channel. That's a quick and dirty method that helps preserve your mono audience. Getting at the root of the phase problem can be a much more complicated matter.

There are several possible causes of phase outages:

- Tape head misalignment.
- Out-of-phase tapes or records.
- Out-of-phase elements in the control console and other station equipment in the circuit.
- Telco line problems between the studio and transmitter.

Richer believes that the extreme case of 180°

is no longer the major difficulty today. His contention is backed up by many stereo broadcasters who have this problem pretty well under control. It's the slight phase differences that are the most acute ones, since they produce an annoyance rather an obviously bad or attenuated signal. Given enough of these petty annoyances, or a steady diet of phase outage, and your audience can dwindle very rapidly. First thing they'll do is twirl the dial looking for a station that sounds good to them and fits their taste. If there just isn't any such station, the next step in the listener revolt is to turn the radio off.

Engineers Must Care

Too many stations suffer from lackadaisical engineering practices. You can install a phase meter—a simple matter of hooking a bridge across the stereo monitor's output to feed an outboard VU meter. But if that meter's going to do any good, someone has to look at it. Will your combo night man simply ignore the meter, walk out of the control room when a 15-minute tape is on, and just forget about good practice in general? Attitude is at least as important as technical capability.

If you suspect a chronic phase problem, by all means hook up the circuit and VU meter shown in the schematic. At least your desk man will have an opportunity to know what's going on. If you find that 180° phase outage is a continuing problem with records and tapes, then install a phase-reversing switch on the board to be flipped when the meter does not deflect upward with modulation.

Another check is an oscilloscope fed by both stereo channels. The scope will show phase changes instantly with a high degree of precision. At least one station, Chicago's WFMT, uses Marantz 10B stereo tuners for monitoring in the station and in the homes of key station personnel. This tuner features a one-inch oscilloscope screen used as a tuning and stereo indicator. It will also let you know if the station is out of phase and how the stereo balance and separation are. Alfred Antlitz, WFMT's manager of engineering, says that the station is now in the process of installing large-screen scopes in both of its control rooms to improve the monitoring situation.

Some engineers prefer to monitor the board rather than off the air; it sounds better, they say. This can be suicide! First, you must know whether or not you're on the air. Second, there could be some phase shift in the telco line between your studio and the transmitter. Off-the-air monitoring would certainly show up telco line problems right away, and you might be able to compensate for them at the studio temporarily until the trouble is cleared up.

Mono (L+R) off-the-air monitors feed speakers in the office areas of many stereo stations. During the day, at least, the station's clerical personnel make an excellent monitoring crew with instructions to yell for the engineer the minute they hear anything strange. But this only works for eight hours of the broadcasting day. The rest of the time, it's up to that man riding the board.

Previewing Averts Disasters

The most common culprits in phase criminology continue to be records and tapes. New York's WTFM previews all records, not only in stereo but in mono as well. This way, the previewer knows instantly if a disc has a phase problem and can label it as such. Records that fail the phase test go right into the garbage pail at this station.

According to WTFM's chief engineer, Ed Karl, careful engineering of the studio and its equipment will eliminate at least 99 percent of all phase problems. One continuing possible source of trouble, he says, is the dual-prong audio patch cord. At his station, they're color-coded with red on the right side. But there's always that chance that a plug will be put in reversed. "If I were re-doing the station from scratch," says Karl, "I'd use three-conductor, single-prong plugs for patching. This way there would be absolutely no opportunity for patching to cause phase problems."

A useful trick is to listen carefully when you cue up a record or tape. In the cue position on most stereo consoles, the cue speaker gives you a full L+R signal. If there's a phase problem, and the desk man is interested, he'll spot it instantly. Stereo carts can be another problem. At New York's WRFM, commercials in stereo tend to have serious phasing errors—often going in and out of phase. As a rule of thumb, that station uses only mono spots on carts, especially if there's a jingle or any kind of music on it.

WTFM on the other hand, emphasizes stereo all the way, including its commercials. But it too, has had trouble with stereo carts. Major problem here was the three-channel head. Ed Karl simply couldn't find a mass-produced three-channel cart head that worked to his satisfaction. He found that production-line heads are not only frequently out of phase track-to-track, but alignment within the head has also tended to be a problem. As a result, the station has had its stereo cart heads made to order. Karl says the extra cost amounted to only $15 per head over the price of the mass-produced items.

Ideas for gimmicking up the stereo lines come fast and furious, once you start attacking the phase problem. But all that's really needed is some careful engineering in studio design, and a man on the board who cares. You can have all the fancy indicators you want, but if that night man doesn't eyeball them, your station will lose listeners. One last thought: if you want to ride herd on a carefree night man and have personnel problems (and who doesn't?), you might hook up a repeater for the VU phase meter. The repeater can be a low-cost strip-chart recorder in a locked cabinet. Next morning, you can tell at a glance if the playboy has been doing his job or not. **BM/E**

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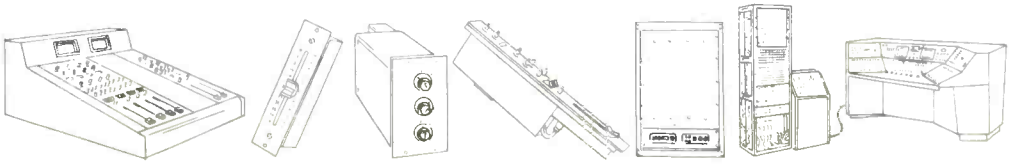
A number of other advanced features make the new Fairchild Reverbertron 659 highly suitable for broadcast or recording purposes. Contact your Fairchild Distributor or write Fairchild for more data. **FAIRCHILD RECORDING EQUIPMENT CORPORATION,** Dept. BME-12, 10-40 45th Avenue, Long Island City, N.Y. 11101.



*U.S. Patent #3436674

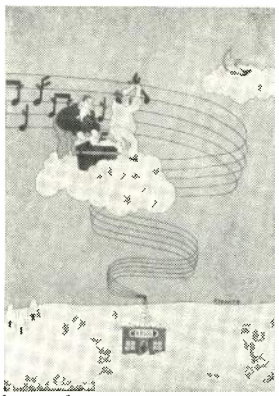
DESKTOP MODULE CONSOLE / LUMITEN / REVERBERTRON 658B / INTEGRATED CONTROL MODULE / REVERBERTRON 659 / REMOTE AUDIO CONSOLE

Circle 133 on Reader Service Card

Sweep-Frequency Measurements for Broadcast Systems

One of the most useful methods of making measurements over a band of frequencies is to use a sweep-signal generator and an oscilloscope read-out. The system is fast, accurate within one percent, and instantly displays the effect of any adjustment to the device or system under test.

By Jim Plumb



SWEEP-FREQUENCY TESTING can be used in broadcasting to measure such parameters as antenna impedance, video amplitude and phase linearity. The technique described here shows amplitude and phase vs frequency on an oscilloscope screen. You can measure input and output impedances as well as the gain or loss of the device or system under test. The equipment used has a phase resolution of less than one degree and amplitude resolution of less than one percent of the reference used. An overall accuracy of plus or minus one percent may be obtained if accurate reference impedances are used over a limited frequency and amplitude range.

In Section 73.54 of FCC Rules, detailed instructions are given for measuring the power input to an a-m broadcast antenna system. An antenna or common-point ammeter is used to indicate rf current, and power is computed by the formula .

$$P = I^2 R$$

where P is power in watts, I is rms antenna or common-point current in amperes, and R is antenna or common-point resistance in ohms. The Rules require a series of measurements of both resistance and reactance at the operating frequency and at points 5, 10, 15 and 20 kHz on either side of the operating frequency. Good engineering practice and the Rules require that antenna or common-point reactance at the operating frequency be reduced as near to zero as practical.

The usual method of measuring antenna or common-point resistance and reactance is with an rf signal generator, an rf impedance bridge (such as the General Radio 1606-B or 916-AL or the Hewlett-Packard 250B) and a communications receiver as a null indicator. While this system has sufficient precision, it's time consuming; several minutes are required to make each measurement, you have to make at least nine readings, and some engineers prefer to take additional measurements to insure the accuracy of the smooth curve which is plotted and submitted to the FCC.

In many cases the radiating system must be adjusted to zero reactance, and this requires several sets of measurements before the goal is accomplished. These measurements are normally made late at night when the station is off the air. With the necessity for slow and painstaking work, it's not uncommon for the job to take all night, or even several nights. If your station programs 24 hours, the all-night programming must be suspended for as long as the measurements and adjustments take. That deprives the public of a broadcast service, and your company of revenue, for that period.

By contrast, the measurement technique described here maintains the required accuracy and takes less time than the bridge method. Also, antenna or common-point impedance is displayed on a crt and you can see the effect of system adjustments immediately.

Measurement Technique

These measurements are made with a sweep-signal generator and its associated tracking detector, such as the Hewlett-Packard Model 675A/676A network analyzer. If nighttime skywave interference at the antenna is no problem, the Hewlett-Packard 11138A impedance adapter may be used with the network analyzer to make impedance measurements. The circuit arrangement is shown in Fig 1.

The network analyzer is designed to make gain and phase measurements of low-impedance (50 or 75 ohms) amplifiers, filters, cables and similar circuits. It does this by supplying a constant-level, swept rf signal to the input of the circuit under test, and simultaneously to a reference, which is a precision resistor or a short piece of coax. After passing through the two networks, the signals are fed to the detector portion of the analyzer for measurement, and are converted to dc voltages. One such voltage is proportional to the gain or loss in decibels, another to the phase shift

Jim Plumb is an engineer with the Hewlett-Packard Company, Loveland, Colorado.

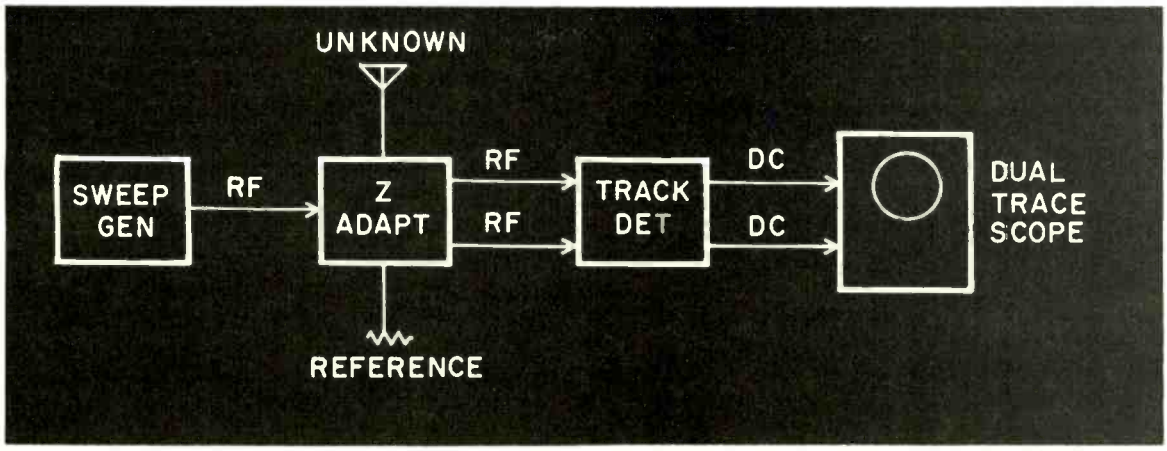


Fig. 1. Measuring equipment is connected as shown. Reference may be resistor or short piece of coaxial cable, depending on parameter being measured by analyzer.

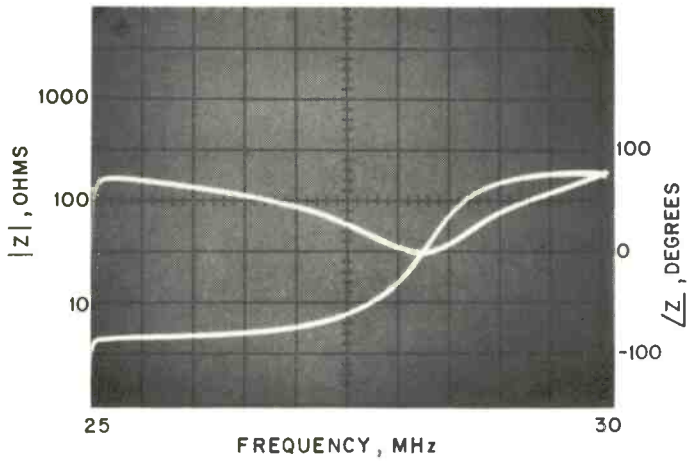


Fig. 2. Dipped trace indicates impedance, ascending trace phase angle, of a whip antenna under test.

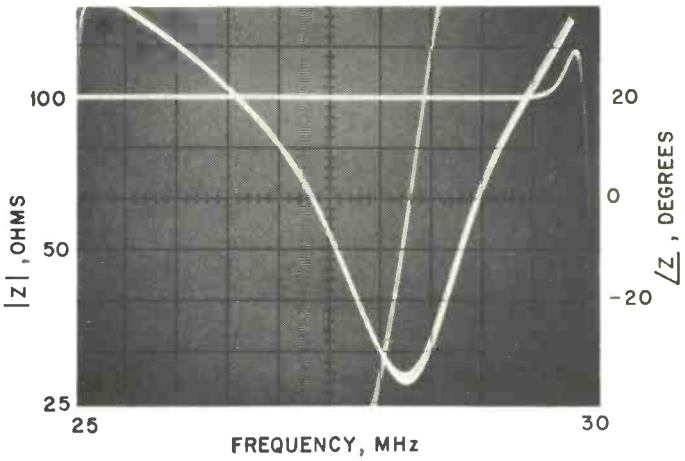


Fig. 3. Trace has been expanded vertically over that shown in Fig. 2 of same antenna.

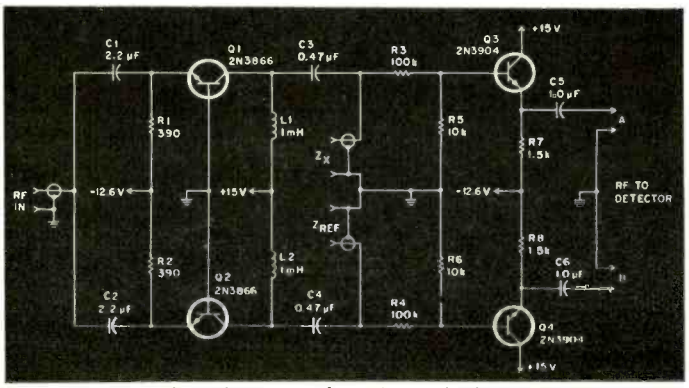


Fig. 4. This adapter, made with standard components, converts sweep generator output to match low impedance of broadcast antenna.

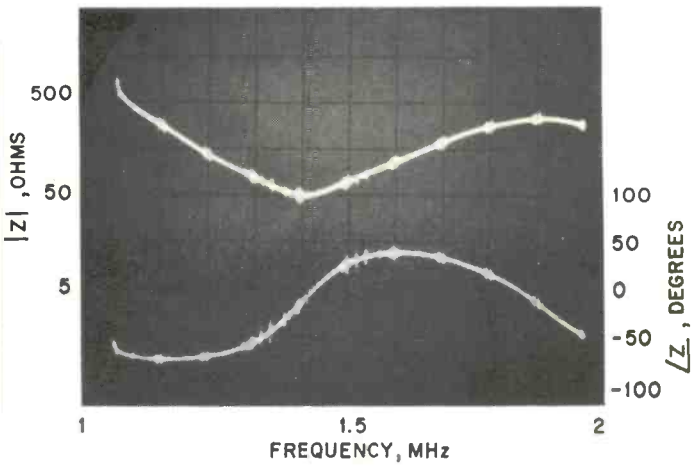


Fig. 5. Impedance of a 1570-kHz BC antenna. Pips are signals of stations on nearby channels.

in degrees. A third is available which indicates the difference in gain in decibels between the test and the reference.

The dc voltages are fed to a dual-trace oscilloscope whose horizontal input is driven by the sweep generator to display the band of frequencies of interest.

Generator current I flows in unknown impedance Z_x (the total resistance and reactance of the antenna or common point under test) and drops voltage E_o across it. The analyzer measures the amplitude and phase of E_o.

The adapter converts the 50-ohm output of the network analyzer into a 33,000-ohm circuit, changing it from a voltage source to a current source. At the same time, it isolates the 50-ohm terminating impedance of the network analyzer, providing a high-impedance, voltage-sensing port for the measurement of E_o.

In practice, the antenna under test is connected to one analyzer channel, and a nonreactive, 100-ohm reference resistor is connected to the other. The result is shown in Fig. 2, where one scope trace indicates impedance in ohms, while the other indicates phase angle in degrees. The traces shown are for a loaded whip antenna. Measurement range can be expanded, as shown in Fig. 3, simply by increasing oscilloscope vertical sensitivity as desired.

The phase measurement is calibrated by pressing a pushbutton which feeds a fixed 5-degree signal (accurate within 0.2 degree) into the circuit, moving the scope trace 5 degrees. There is also a 100-degree button for other scales. Amplitude measurements are calibrated with a precision attenuator in the sweep-signal generator.

Since the impedance adapter converts the network analyzer source impedance simply by putting a high resistance in series with it, available output current is reduced. As a result, the generator signal may easily be overridden at the antenna by interfering skywave signals from other broadcast stations. The solution to this problem is an impedance adapter using a current-amplifier stage. Fig. 4 is the schematic of such an adapter, which is used in place of the one previously described.

Equipment Operation

Fig. 5 shows the results obtained when the analyzer and adapter were used to measure the impedance of a broadcast antenna whose operating frequency is 1570 kHz.

When using the bridge method, the operator reads out resistance and reactance as separate quantities on the bridge dials. You can't do this with the analyzer; on the other hand, you can read total impedance and phase angle on the scope screen.

Notice that in Fig. 5 the antenna is reactive at its operating frequency of 1570 kHz. For a detailed examination of this antenna, the expanded-scale feature was used. The results are shown in Fig. 6.

Signals from interfering stations can be seen in both Figs. 5 and 6; the carrier and sidebands are clearly visible. More important, though, is that the phase angle of the antenna is 37 degrees and its impedance is 100 ohms. The resistance is found by

$$R = Z \cos \phi = 100 \cos 37 = 80 \text{ ohms}$$

In practice, you adjust the antenna system until the phase angle is reduced substantially to zero, removing nearly all reactance from the system. At that point, the impedance trace on the oscilloscope indicates the resistance value, which is used to compute rf power.

The same techniques used to measure antenna impedance can be used to measure video parameters. Knowledge of any amplitude and phase distortion introduced in video processing equipment between camera and transmitter is important to the television broadcast engineer, particularly in color TV.

To measure amplitude response, connect the device under the test into one channel of the network analyzer, without using either impedance adapter described above.

Fig. 7 is a dual-trace presentation of the amplitude response of a video amplifier. Note that both traces contain identical information; the upper trace shows overall response scaled at 10 dB/div, while the lower is scaled at 1 dB/div, and uses the amplitude-difference output of the analyzer. That output has the greatest precision and resolution, and with a precision attenuator in the reference channel, you can get accuracy of 0.05 dB and resolution of 0.02 dB.

Phase Response

An ideal network, whether active or passive, has linear phase response; its phase-vs-frequency curve is a straight line. But no practical network has ideal phase response. Nonlinear phase response can be lived with in audio circuits, but in color television it's a critical factor. If phase response deviates seriously from linear, color-TV picture quality is affected.

To measure phase response, the analyzer compares time lag in the unknown with that in the reference channel. The readout looks like Fig. 8.

If the phase response of a network, is linear, its envelope delay (or group delay) is constant. Mathematically, envelope delay is the first derivative of phase shift with respect to angular frequency, and is given by

$$D = \frac{d\phi}{d\omega}$$

Delay D is in seconds; if angular frequency is converted to frequency in Hertz, the equation becomes

$$D = \frac{d\phi}{dF} \times \frac{1}{360}$$

The point is that if D is constant, all frequency components of a composite video signal are de-

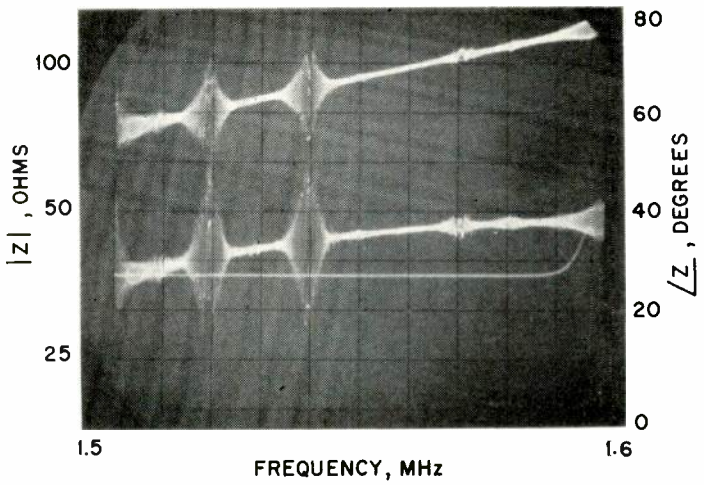


Fig. 6. This is both horizontal and vertical scale expansion of signals shown in Fig. 7 on page 35.

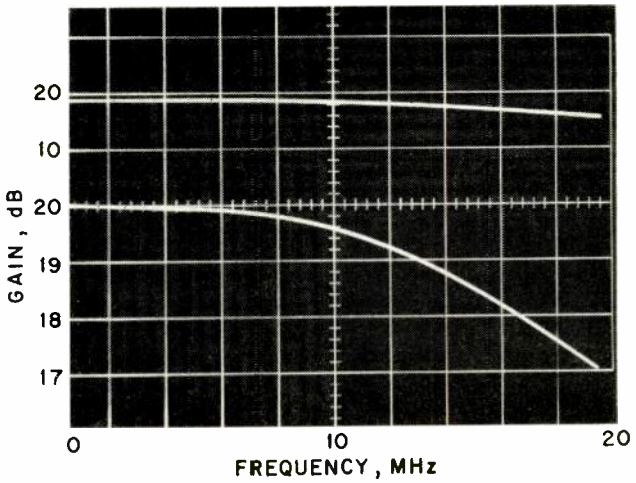


Fig. 7. Amplitude response of a video amplifier. Upper trace is 10 dB/div; lower is 1 dB/div.

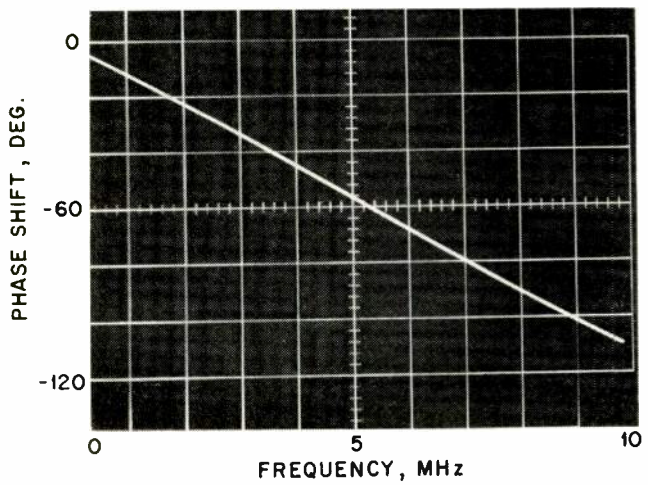


Fig. 8. Phase response as measured by the analyzer shows effect of increasing frequency in video amplifier.

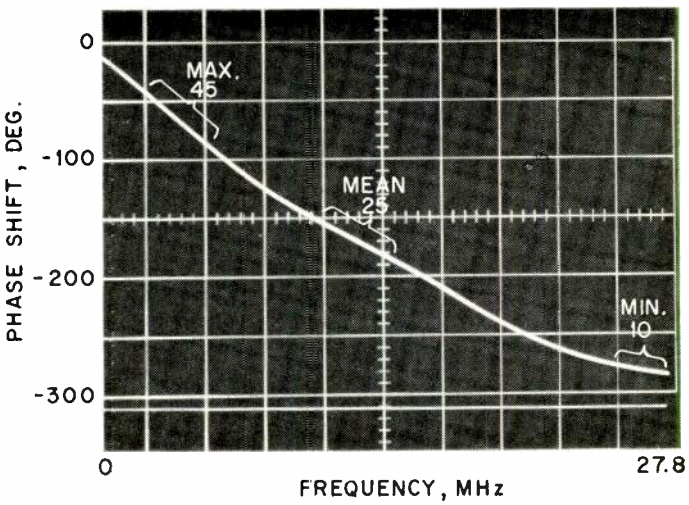


Fig. 9. By comparing maximum, mean and minimum slopes of trace you obtain delay deviation from reference.

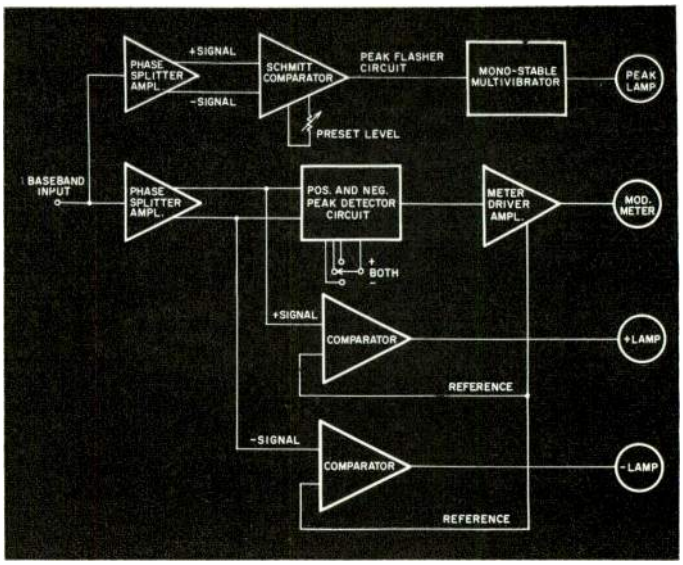
layed by the same amount of time. Envelope delay is useful because you can measure it much easier than phase shift. Thus most phase linearity specifications are written in terms of seconds of delay from some reference. Remember that the absolute amount of delay is unimportant; only the deviation from reference is important.

To relate phase information (which is read out on the scope) to envelope delay information, consider the preceding equation. If $d\phi$ is taken as $(\phi_2—\phi_1)$ and df as $(f_2—f_1)$ then a swept bandwidth of 27.8 MHz provides the correct scale factor so that $(\phi_2—\phi_1)$ over the 27.8-MHz bandwidth represents envelope delay in 10^{-1} nanoseconds. That is, each degree of phase shift represents 0.1 nanosecond of envelope delay.

Of course, the indicated value will be only the mean value for any but linear phase shift. However, if you consider the phase shift for a 2.78 MHz frequency segment (one scale division on the scope if it's set up to sweep 27.8 MHz), you will see that each degree represents 1.0 nanosecond of envelope delay. If the phase shift isn't linear, use the mean value as the reference delay. Then compare the maximum and minimum slopes, as observed within any 2.78-MHz segment of the display, to the mean to obtain deviation from the reference.

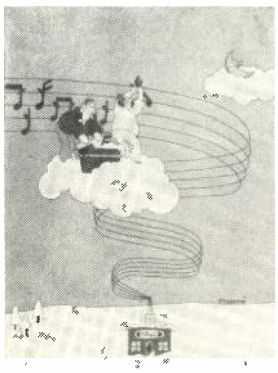
Fig. 9 shows an example, the nonlinear phase response of a video amplifier. Sweep is set so that each horizontal division represents 2.78 MHz, and each vertical division represents 50 degrees (50 ns). The envelope delay deviations can thus be measured with nanosecond resolution.

In Fig. 9, the maximum slope is 45 ns, the minimum 10 ns, and the mean 25 ns. Envelope delay is thus 25 + 20 − 15 ns, and envelope delay distortion is ± 17.5 ns. **BM/E**



Block diagram of fast-response modulation monitor shows circuits that let it read level despite signal polarity.

Now It's Blinking Lights for TV



MEASURING FM MODULATION has been a headache for the broadcaster as well as the FCC. The broadcaster must use a "Type-Approved" monitor to measure his modulation while the FCC field monitoring trucks may use a number of different methods to check a station's modulation level. And there's the rub—a properly calibrated fm monitor will agree precisely with the field truck's measurement when a single tone is broadcast. But if the tone is more complex than that—the usual condition in today's stereo broadcasting—then the correlation breaks down.

Playing it Safe

To complicate matters further, the broadcaster will use a limiter ahead of the transmitter to keep him "safe" from overmodulating. But if he uses a conventional limiter, he'll only be safe if he restricts his modulating frequencies to below 2000 Hz, since the pre-emphasis in the transmitter causes a rising frequency response. The conventional limiter limits all frequencies equally, so that for a constant limiter output, the modulation level out of the transmitter for 4000 Hz is 6 dB greater than for 400 Hz; at 15,000 Hz the modulation level is 17 dB greater. The one saving grace that prevents the broadcaster from modulating at these astronomical levels is that most of the program energy is concentrated in a 3-to-4-kHz bandwidth. Thus the degree of overmodulation is only 3 to 6 dB.

Today's limiters have pre-emphasis in the control circuit, which prevents overmodulation. The drawback, however, is that the overall modulation level will be low, since the level of the mid-frequencies is depressed. One answer to this is to stop the pre-emphasis in the limiter control circuit at 3 to 4 kHz.

If the broadcaster had accurate audio processing equipment, the measurement of modulation would then be academic. But since the broadcaster does not, it becomes most important that he have accurate monitoring equipment. The modulation monitor should provide two functions: it should accurately indicate modulation peaks as well as the average level.

The FCC rules on multiplex modulation monitors require the peak indicator, "peak flasher," to be independent of modulation polarity. The peak flasher must accurately indicate a peak that exceeds a preset level whether it is positive or negative. A properly designed peak flasher circuit works very well in indicating this peak. The present rules require that the lamps stay on from two to four seconds, but a number of peaks may occur during this time so that the lamp only indicates one peak. This causes a lack of correlation with other methods of modulation meas-

Arno M. Meyer is president of Belar Electronics Laboratory, Inc., Upper Darby, Pa.

urement. Suggestions have been made to cut this time down to 50-150 milliseconds.

The FCC rules also call for a metering circuit that accurately measures the peak value of a composite multiplex signal. A properly designed peak modulation meter circuit will not only measure the composite signal but will measure program material more accurately. There are proposals that assume that a metering circuit is not capable of performing the above functions and strong suggestions have been made to discard them in favor of instantaneous lamp indicating devices. But before we throw out the meters and take on new problems, we should know what is wrong with meters to begin with.

First of all, the metering circuits in today's monitors respond to only one polarity at a time, the one selected by the polarity switch. Thus when the peak flasher indicates a peak, chances are its polarity was opposite to the modulation meter polarity. And since there's no way to guess the polarity of the program material, this continues to be a problem with present systems.

The charging time constant of the peak rectifier circuit must be extremely short to respond accurately to short-duration program peaks. It is this characteristic in particular that makes a modulation meter differ from a VU meter. Engineering-wise, it is no great feat to make a modulation meter do this. The decay time constant of 500 to 800 milliseconds called for by the FCC provides good integration to display average level.

Since a peak metering circuit can be designed and economically manufactured to respond accurately to short duration peaks (such as the Belar FMM-1) the real problem is to make it independent of modulation polarity. The block diagram shows a modulation measuring system that solves these two problems. The baseband signal is split and applied to a peak detector circuit that automatically selects the higher of the two polarities and rectifies the signal to drive the modulation meter through the meter amplifier. The switch permits selection of either the positive or negative polarity; it also automatically selects the higher of the two polarities.

Is it Negative or Positive?

When the metering circuit is busy selecting the polarity, there may be a need to know what instantaneous polarity the meter is measuring. The two comparators sense the indicated signal and display the polarity on positive and negative signal lamps. The baseband signal is split and applied to the Schmitt comparator in the peak flasher circuit. The potentiometer presets the comparator to fire from 50 to 120 percent. The comparator drives the monostable multivibrator which determines the duration of the lamp.

This modulation measuring system is incorporated in Belar's new TV aural modulation monitor soon to go into production. Field tests indicate that its accuracy will more than satisfy the demand for accurate modulation monitoring of program material. It will respond to short-duration peaks and since the metering is independent of modulation polarity, it tracks with the flasher on program peaks. Because it is a metering circuit that conforms to the ballistic requirements of the FCC rules, it displays the average program levels accurately.

Instantaneous lamp indicating devices have many drawbacks and problems to be solved. The main one is that they measure levels in discrete steps. To cover the range from 0 to 130 percent in 10-percent steps, for example, requires 14 lamps. To cover that range in 5-percent steps (for 5-percent accuracy) requires 27 lamps. The device should be independent of modulation polarity which further complicates it. To have fewer than 10-percent steps would seriously limit the usefulness of such a device. An integration circuit should be built in to give an indication of average program levels, since it's difficult for the human eye to average a series of flashing light sources. An optimum time duration for the lamps to stay on will have to be determined. In view of these complexities and shortcomings, it's difficult to give up the meter as an indicator.

The flashing-light modulation measuring system described is used in Belar's TVM-1 TV modulation monitor, which meets all present FCC rules for monitors. Its peak flasher gives an instantaneous indication of when a peak exceeds the preset level, and it is independent of modulation polarity. Its metering circuit will indicate the true program peak and it is also independent of modulation polarity. The metering circuit has a continuous scale so that it reads all values of modulation from 0 to 133 percent. Since the metering circuit is an integrating device as well, it also gives the average program level. **BM/E**

How many lights?

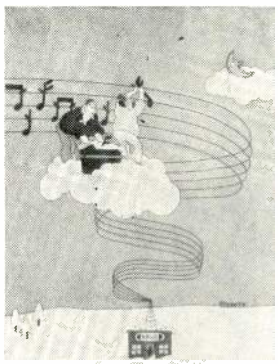
The ideal number of flashing lights is still open to debate. In the June **BM/E** ("Why Johnny Can't Read Modulation," pp. 50-52), we reported that Virgil Duncan and Fred Zellner tested light indicator designs that complied with FCC proposals. They found the ideal number to be somewhere between five and 15. Some tests used as many as 25 lamps, but these units were too complicated to follow accurately.

Belar's 27-bulb flasher complies with latest spec proposal for five-percent accuracy, but is too difficult to monitor continuously. Belar's Arno Meyer says he feels his company's meter monitor (which he calls the most sensitive and accurate in the industry) will eventually be coupled with lights for best all-around station use. Meter will read pulses as short as 50 microseconds or less—always making readings, no matter how short the pulse. Problem is to get the Commission to adopt a realistic spec once and for all.

Quality Control of

By Charles W. Rhodes

A new test signal and a new technique for keeping that color signal clean.



TRANSMITTING A CLEAN color TV picture from camera to antenna makes stringent requirements on equipment in the chain. The only reliable way to check the quality of the transmitted picture is by sending test signals of known characteristics through the equipment, and measuring them when they come out. The test signals and the measuring equipment must be able to isolate and indicate the various types and amounts of distortion introduced in video processing gear. This article describes a quality-control technique which is complete and accurate.

You can tell that a picture's bad by observing it on a picture monitor. However, the distortion can be spotted more accurately and easier on a waveform monitor.

In general, video distortion can be divided into two classes—linear and nonlinear. Linear distortion is independent of the signal amplitude. Theoretically, there are two kinds of linear distortion: amplitude or gain dependent upon frequency, and time delay dependent upon frequency.

Nonlinear distortions are dependent upon amplitude. Two examples are differential gain and phase, and dynamic gain. While nonlinear distortions cause only slight black-and-white picture impairment, they are disastrous in color.

You cannot measure linear distortion in a system which contains an appreciable amount of nonlinear distortion. For example, when sweep-frequency testing a video circuit, you often get different measurements as you vary the signal level. Often full amplitude multiburst testing of transmitters isn't possible because of the nonlinear distortions which occur in the transmitter at full modulation.

To facilitate accurate measurements of all nonlinear forms of distortion encountered in color TV broadcasting, Tektronix has recently developed the model 140 test signal generator. It is

Charles W. Rhodes is manager, Television Instrument Engineering for Tektronix, Inc.

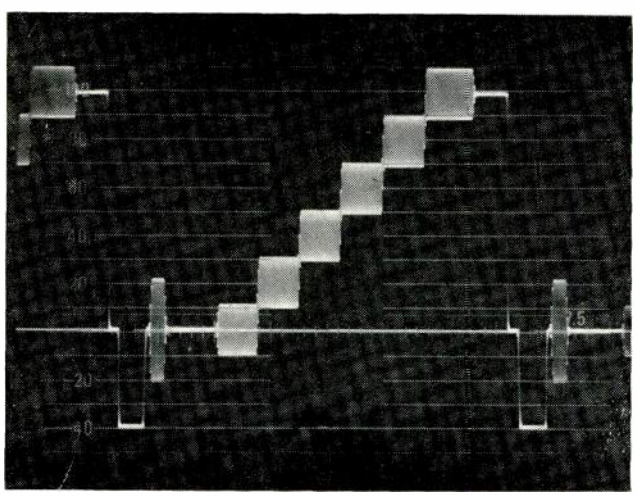


Fig. 1. Staircase test signal in which subcarrier is phase locked to burst; amplitude is 20-40 IRE.

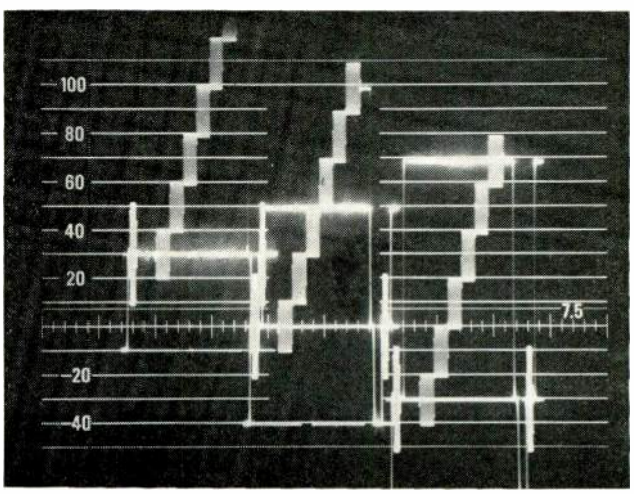


Fig. 2. With dc restorer off to show true dynamic range of video signal, waveform is 10, 50 and 90 percent APL staircase.

the Color TV Signal

used with the model 520 vectorscope and a waveform monitor.

The model 140 generator produces a five-step stairstep signal with or without a phase-locked subcarrier. NTSC color bars are alternatively available in EIA split-field form or as full-field bars of either 75 or 100 percent amplitude. Either of these test signals may be inserted in the vertical blanking interval within the instrument. A complete EIA sync generator is also provided so that a minimum of interconnections are necessary to carry out test routines.

The staircase test signal shown in Fig. 1 has an average picture level (APL) of 50 percent.* When this test signal appears on every fifth line, a luminance pedestal is on the intermediate lines and the APL is variable from 10 to 90 percent, as shown in Fig. 2. When the pedestal is set at blanking, the APL is 10 percent. Blanking is +30 IRE units, white level being at +130 IRE units. When the pedestal is set at white level, the APL is 90 percent and blanking is at −30 IRE units, depressing the sync tips to −70 IRE units, while white is at only +70 IRE units.

The effect of APL variations from 10 to 90 percent is to increase the required dynamic range which unclamped video amplifiers must accommodate from 140 to 200 IRE units. White compression is most likely during low-APL scenes while sync compression is most likely with higher scene brightness conditions.

Thus differential gain and phase, as well as all nonlinear distortion, should be measured not only at 50 percent APL, but at the 10 and 90 percent levels also. This is particularly important since most transmission systems do not exhibit constant gain over the entire dynamic range encountered.

Table 1.

75 Percent Color Bar	Chroma	Burst	APL
Yellow	Cyan		
−4.9	−6.0	−5.4	10
Reference	Reference	Reference	50
+6.5	+4.7	+5.4	90

All figures are percentages

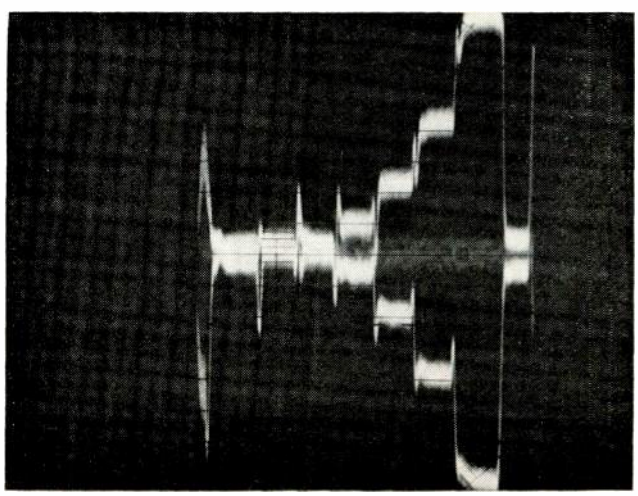


Fig. 3. Burst phase error −2 dgrees with respect to 0 IRE subcarrier.

Dynamic Gain

The effect of gain variations caused by changes in APL is called dynamic gain. Typically, dynamic gain of components of the video signal is measured as follows:

- Luminance dynamic gain: Blanking to white reference level.
- Sync dynamic gain: Blanking to sync tips.
- Burst dynamic gain: Peak-to-peak burst amplitude.
- Chrominance dynamic gain: Peak-to-peak amplitude of the staircase subcarrier at 60 IRE units, to simulate facial highlights which are most critical in a typical scene.

The stairstep signal already discussed is suit-

*APL, or average picture level: The average signal level, with respect to blanking level, during active picture scanning time (integrated over a frame period, excluding blanking intervals), expressed as a percentage of the difference between the blanking and reference white levels.

able for these measurements. The procedure is to normalize the component to be measured at 50 percent APL, as viewed on the waveform monitor. Thus the composite video level in the system should be normal. With 50 percent APL, the blanking-reference white is adjusted for exactly 100 IRE units, and without changing the gain of either the system or the monitor, the APL of the test signal is changed to first 10 and then 90 percent while reference white level is observed. It is assumed that the waveform monitor dc restorer holds the blanking level constant. (The Tektronix type 420 vectorscope can also be used for these measurements; however it has a sync-tip dc restorer and therefore blanking level may change slightly with variations in APL, due to sync dynamic gain.)

Luminance and chrominance dynamic gain equals $E_{max} - E_{min}$ where E is expressed in IRE units. Burst and sync dynamic gain are measured in exactly the same way, except that the waveform monitor's gain is set up for 40 IRE units burst or sync at 50 percent APL initially.

Burst or sync dynamic gain equals 2.5 times ($E_{max} - E_{min}$) as above. Chrominance dynamic gain is measured the same way. However the subcarrier level would be expanded from 60 to 100 IRE units peak-to-peak amplitude at 50 percent APL.

The + sign is used to denote that luminance dynamic gain is maximum at 90 percent APL, and the − sign to the contrary. It is quite common to find that luminance dynamic gain is + while sync is typically −.

In transmitters, while the video signal is dc restored at the modulator input, the APL may still have an influence upon linearity. One transmitter tested as shown in Table 1.

The consistent pattern of increased chrominance at higher values of APL at all luminance levels suggests the presence of some sort of tuning effect as a function of average *power* level.

Dynamic Burst Phase

It is unfortunate that the color burst is located on the horizontal back porch. If it were located at some luminance level comparable to

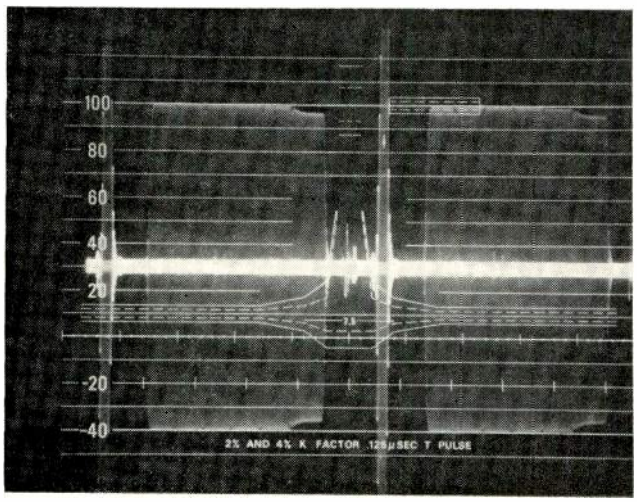


Fig. 4. Waveform monitor display of 5-percent differential gain.

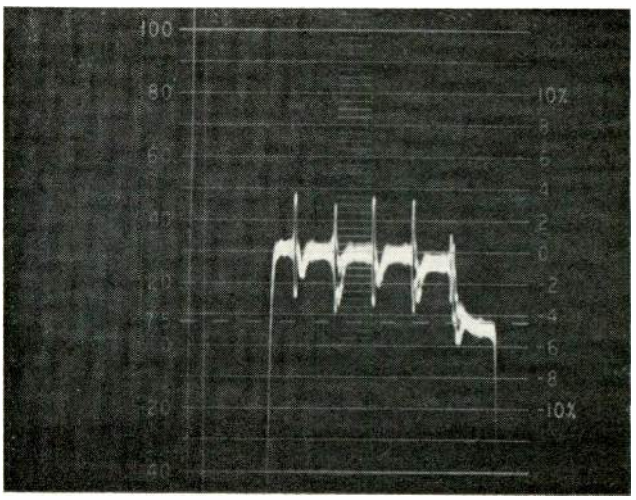


Fig. 5. Vectorscope display of 5-percent differential gain. Note square graticule overlaid on vectorscope.

facial highlights, instead of below black level, the effects of differential phase would be minimized. If it did not fill the back porch, then perhaps back-porch clamp circuits could more easily avoid the burst and produce neither clamping errors nor burst phase modulation. However, burst is where it is and thus we need to measure the burst signal for phase accuracy. As burst is regenerated in transmission, perhaps several times, the original and the transmitted burst phases may not be identical.

The Tektronix stairstep test signal provides a means for measuring burst phase errors. The vectorscope compares the phase of the burst with that of the first part of the stairstep modulation, which is at blanking level. Fig. 3 shows the blanking level subcarrier nulled. The phase error is then obtained by adjusting the precision phase shifter on the vectorscope to null the burst. The different in phase-shifter dial indications is the burst phase error. If any phase error is independent of APL, it is static; that part of the phase error which changes with APL is called dynamic burst phase.

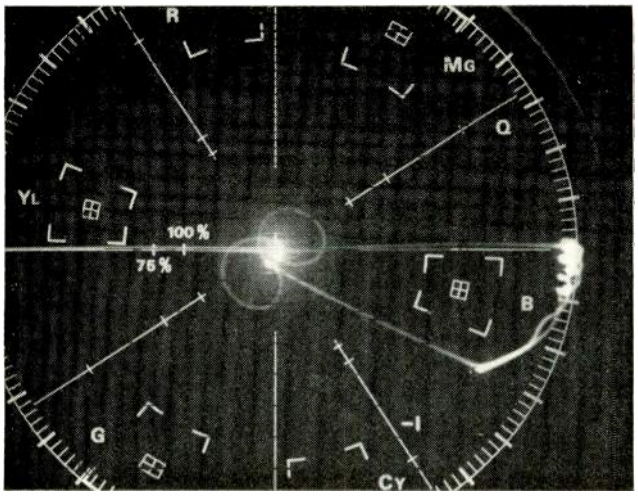


Fig. 6. Initial setup of vectorscope to measure differential gain and phase.

An interesting variation on the above technique is to measure the burst phase error with respect to the subcarrier, not at blanking level but at a luminance level of, say, 60 IRE units. The idea is that facial highlights are the most critical commonly viewed TV subjects, and phase errors are usually apparent in faces.

Thus picture impairment is much more closely related to burst phase errors when luminance is at the 60-IRE-unit level than when it's at the zero-IRE-unit level. This is especially so with the passage of time or variations in APL, or if these phase errors are unequal from station to station. When making distortion measurements, the operator should identify the burst phase error as static or dynamic, and note the luminance reference.

Differential Gain and Phase

Amplitude modulation of the color subcarrier by the luminance signal produces differential gain. This amplitude modulation occurs due to the nonlinearity in the amplitude-transfer characteristic of the transmission system. In general, the video signal encounters different amounts of differential gain at various values of APL. Of course, the 50 percent APL test condition is close to that of typical program material, while 10 and 90 percent APLs represent extremes which are seldom found in programming. Thus the system performance should be optimized at 50 percent APL and not compromised to minimize differential gain at the extreme conditions.

Differential gain may be measured either on a waveform monitor, as shown in Fig. 4, or with a vectorscope, as shown in Fig. 5. These displays differ in three ways.

The waveform monitor displays the peak-to-peak amplitude of the subcarrier component of the test signal, but its resolution is limited. The peak subcarrier being 70 IRE units, a 5 percent value for differential gain produces a change of only 3.5 IRE units in subcarrier amplitude. Less than 5 percent differential gain is hard to see when some noise is present. Display intensity is limited, which is important only in vertical interval testing. This is because the waveform monitor is in essence producing a raster display rather than a line display.

Both of these problems are overcome by using a vectorscope. Only the subcarrier component of the test signal is peak detected and amplified so that the line waveform has increased resolution and brightness.

The added resolution is achieved by the expanded-scale technique. It requires that the test-signal level be accurately set by the test engineer while observing the vector-display signal.

Fig. 6 shows the test-signal gain and phase set optimally for making measurements in quick succession of both differential gain and phase. The gain is set so that the vector dot representing the largest amplitude packet of subcarrier lies at the compass rose and is phased to zero degrees. The measured value of differential gain (or phase) is taken as the difference in the extreme values of the subcarrier signal.

The preceding is method (c) as given in IEEE Standard No. 205 (formerly IRE Standard 23 S1 1958). It is the easiest to use because the maximum amplitude signal is considered to be 100 percent and the differential gain scale reads directly when the maximum amplitude subcarrier is positioned to the zero percent point on the scale. You must specify which of the three methods was used when reporting results, as the other two methods generally yield different numbers and that difference may be as much as 2:1.

Differential phase may either be read off the compass rose in the vector-display mode when extremely large, or from the precision phase-shift dial in the differential phase mode. Some confusion has existed about this technique. When making differential-phase measurements, use only as much gain as needed to make a sensible display in terms of both the noise level and the distortion observed. Unlike the differential-gain measurement, which requires a fixed gain, noise effects are minimized by reducing video gain without causing any errors in measuring differential phase. When nulling the test signal, first set the precision phase dial to read zero and null the test signal at any chosen luminance level with the goniometer. Then null the other chosen subcarrier with the precision phase shifter. Do not divide the dial reading by two; it is correct as read out.

Differential gain (and phase) may be reported in either of two ways as regards the 10 and 90 percent APL measurements. A recommended procedure is to first made the measurement at 50 percent APL. Without changing gain, make the measurements again with 10 and 90 percent APL. With changes in APL, there is usually an average change in subcarrier level, i.e. dynamic chrominance gain. This the + and − portions of the differential gain scale are provided as the gain may be even higher at either extreme of APL than at 50 percent, at least for some portion of the test signal.

This procedure measures not only the dif-

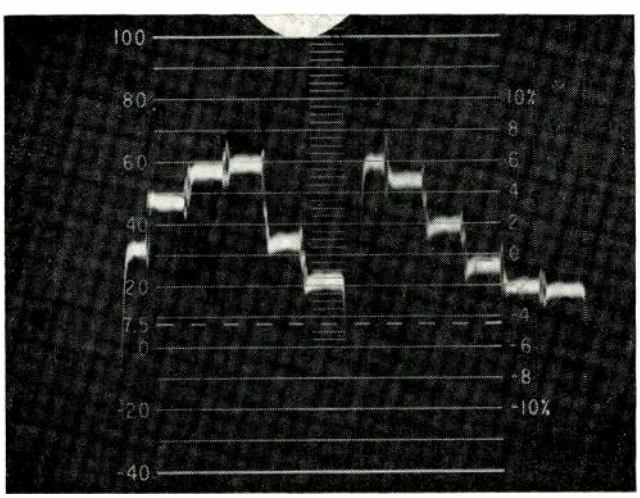


Fig. 7. Differential gain of 8 percent; shape factor influences picture impairment.

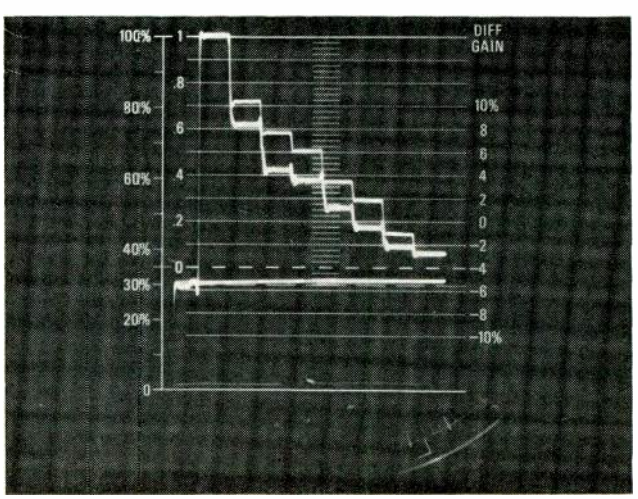


Fig. 8. Color bar luminance signal: brighter trace is 0 percent saturation; dimmer race is 100 percent saturation.

ferential gain at each APL, but the variance in chrominance gain with APL. It differs from the IEEE standard, which ignored dynamic gain.

To conform with the standard, three measurements are made. Each involves normalizing the gain first at that APL. If the dynamic chrominance gain is then measured also, the measurement is complete.

Picture impairment is related to the shape of the differential gain and phase as they appear on the vectorscope, as well as to their magnitudes. Consider the case where differential gain varies fairly smoothly from blanking to peak white. Contrast this with the case where most of the gain change occurs in the middle of the luminance range, where facial highlights are. In the first case, most facial features have nearly the same chrominance, while in the latter the luminance variations of the facial features cause most of the total chrominance variations. A shiny forehead and a ruddy throat is one possible result. The viewer may adjust his receiver for a realistic-looking forehead or throat, but not both.

Alas, how to measure the shape factor if it is judged significant? Several manageable ways exist. Shapes such as ramp or bow with signs to indicate whether gain is maximum or minimum at the white level with respect to mid-range would help.

The amount of acceptable differential gain might be considered for two different cases, with ramp shape 15 percent maximum, or − bowing 10 percent, + bowing 5 percent. A similar scheme would also then exist for differential phase, recognizing the significance of shape factor.

An example of shape factor is shown in Fig. 7.

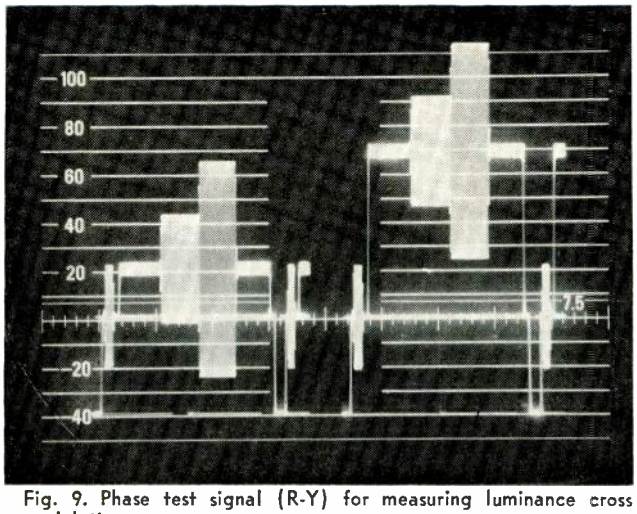


Fig. 9. Phase test signal (R-Y) for measuring luminance cross modulation.

Luminance Cross Modulation

Just as differential gain is the result of the luminance signal amplitude modulating the chrominance signal, a corollary effect that's much less well known in the U.S., is luminance cross modulation. This form of distortion affects the luminance signal amplitude of those parts of the picture which are high in saturation.

This effect, when present, is proportional to the square of the chrominance signal amplitude. For the staircase test signal, the usual 20-IRE-units subcarrier level is too small to provide a sensitive test for this distortion. With the subcarrier at 40 IRE units, the distortion can be readily measured. The subcarrier amplitude may be conveniently adjusted in the type 140 over a range from 20 to 40 IRE units.

The color-bar signal provides a very sensitive test for luminance cross modulation because it contains very large chrominance signals, corresponding to 100 percent saturation of 75 percent amplitude colors; it also includes a range of luminance signals.

Fig. 8 shows the luminance signal of the NTSC color-bar display as viewed on the type 520 vectorscope. The luminance display mode of this vectorscope deliberately has narrow-band response, somewhat similar to the IRE roll off. However, the subcarrier is much more attenuated, −34 dB being typical at 3.58 MHz vs only −20 dB for the IRE roll off. The waveform shows a double exposure taken when the chrominance was on (brighter trace) and off (dimmer trace). Note that the cyan color bar suffers the greatest luminance error, which is quite typical.

Luminance cross modulation is seldom a problem in video amplifiers operating at baseband (not rf). In fm relay and CATV systems, where demodulators are used, luminance cross modulation appears and alters black-and-white as well as color pictures.

A new test signal expressly designed to make the measurement of luminance cross modulation very simple has been developed by Tektronix, and is incorporated in the type 140 staircase test

signal. This new signal is shown in Fig. 9 as it appears on the waveform monitor. The largest-amplitude chrominance component of the signal is comparable to the cyan color bar. The luminance is variable from zero to 100 IRE units in small, equal increments. Phase is 90° from burst, (R−Y) and thus on a receiver screen appears a broad pink color. Immediately to the left of the largest chrominance signal is a signal with the same phase but with only half amplitude.

Luminance cross modulation is generally a function of both APL and luminance pedestal level. Thus the test signal has a variable pedestal capability. Take care when using it to not exceed the practical limits of pedestal, which are 20 to 60 IRE units, corresponding to luminance values of red and cyan 75 percent color bars. Fig. 10 shows the distortion as measured with the aid of this signal. Either the 75 percent color bars or the variable pedestal R−Y signal, or staircase signal may be inserted on the program line. The type 140 includes VITS keying circuitry which has been designed for fail safe operation.

Luminance Distortion

Nonlinearity may be frequency independent, but there are many cases where there is differing linearity for the luminance and chrominance signals. Thus, differential gain is not a complete measure of the system amplitude linearity.

To examine the system for incremental gain distortion, or low-frequency differential gain, the step component of the staircase signal is differentiated with a suitable time constant. Thus each step riser appears on a common base line. The differentiated signal may be magnified for detailed examination. Less than two percent step height differences may be read, as shown in Fig. 11.

This test is valid only where it is known that the step risers all have identical rise time, a condition fully specified for the type 140 generator. The steps are generated as extremely fast transitions of integrated circuits. Their combined output is controlled as to transient characteristics by a single filter of approximately $\sin^2$ type, which cuts off below the chrominance band.

A suitable video staircase differentiator is made by Tektronix. It has 75-ohm input impedance and includes a noise filter which has been found necessary in this work.

Cumulative Testing

All of the tests described have isolated one form of distortion and measured it. Picture impairments are actually dependent upon the total impact of these distortions at any time. The vectorscope display of the 75 percent color-bar signal, especially as a vertical interval test signal added to the program signal, gives a clear measure of the cumulative effects of differential gain and phase, burst dynamic phase, and chrominance dynamic gain.

The author has conducted some tests where picture impairment was judged by the chrominance errors as indicated by the color-bar vector dots displacement from the center of the small boxes of the scope graticule. These tests were done using split-screen techniques, and thus memory is not involved in making impairment assessments. The conclusions reached were:

- No perceptable color shift with respect to the correct colors can be noted as long as the vector dots remain within the small boxes.
- The FCC limits of ±10° in phase alone, produces a noticeable but not objectionable color change with respect to the correct colors.
- The FCC limits on chrominance gain, ±20% alone produce noticeable but not objectionable changes with respect to the correct colors.
- The preceding two combined effects are objectionable.
- Comparing two signals in which combined effects are additive produce unacceptable color changes.

The author recommends that the vector display of color bars be evaluated as an overall quality test while the diagnosis of transmission distortions is most easily carried out, using the familiar differential gain and phase and dynamic techniques. **BM/E**

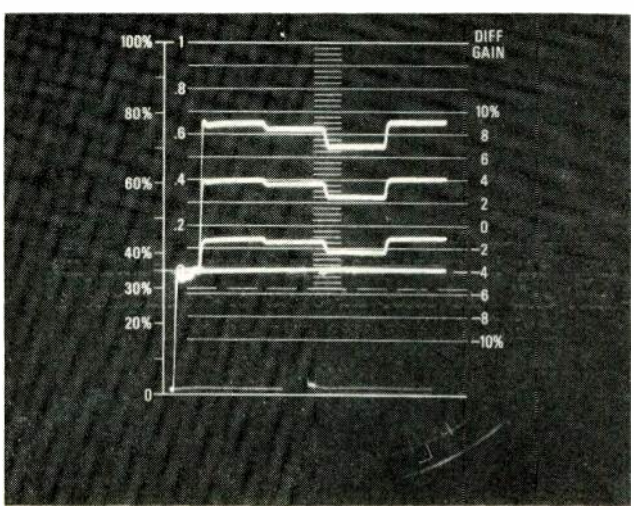


Fig. 10. Luminance cross modulation measured on the (R-Y) phase test signal through a modulator-demodulator pair.

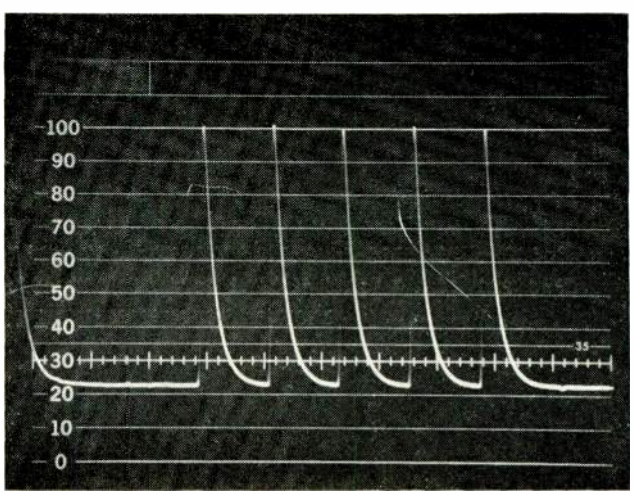
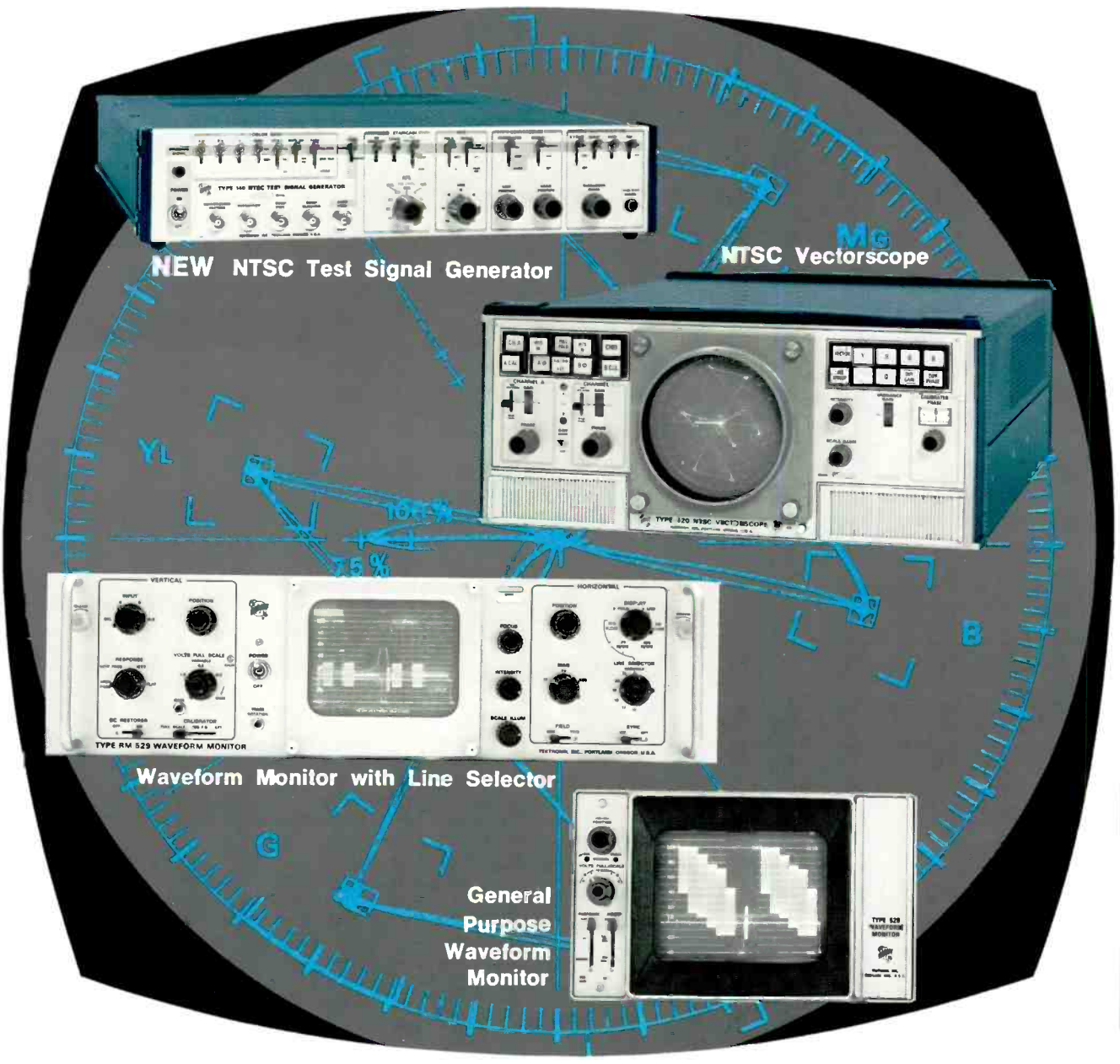


Fig. 11. Differential steps of staircase test signal to measure low-frequency differential gain.

product report
television instruments

Total Measurement Capability for NTSC Systems



■ With the introduction of the NEW TYPE 140 NTSC Test Signal Generator, Tektronix now provides measurement capability from signal source to waveform display. ■ Each instrument in the Tektronix television family is designed to satisfy a specific portion of your video measurement requirement — with performance to spare! ■ All of these units provide long-term stability and reliable performance through use of solid-state circuitry and state-of-the-art engineering techniques. ■ Mechanical configurations include rack-mount, cabinet and portable units.

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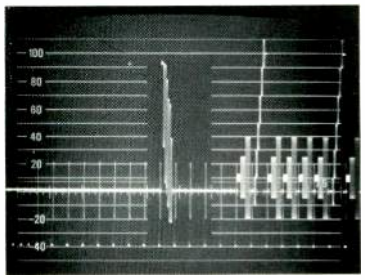
MAKING THE MEASUREMENT

A complete family of television test instruments from Tektronix.

THE TYPE 140 NTSC TEST SIGNAL GENERATOR is a compact, solid-state source of high-quality television test signals for 525-line, 60-cycle field NTSC color TV systems. Combined in one compact unit are: ■ NTSC ENCODED COLOR BARS with 75% and 100% amplitude, full-field or split-field bars at 10%, 7 1/2% or 0% setup level. ■ MODULATED STAIRCASE providing variable APL, 10% to 90% and fixed APL, 50%. The test signal contains 5 steps plus blanking level with subcarrier phase locked to burst. A new signal capability provides a means to check luminance signal distortion caused by rectification of the subcarrier signal. ■ CONVERGENCE CROSSHATCH provided for picture monitor linearity evaluation in accord with IRE specification 54 IRE 23.S1 and color picture monitor convergence adjustment. ■ VERTICAL INTERVAL TEST SIGNALS, staircase or color bars can be applied to lines 15 through 21 of either or both fields. ■ EIA COLOR STANDARD AND SYNC GENERATOR include a temperature controlled color standard with excellent frequency stability. Digital integrated circuits are extensively used to achieve stability, accuracy, and reliability. Outputs are provided of subcarrier frequency, composite sync and blanking, vertical and horizontal drive, burst, composite video and the convergence pattern signal.

140 NTSC Test Signal Generator $1800
R140 NTSC Test Signal Generator (includes rackmounting hardware) $1800



Color bars inserted during vertical interval. The full field signal is a modulated staircase, variable APL, 90° modulated subcarrier inserted.

THE TYPE 529 AND RM529 WAVEFORM MONITORS are general-purpose video monitors with VITS measurement capability. ■ Vertical response characteristics are HIGH-PASS, LOW-PASS, IEEE and FLAT (8 MHz). Vertical sensitivity range is 0.12 V to 1.5 V for full-scale deflection. Full-scale calibration at 0.714 V or 1.00 V is provided. ■ A VIDEO-OUTPUT AMPLIFIER supplies video and a brightening pulse to a picture monitor, intensifying the same line(s) displayed on the instrument when using the LINE SELECTOR. ■ DC RESTORATION maintains the back porch at a constant level and may be turned off for viewing other than video signals. The circuit can easily be modified for sync-tip restoration. ■ HORIZONTAL SELECTION provides 2-field or 2-line displays, plus calibrated sweep rates of 0.125 H/cm or 0.25 H/cm. Either calibrated rate may be delayed for line selection. SWEEP MAGNIFICATION extends the sweep rate by X5 or X25. POSITIVE FIELD SELECTION in the LINE SELECTOR mode permits detailed study of any desired line(s), and a front-panel switch selects line 16 through 21 for viewing VIT signals.

Type 529 Waveform Monitor $1200
Type RM529 Waveform Monitor . $1250

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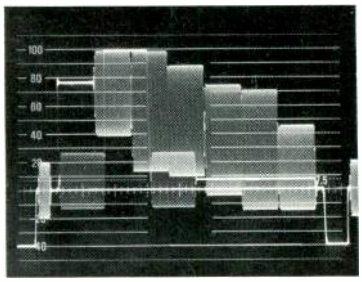
Type 520 Vector Display of VITS color bars conforms to EIA Spec. RS189. Signal Source — Type 140 NTSC Test Signal Generator.

THE ALL SOLID-STATE TEKTRONIX TYPE 520 VECTORSCOPE is designed to measure luminance, hue and saturation of the NTSC composite color television signal. ■ PUSHBUTTON SWITCHES permit rapid selection of displays for quick analysis of VIDEO signal characteristics. ■ DUAL INPUTS provide time-shared displays for comparison of input-output signal phase and gain distortion. ■ A CHROMINANCE CHANNEL demodulates the chrominance signal for use in VECTOR, LINE SWEEP, R, G, B, I, Q, Differential Gain (dA) and Differential Phase (dϕ) displays. ■ A LUMINANCE CHANNEL separates and displays the luminance (Y) component of the composite color signal. The Y component is combined with the output of the chrominance demodulators for R, G, and B displays at a line rate. ■ A DIGITAL LINE SELECTOR permits positive selection of Vertical Interval Test Signals from lines 7 through 22 of either field.

Type 520 NTSC Vectorscope ... $2150
Rackmount Type R520 ..... $2175



Type 528 Waveform Monitor Display of split-field color bars per EIA Spec. RS189. Signal source — Type 140 NTSC Test Signal Generator.

THE TYPE 528 SOLID-STATE WAVEFORM MONITOR is ideally suited for monitoring waveforms from camera outputs, system output lines, transmitter input lines, closed-circuit and educational TV systems. ■ This COMPACT INSTRUMENT requires only 5 1/4-inches x 8 1/2-inches mounting space. ■ Either of TWO VIDEO INPUTS may be viewed on the 8 x 10-cm screen. The signal being displayed is provided at the rear-panel connector for viewing on a picture monitor. ■ Calibrated 1 V and 4 V full-scale deflection factors provide convenient displays of typical video and sync signal levels. A variable control provides uncalibrated full-scale deflection factors from 0.25 V to 4.0 V. FLAT, IRE, CHROMA, and DIFF GAIN vertical amplifier response positions permit rapid measurement of waveform characteristics. ■ A SLOW-ACTING DC RESTORER maintains a constant back porch level despite changes in signal amplitude, APL, or color burst, and may be turned off when not needed. ■ Sweep modes are: 2-V SWEEP (two field), 2-V MAG-SWEEP (expanded two field), 2-H SWEEP (two line), and 1-μs/div SWEEP (calibrated sweep with accuracy within 3%). Internal or external sync is selectable. ■ Provision is made for YRGB and RGB displays. ■ This lightweight waveform monitor converts to a portable unit for field service by adding an optional protective cabinet. An optional Rack Adapter permits side-by-side mounting of two Type 528's.

Type 528 Waveform Monitor $890

For a demonstration call your local Tektronix field engineer or write: Tektronix, Inc., P. O. Box 500, Beaverton, Oregon 97005.

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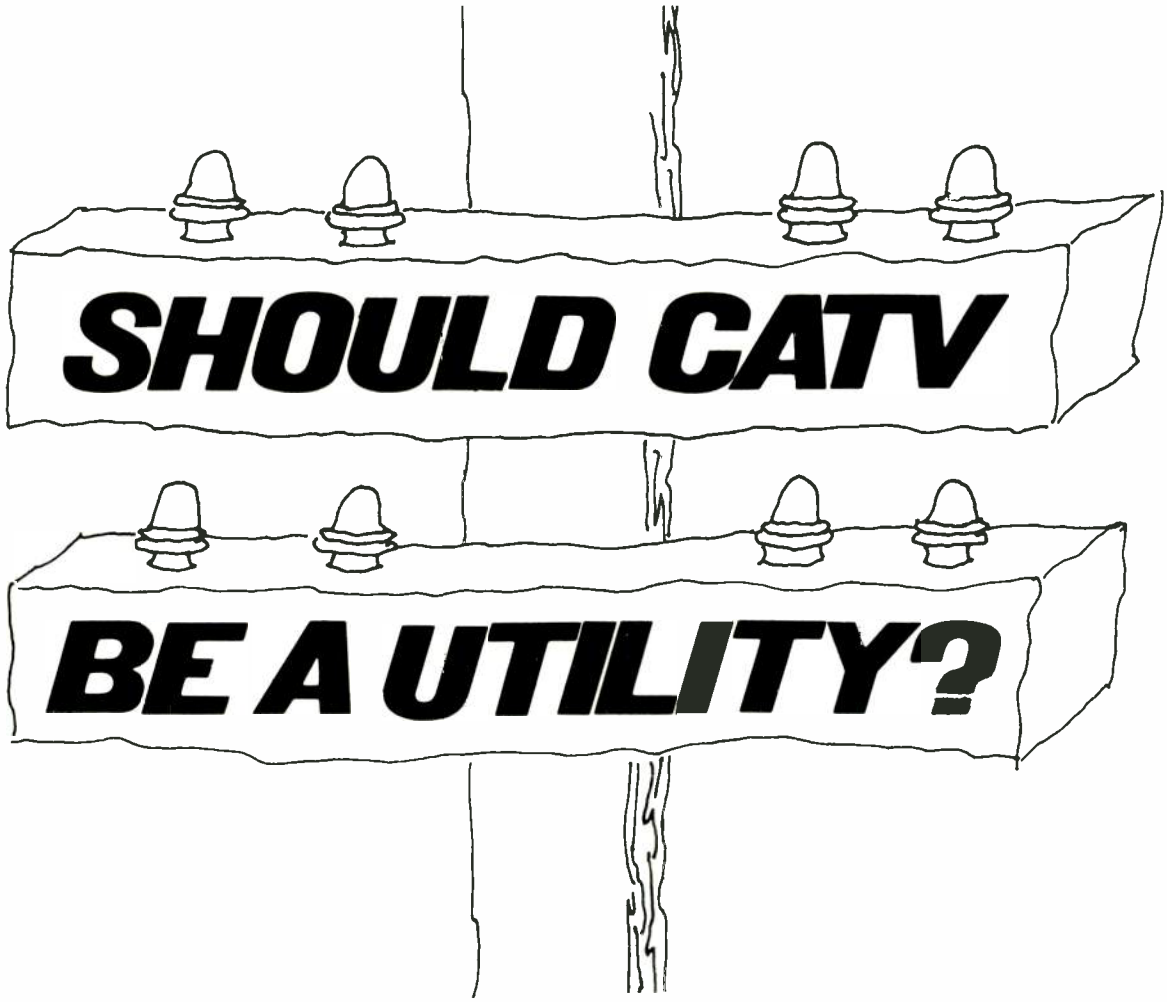

Utility status has been traditionally applied to necessities that are "naturally" monopolistic. Since CATV is more properly classed as a luxury and certainly not monopolistic in many areas, should the stranglehold of utility regulation be applied here?

By Gary L. Christensen

THE REGULATION of cable television by State PUCs increasingly is becoming a topic of conversation at the FCC, the state utility commissions, and among CATV system operators.

The CATV industry generally views such regulation as a battle between two conflicting regulatory concepts in which the lines are still being drawn. State utility regulators of some states and their national association, capitalizing on consumer protection publicity, are attempting to place CATV system operators under the control of utility regulatory commissions, whether such control is needed or not.

As a result, much misinformation about the "terror" of PUC regulation and also about the "necessity" to regulate CATV, has been circulated among the parties to the controversy. The whole problem deserves a closer look.

Utility Regulation

Public utility regulation, always difficult to define, is becoming even more so. Francis Welch gives us a definition that involves three factors: a monopoly, a duty to serve and an obligation to maintain reasonable rates.[1] The question which must be answered is whether CATV can be fit into that concept, and should it be?

The FCC has determined that CATV is an extension of the television broadcasting industry, an auxiliary service in the chain by which television programs flow from the originator to the recipient, yet one which engages in competition with the television broadcasting industry. At the same time, CATV is not Pay-TV, nor is it a broadcast service, nor is it a common carrier. The FCC's definition of CATV, found at 47 CFR §74.1101(a), fits into the concept that CATV is like a "master antenna," a concept which has been recognized by the United States Supreme Court. This is traditional CATV and the vast majority of American systems fall into this category. In time, it is believed that the character of CATV will change from a reception service into a total communications service, but that concept really shouldn't be considered, since it is only a future *possibility*.

Early in the development of business, and simultaneously with the development of the utility concept, business economics usually created a monopolistic atmosphere. Just about all business was "public" and subject to price control—including such private sector businesses as bakeries and breweries. In those days, monopoly resulted in the cost per unit of product dropping sharply as the number of units produced increased. The planners thought at that time that competition increased the cost and en-

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1. Welch, Francis, "Cases and Text on Public Utility Regulation."

couraged the duplication of facilities.

The increasing trend toward business regulation, evident most prominently since the 1930s, is sometimes confused with utility regulation. The two concepts are distinct, however, and it is important that each retains its separate identity. Each can usually be recognized by observing the purposes for which it is intended.

Public utility regulation usually seeks to:

- Prevent entry of new enterprises into the business (or the departure of old enterprises).
- Limit expansion into new territory.
- Control issues of new securities.
- Prescribe the minimum quality of service.
- Prescribe uniform accounting procedures.
- Require submission of periodic uniform financial and other reports.
- Control rates.
- Control transfers, mergers, reorganizations, etc.

The purpose which usually attracts the most notice is the control of rates. One formula used to determine fair rates is the rate base computation: rate base times rate of return plus operating expenses equals allowable revenues. After the allowable revenues are established, they're measured against the revenues of the business during its average year. If the actual revenues are more than the allowable revenues, the rates will be reduced. If the actual revenues are less than the allowable revenues, the rates will be increased.

The business has the burden of proving the dimensions of the rate base. In practice, this means that the business makes all of its financial and operational information available to the utility commission and then has the burden of persuading the commission that the rate of return and the rates requested are fair and reasonable. The total burden is enormous. Just the establishment of a reasonable rate of return is a tremendous burden.

For example, the rate of return, commonly 6 or 7 percent, must be enough so income inspires confidence in the stability and profitabilty of the business. The rate of return varies with the risk of the utility. Water companies, a low risk, have a rate of return of 6 to 7 percent, which yields a return on common equity of about 10 percent. Electric and gas utilities, not as necessary as water and therefore a slightly higher risk, have a return on common equity of about 12 percent. Transit companies, less necessary than gas or electricity and having other economical alternatives to their service, are a still higher risk. Transit companies, although they have a rate of return of about 12 percent which ordinarily would bring them a much higher return on common equity, seldom even make the rate of return because of competition from automobiles which operate in the free market. As a result, the government is required to take over destitute transit companies and run them at the taxpayers' expense.

CATV is a still higher risk than transit companies, because a television reception service is not as necessary as transportation and there are numerous economical alternatives. Thus, while in low-risk businesses such as telephone utilities a 6 or 7 percent rate of return is sufficient, high-risk businesses such as CATV require much greater rates of return to survive under such regulation.

The cost of the rate case is passed on to the public, and the rate making process is costly. The fees of lawyers, accountants, economists, investigators, experts of all kinds, and the expense of the business' own staff's lost time during the case can be staggering, and, under utility commission rules, can be passed on to the public. But the cost of the rate case is not the only burden which the public must bear as a result of such regulation.

The type of regulation usually imposed by state utility commissions either is or can be exerted by local governments and non-utility state and federal agencies. Some functions, such as the regulation of securities, would be redundant because the practice is already regulated by the Federal Securities Exchange Commission and similar state agencies. In fact, a recent study by Associated Utility Services, Inc., an independent consulting company, shows that subscriber charges would have to be increased by

Someday a Utility

The CATV industry has acquired a powerful new ally—the Electronic Industries Association. In a recent filing before the FCC, the EIA's Industrial Electronics Division took the position that cable should be allowed to grow with little in the way of local restrictions.

CATV, it is felt by EIA's IED, is in its commercial infancy—about the same condition as was the telephone industry five or ten years after the telephone was invented. It wasn't until about 1905—when a substantial number of telephones had been put in service—that the phone finally became a really useful instrument.

The entertainment uses of CATV will be secondary to newer and more sophisticated utility-like applications for the medium, says this industry group. Such "typical" new services cited could include: electronic postal service, library books, business or personal data exchange and transactions, merchandise displays and information, press services, composed publication material, computer data exchange, protection and surveillance, selected visual data of limited public interest, classroom instructional material, press releases, newspapers and magazines.

In its filing, the EIA has tried to suggest to the FCC some kind of regulatory "envelope" that would allow CATV to exist and grow. Yes, the transmission plant should be regulated, says EIA, but only the transmission plant. Local terminals and tapoffs should be regulated only by local option.

A free and unrestricted interconnection of nationwide CATV systems via microwave and domestic satellite could make the cable a national asset and eventually a utility. This is the "natural" direction for cable development, says the EIA, and cable should thus be allowed to grow freely in the competitive marketplace. Participating on the IED/EIA Committee were members of many different, and sometimes antagonistic segments of the communications industry. The Committee made rather strange bedfellows with CATV people working alongside telco executives. But the telco men had other problems. "We have to spend the first 20 minutes of every meeting," they said, "explaining why telephone service is so bad."

Utility poles are common denominator for power, telephone and CATV systems.

about 14 percent to pay for regulation by utility commissions—most of which would be redundant and unnecessary, and subject to preemption by the FCC. At the same time, state utility regulation would deprive municipalities of income and the right to choose the best qualified CATV system operator from the local citizens' viewpoints.

There are continuing strains put upon businesses as a result of utility type regulation. For example, if the utility commission can eliminate competition, which it tries to do, there is no incentive to provide more and better-quality service, so the commission must prescribe minimum technical standards of service. With most utilities, the adoption and enforcement of such minimum standards poses little problem. But in television, the federal government does not impose technical performance standards on the television networks, even though it requires CATV systems to carry such network programs as well as local commercial television signals. If utility commissions imposed minimum standards, small CATV systems could not economically comply, which would invite national business giants to take over the industry. Thus, ownership of the CATV industry would pass from local control to outside interests. Yet, local control of CATV is one of the best ways to insure responsiveness to the community's needs.

No Guaranteed Profit

Aside from complaints that utility regulation limits a business' income but doesn't guarantee a profit, utility commissions are often criticized for narrowing managerial discretion to take advantage of speculative and expensive advanced technology. Such technology benefits the public only if it can be made available by the business. Some rates of return are so depressed that earnings levels are insufficient to attract new capital necessary for equipment replacement. If returns are depressed for too long, manufacturers are forced to reduce research and development of technical innovation (a hallmark of CATV) which eventually leads to consumer dissatisfaction. Utility Commissions are also criticized for being protective of the industries which they already regulate, and thus being unable or unwilling to devise new techniques tailored to the development of newer industries. This deprives the public of the services which the new industries offer. On the other hand, some critics charge that utility commissions are inept in regulating the operation of the existing utilities and should set their house in order before assuming additional duties. In fact, in order to protect the consumers' interest, a bill, S.607, has been introduced into the 91st Congress, which would create a Utility Consumers' Counsel to represent consumers before utility regulatory agencies.

In the headlong race to get a piece of the CATV action for State utility commissions, it is often overlooked that unless legislation has changed the definition of utility to include CATV, CATV cannot be considered, legally or otherwise, a utility. Well over half the States have had an opportunity to determine whether CATV should be regulated as a public utility, and only three have done so. In those states where CATV has been placed under public utility commissions, no new CATV systems have started operations since they came under PUC authority. Federal and state regulation, much of which appears designed to stifle competition, has not successfully provided consumers with a service which they want.

Not a Necessity

The CATV industry, still in its infancy, provides a convenience rather than a necessity. It is an extension of the broadcasting industry, an electronic informational service similar to translators and boosters, all of which are not regulated as public utilities. It is the public's demand for the convenient provision of better reception of a greater variety of product which justifies CATV's existence. It is this demand which allows CATV to compete with commercial television broadcast stations, translators, boosters, radio stations, electronic video recorders, theatres, newspapers, magazines and music services.

As a Federal Court said in Greater Fremont, Inc. v. City of Fremont, et al, CATV, unlike water, gas and electric companies is not a natural monopoly and "thus, the scope of regulation which is necessary in the natural monopolies is not here necessary . . . Likewise, the economic factors which necessitate the regulation of the rates of the natural monopolies are not here present." In concluding that CATV is not a necessity, the same Court said, rather unflatteringly, "The public has about as much real need for the services of a CATV system as it does for hand-carved ivory back-scratchers. Even if in fact the CATV system is the only one in the market, it is not a monopoly in the economic sense as has been previously demonstrated. Thus CATV is not a public utility within the meaning of the definition that has been accepted."

Except in States where the legislatures have redefined utilities to include CATV, Courts and Commissions have consistently concluded that CATV is not a monopoly-utility. This is a logical conclusion because most local governments grant only non-exclusive CATV permits, and in at least 50 communities there are two or more CATV systems

operating or holding permits to begin operation. Well reasoned analysis leads one to conclude that CATV is a luxury, and is neither a monopoly in fact nor a monopoly in law.

Claims that CATV systems remove roof-top antennas which limits the homeowner to viewing cable TV are generally without foundation. No CATV system operator would remove such an antenna without his customer's permission, and the customer is always free to replace it. Of course, some zoning restrictions prohibit unsightly roof-top antennas, and certainly should not penalize the local CATV system. In many cases, federal regulation requires CATV systems to provide a switch so that householders may choose between off-the-air reception and cable television at any given time. Claims that CATV forces a householder to use only CATV reception services are nothing more than obvious attempts to implant the false impression that CATV is a monopoly. Quite often, these claims are coupled with the argument that CATV ought to be available to "everyone."

The "CATV for everyone—under utility regulation" bunch either ignores or overlooks the fact that federal regulation practically forecloses CATV entry into areas containing about 82% of the nation's population, and CATV expansion within areas already served is severely restricted. Even if CATV were not so limited, those advocates offer no realistic economical plan to serve isolated homes without raising rates to the remainder of the public. Forcing CATV to serve isolated areas would lead to rate increases, a fact that is not lost on anti-CATV people.

The most vociferous advocates of utility regulation have claimed that the lack of governmental control of CATV rates has allowed unreasonable raises in rates resulting in excessive CATV profits. Seldom have these people mentioned any independent study which substantiates such claims. On the contrary, a recent survey of Canadian CATV systems reflected a return margin of only 2.1% after taxes yielding a return on common equity of only 3.5%. Edward Shafer, in the July 3, 1969, issue of *Public Utilities Fortnightly*, indicated an analysis of United States CATV systems revealed a return of less than 5% on stockholder equity plus debt. On May 28, 1968, before the Massachusetts Government Regulations Committee, Frederick W. Ford, former FCC Chairman and President of the National Cable Television Association, Inc., testified, "CATV rates are reasonable. A recent study by NCTA reflects that since 1960, the monthly service charge has increased only 6.5%, and installation charges have decreased sharply during the same period. Compare this with the increase in the average weekly earnings of workers in manufacturing of 20% from 1960 to 1966. During the same period the cost of living and, consequently, of doing business has increased 9% . . . [CATVs] furnish at least 72,000 kilohertz of channel space about 18 hours a day for a cost of about $5.00, whereas the telephone company, as a public utility, charges about $6.00 for a few calls a day over 3 kilohertz of space." Competition, and existing regulation, have kept CATV rates and profits reasonable.

Some opponents of CATV claim that the profit motive deprives, or will deprive, the public of fair and diverse programs originated by the CATV system, unless the public utility commission requires it. Setting aside questions of government regulation of free speech, about 15% of CATV systems originate programming under a voluntary code of ethics. These programs are provided to the subscribers without additional charge. The CATV industry has recently proposed six public service channels to be provided in conjunction with a synchronous earth satellite, the cost to be recovered from projeced additional subscribers rather than increased rates.

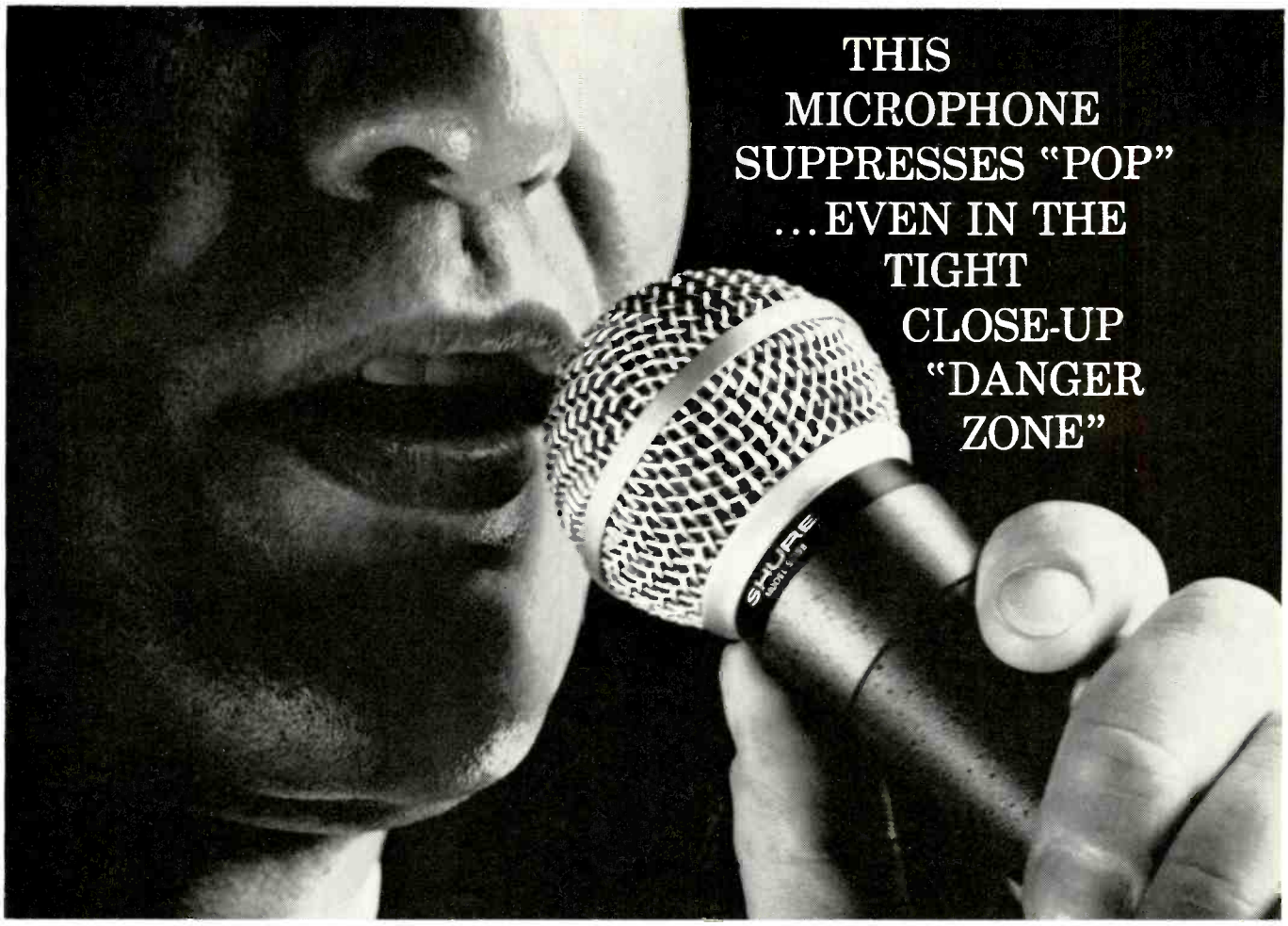
Far from being free from regulation, CATV systems are regulated by local, state and federal statutes. Under municipal regulation, CATV started and achieved its greatest growth, contributing its educational and informational capacity and adding to employment and tax rolls. Municipalities held the first hearings, conducted the first studies, designed the first permits for operation, made the first in-depth policy recommendations, and kept CATV permits for operation substantially shorter than those which utility commissions granted to regulated public utilities. Under local governments, CATV rates and rate increases have been less than those of regulated utilities while at the same time CATV technology has advanced so rapidly that systems are technically obsolete in three to five years.

All of these considerations led the Committee on Federal Legislation of the New York State Bar Association to recommend that cable TV systems should not be regarded as an essential public utility. The Honorable Reese H. Taylor, Jr., Chairman of the Nevada Public Service Commission which regulates CATV in his state, and a proponent of state regulation of CATV, says, "Even in Nevada, we have had our doubts regarding the propriety of public utility regulation, particularly from the standpoint of accounting practices, rate base determinations, and setting a fair rate of return." He poses alternatives such as a state CATV commission or regulatory schemes adapted to cities and counties which include the funding of small technical staffs.

This is not the time to impose additional strictures on the CATV industry. As the final report of the President's Task Force on Communications Policy stated, "Although a number of methods can be imagined for expanding the number of channels, the most promising is cable television . . . In the absence of restrictive government policy, cable television will probably continue to grow rapidly. Those willing to pay will be able to enjoy the benefits, in terms of greater variety and diversity of programming, without governmental assistance, promotion or other intervention."

Even the opponents of CATV unwittingly recommend it. In a July, 1968, report to the National Association of Broadcasters entitled "Television and the Wired City," Herman W. Land Associates, Inc., concluded that CATV would alter present patterns of entertainment and information programs: "One has only to think back to the days of the theater newsreel, the motion picture industry's contribution to public enlightenment, to see the potential implications of such a change." It is this change, this public enlightenment, that CATV can accomplish if left free to develop without the strictures of state utility regulation.

The nature of CATV, its stage of development, and a comparison of CATV with public utilities, rebut the necessity of regulating CATV as a utility. The time, and the nature of the regulation, are inappropriate. Until time and circumstances change, public utility commissions can do much for the CATV industry by leaving it alone. **BM/E**



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On the other hand, the unusually effective unidirectional cardioid pickup pattern (uniform at *all* frequencies, in *all* planes) means that it is a real problem-solver where background noise is high or where the microphone must be operated at some distance from the performer. Incidentally, but very important, the SM58 tends to control the low frequency "boominess" that is usually accented by close-up microphones.

All in all, close up or at a distance, the Shure SM58 solves the kind of ever-present perplexing problems the audio engineer may have felt were necessary evils. The SM58 might well be the finest all-purpose hand-held microphone in manufacture today. And, all things considered, it is moderate in cost.

Other features: the complete pop-proof filter assembly is instantly replaceable in the field, without tools. Filters can be easily cleaned, too. Stand or hand operation. Detachable cable. Rubber-mounted cartridge minimizes handling noise. Special TV-tested non-glare finish.

For additional information, write directly to Shure Brothers Inc., 222 Hartrey Ave., Evanston, Illinois 60204.

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MANAGEMENT
ROUNDTABLE

Techniques that Sell

By Fred Herman

Part 2. Some basic sales techniques for the broadcaster—in particular, presenting the facts and clinching the order.

UNLESS A PROSPECT believes in you and the station, it's very unlikely you'll ever sell him anything. Obviously, your first step in the actual sale is to gain the prospect's confidence in your station's effectiveness and what it can do for him and his company.

If you've done an effective job on your approach, the prospect should be saying to himself, "Tell me more." In the back of his mind he should have such questions as:

- What is it?
- Will it really benefit me?
- Who has used it?
- Can you prove it?

The conviction step, or telling the facts and benefits, and the story of the product don't hold much fear for the salesman. If someone asks, "Tell me about your product," you wouldn't waste much time; you'd rear back and let go. The trap here is that most salesmen say too much and prove too little. The conviction step is the one where the salesman spends five minutes selling his product and 25 minutes buying it back. Sometimes he goes to great lengths proving the facts about the product. If they are facts they do not need to be proven. The customer wants proof of the benefits.

I Believe in You

One advantage the salesman always has going for him is that the prospect really wants to believe that your product will benefit him. You can best get him to believe this by answering his mentally formed questions. Be prepared to offer evidence. Evidence is something which proves your point. More evidence is needed as proof for some customers than for others. No salesman is really prepared to sell well unless he has several of each of these types of evidence ready to offer:

- Testimonial.
- Example.
- Analogy.
- Charts and graphs.

Although sometimes difficult to obtain, written testimonials are quite effective. And if you can get several that say precisely what you want them to, you're in business. One way is to write the testimonial yourself. This can be done by getting satisfied advertisers to talk about their success. Then ask for a couple of his letterheads, write the letter, then get his signature that it is all right to use. Another effective testimonial is the oral one, particularly if it comes from an individual or firm respected by your prospect (certainly not a competitor). During the conversation with the prospect, call an individual with whom you have made prior arrangement, and ask him to verify what you have said about your station.

Draw a Picture

Many salesmen believe that they can convince by sheer vocal power. A pencil and paper, a diagram or printed charts and graphs simple enough for the prospect to understand are far more effective.

To call on a prospect without something specific to offer him is a waste of the ambitious salesman's time. If you have concentrated on your research and have done your homework, you can at least offer something—an announcement schedule, a program or newscast, etc. Perhaps the prospect won't buy precisely what you've prepared, especially if it's your first call, but he at least knows that you're sincere and really want to help him, not just fatten your commission check. A recorded announcement or sample copy will serve to strengthen your position.

"Showmanship is presenting something in an interesting or dramatic manner," says Webster. Showmanship, within reason, should be used in every step of the sale. Many of us recognize showmanship when we see it, but the problem for the salesman is to find bits of it to help him sell.

The first essential is to get the prospect into the act. If your presentation revolves around the prospect's interests, he can't help but be interested. Your presentation, both visual and oral, should demonstrate how you plan to bring customers to his store. An advertising salesman has many resources at his disposal: the tape recorder with samples; perhaps a slide projector to demonstrate certain aspects of broadcast advertising in general and your station's success in particular; colorful brochures citing facts and figures about advertising in his field, etc.

These techniques, and their many variations, directly involve the prospect, and if handled properly will have him anticipating what can be done for his business. Since showmanship often requires something unexpected or unusual, you can work tape-recorded testimonials into your presentation. The voice of a friend or someone else who is respected will have a dramatic effect. Of course, there's no better way to involve an advertiser than to have him record his own announcements.

Many salesmen have a twinge of pain or fear when they run into an objection or negative idea, and their defensive action is much the same as the tensing and withdrawing of the muscles from a physcial pain. Subconsciously it seems to signal that they might get hurt. But an objection that's handled intelligently and persuasively can turn out to be a help in closing the sale. This is true because a prospect

Continued on page 62

Fred Herman is a sales-training and public-speaking consultant in Torrance, Calif. This material has been adapted by the author from his book, *Selling Is Simple*, TAB Books, Blue Ridge Summit, Pa. 17214.

FOCUS ON CATV

FCC dissolves Fri. 13 cable freeze on Fri. 24

With its Friday, October 24, announcement of the first cable television rulemaking in a projected series, the FCC dissolved the freeze on CATV as suddenly as its CATV proposals had created it on Friday, December 13, 1968 (see *BM/E*, January, 1969, p. 12).

Overriding all state and local rules on cable TV, the Commission's ruling: requires CATV systems with more than 3500 subscribers to start originating programs "to a significant extent" on January 1, 1971; permits commercial advertising "at natural breaks" in programming; and encourages the formation of a CATV network.

CATV Task Force Chief Sol Schildhause and Ruth Reel of the general counsel's office, described the new rule at an afternoon news conference after the story's morning appearance in *The New York Times*. They said that the FCC decided to pass separate rulings on each part of the overall CATV proceeding—the Commission's "Third Report and Order"—due to the complexity of the issue. They reported that the Commissioners passed this first rule on a 6-1 vote, with Robert E. Lee dissenting because he believed the Commission shouldn't adopt a policy without the new commissioners, Dean Burch and Robert Wells, present. (At the time, the Senate Commerce Committee was still hearing from citizen groups opposed to the Presidential nominees for FCC chairman and commissioner, respectively.)

CATV Gains

According to responses of CATV leaders, the biggest breakthrough represented by the rule isn't FCC support of CATV program origination, because of some 282 systems providing local originations for more than 3500 subscribers, about 197 are already "local live." Rather, the Commission's outright encouragement of CATV system interconnection—opposed previously—is said to offer the most far-reaching implications for CATV growth. Mrs. Reels said that the FCC is "hopeful" that a new CATV network will emerge and that the Commission would oppose any proposal prohibiting interconnection of cable systems on regional or national basis for any reason.

Also, for cable in municipalities like New York City, where CATV program origination had been limited to public services and documentary films, the rule's power to supersede state and local CATV rules is considered to be a real coup. The Commission said that it would allow a period of "free experimentation" after the effective date before deciding whether more specific rules would be necessary.

Not in the Clear

The cable television industry isn't completely out of the dark, according to Schildhause, until the FCC has clarified its restrictive clauses on distant signal carriage and ownership.

As for leasing, the FCC said that systems "should be encouraged and perhaps ultimately required" to lease cable space to provide diversity of control over communications media, program choices, and to increase the number of sources.

In saying that commercials could enable smaller systems to originate programs, the Commission indicated that it expects advertising sales to have the greatest impact on radio, whose rates are more related to CATV's than are TV rates.

All this means "that we in the cable television industry are no longer a passive receiver, but can be an active participant in the communications field," said Alfred R. Stern, president and chairman of Television Communications Corporation, whose 16 operations in 11 states service more than 70,000 subscribers. Anticipating the FCC's positive ruling for CATV several months before the announcement, TVC started selling commercial advertising to local merchants for its cablecasting programs in Pittsfield, Mass., and Winter Haven, Fla., said Stern.

Another company that moved ahead of the Commission's ruling was Teleprompter Corporation. During the week of October 20, Irving B. Kahn, chairman-president of Teleprompter, told the Hollywood Radio and Television Society that the "next giant stride" for the industry is equal participation in the use of satellite communications. He then said that Hughes Aircraft Company (which prepared the feasibility study for ABC's 1965 proposal for a television domestic satellite system) had been studying for Teleprompter the feasibility of a cable television company creating its own domestic satellite system. Kahn's description of the system provided that a ground station serve each headend of 88 cable TV systems. Eighty-eight is also the total number of systems Teleprompter will have in 27 states if its stockholders okay its proposed merger with H&B American Corporation.

Supreme Court adds new dimension to Comtel case

According to the New York Court of Appeals' unanimous ruling in October, Bell Television Inc.'s cable subsidiary, Comtel Inc., may operate without a franchise in New York City by leasing New York Telephone Company facilities. But there's one hitch: according to a U.S. Supreme Court decision later in the month, the phone company will have to file a Section 214 application with the FCC before it can lay more cable for Comtel.

The Supreme Court action was a denial of a petition for appeal filed by AT&T, GT&E and United Utilities Corporation. The telcos filed the appeal after the Commission told the company that according to Section 214 of the Communications Act, it must file an application before laying cable for Comtel. The telcos' appeal was based on the idea that Section 214 doesn't apply to CATV lease-back because it applies to interstate service and lease-back is either intrastate or out of the Commission's jurisdiction. Neither Chief Justice Warren E. Burger nor Justice William O. Douglas took part in the highest court's denying the petition for a writ of certiorari to the N.Y. Court of Appeals.

DUAL CHANNEL PERFORMANCE...

at single channel price

Collins' new 212V-1 Audio Console, with its 8 mixers and 2 metered program channels, increases a station's capability for high fidelity AM and FM, TV broadcasting, and program control.

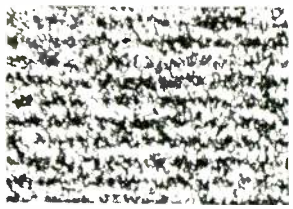
Though priced at only $2600, the new unit carries Collins' reputation for quality, design, performance and styling. Also, the 212V-1 is easily maintained. A hinged front panel tilts forward, allowing easy visual inspection or removal of all components.

Find out how Collins' 212V-1 Audio Console lets you combine economy with solid-state reliability. Contact a Collins representative or write Broadcast Communication Division, Collins Radio Company, Dallas, Texas 75207.

COMMUNICATION / COMPUTATION / CONTROL

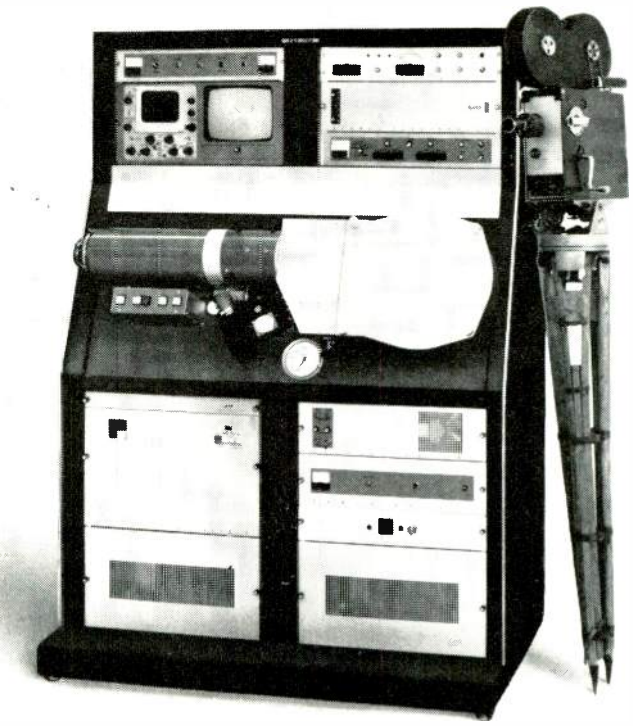
COLLINS

GOOD-BYE KINE
HELLO EBR-100



Television raster lines (right) enlarged from 16mm film frames. Lower: EBR-100 recording on 3M fine-grain (less than 0.1 micron) electron recording film. Top: kinescope recording on television recording film. Line-to-line spacing in both pctures is approximately 0.00058 inches or 14.7 microns.

TRANSFER LIVE OR TAPE TV TO 16 MM FILM ELECTRONICALLY AND GET PRINTS WITH 1000-LINE RESOLUTION.



3M's new Electron Beam Recorder is the first system to produce 16mm monochrome film copies comparable to the original live or video tape signal. It has no energy-wasting optical system. It employs direct electron bombardment of the film, eliminating phosphor granularity, faceplate halation and camera-lens losses and distortions.

The 3M Brand EBR-100 far surpasses the conventional kinescope in reproduction quality and in the ability to produce consistently good films. It opens new horizons for TV taping and mass film distribution for educational and training purposes.

The EBR-100 is a machine that every major TV studio, dubbing center, film lab and government communications center will want to employ. Easy to install, completely self-contained.

Direct beam monitoring provides simple, positive adjustment of exposure and gamma. Secondary electrons imaging the film target verify that focus, size, and linearity are correct. You can choose between a direct positive or a film negative with the flick of a switch. The system also is switchable from US standard 525-line to European 625-line requirements.

The EBR-100 records on low-cost fine grain film. Overall resolution exceeds 1000 lines. The film uses conventional processing and is shown on standard 16mm projectors.

The unit is 68 inches tall, 46 inches wide, 34 inches deep, weighs approximately 1000 lb. and costs about $55,000. Optical or magnetic sound is available at extra cost.

For details, call our EBR-100 information phone. The number is (805) 482-1911, ext. 216. Or write to EBR-100 Dept. at the address below.

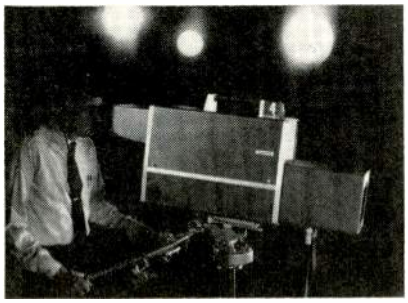
Mincom Division 3M COMPANY

300 SOUTH LEWIS ROAD • CAMARILLO, CALIFORNIA 93010

BROADCAST EQUIPMENT

Color convertible mono camera

Using a single lead-oxide pickup tube, Ampex Corp.'s BC-210M can be converted to color operation by simply adding a second channel, making the transition from black and white to color simple. The BC-210M costs $20,000 and can be converted to color for an additional



$35,000. It weighs 35 lb and measures 8½ in. wide, 13½ in. high and 20½ in. long with viewfinder. Studio quality pictures are produced with scene illumination of 30 foot candles.

Circle 275 on Reader Service Card

Monitor calibrator

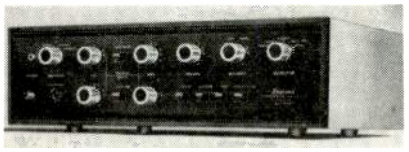
EG & G's Model 570 TV Colorcomp is said to provide precise color alignment of TV monitors. It generates

three control readings which define an established color standard for a given monitor. Lineup of the monitor is achieved by simply dialing these control readings on the Colorcomp and adjusting the monitor controls until a null "zero" reading is obtained on the instrument meters.

Circle 277 on Reader Service Card

Stereo amplifier

Model AU555 solid state integrated stereo amplifier, priced at $159.95,



offers 25 W channel RMS power at 4 ohms. Assuring a power bandwidth of 20 to 30,000 Hz with less than 0.5 percent harmonic distortion over the entire frequency range, the unit features a two-position damping factor selector switch that allows for matching the damping factor with the characteristics of any speaker system. Sansui Electronics Corporation.

Circle 290 on Reader Service Card

Turntable

Model 750 Elac/Miracord automatic turntable is identical to the Miracord 50H, except that the 750 has a special, four-pole induction motor instead of a Papst hysteresis synchronous motor and different trim. It has a push-button, light-touch operation, a 12-in. one-piece die-cast turntable, precision silicon-damped cueing and a metal main cam that is said to provide for long life and exacting performance. $139.50. Instrument Systems Corporation.

Circle 285 on Reader Service Card

Small rectifiers

Selenium rectifiers, put out by Siemens America Inc. for radio and television receivers, are of the bridge circuit type. Flat, flat case and block type rectifiers come in a range of power ratings, sizes and designs to meet most application requirements. They are self-healing and are UL approved for radio and TV use as OEM or replacement equipment.

Circle 278 on Reader Service Card

Phono cartridge

New version of the Shure Brothers' V-15 Type II Super Trackability Phono Cartridge can track the majority of records at ¾ gram, including those containing heavily modulated bass drum, tympani, organ pedal, bassoon, tuba, or piano passages. (In the past records with this type of material may have required increasing the tracking force of most cartridges to avoid bass flutter of IM distortion.) Owners of the older V-15 model need only replace their present stylus with a new Shure VN15E Improved type. List price of V-15 is $67.50; VN15E is $27.00.

Circle 282 on Reader Service Card

Microwave meter

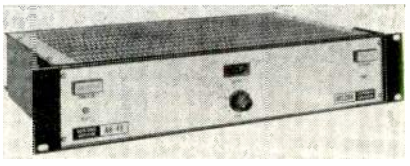
Model 8100 electromagnetic radiation survey meter is designed to test and check radiation coming from

equipment in the 915-2450 MHz frequency range. It combines a metering unit and a probing unit with a choice of three probes. Metering unit range selection enables measurements in four density ranges—in 10 dB segments, from minimum of 10 $\mu W/cm^2$ to 200 mW/cm^2. Other specifications include direct reading capability to ±1 dB accuracy; battery or ac operated; weight of 3½ lb. $725.00 (including one probe). Narda Microwave Corporation.

Circle 295 on Reader Service Card

Audio amplifier

Model AB-49 audio amplifier, providing 80 W of continuous output, is available with an optional isolated 70-V line transformer for sound distribution and reinforcement systems. The power stage consists of four 150 W power transistors mounted on



an aluminum heat sink with plug-in sockets. Feedback protection circuit measures power dissipation and limits the drive signal to prevent exceeding the rating of the output stage under all signal and load conditions, both transient and steady state. A locking level control is said to be of particular interest. Melcor Electronics Corporation.
Circle 286 on Reader Service Card

Vhf monitor

Monitoradio/Scanner provides automatic monitoring on any combination of eight vhf channels. Push button program control enables the operator to monitor his choice of crystal controlled channels in the 148-174 MHz band. Read-out lights for each frequency show the process of the receiver's search for a transmitted signal; on finding an active signal, the scanner locks on and listens to the entire message.

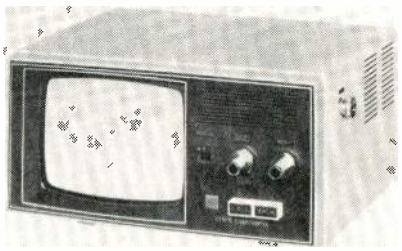
The new Regency Electronics radio is designed for ½ microvolt sensitivity; 50 dB at 15 kHz selectivity; and produces five W of audio output at 1 kHz. Rate of scan is measured at .05 seconds per channel. List price is $139.00 for the radio and $4.95 for each crystal.
Circle 291 on Reader Service Card

Portable reference light

The Bloctube is a portable reference light used in the monochrome mode and held across the receiver or monitor tube face. By direct comparison at the appropriate brightness level, the picture can be adjusted for color balance at illuminant 5600 and correct brightness. The light is made by Power-Optics Inc. out of a 12-in.-long, ⅝-in.-wide 6500K fluorescent tube with a photographic step-wedge inside high-impact acrylic tube that is independent of ambient temperature and voltage fluctuations.
Circle 280 on Reader Service Card

CCTV system

Designed for remote surveillance duty, Watchguard Mini-Camera model TMC-2AU from Toshiba in-

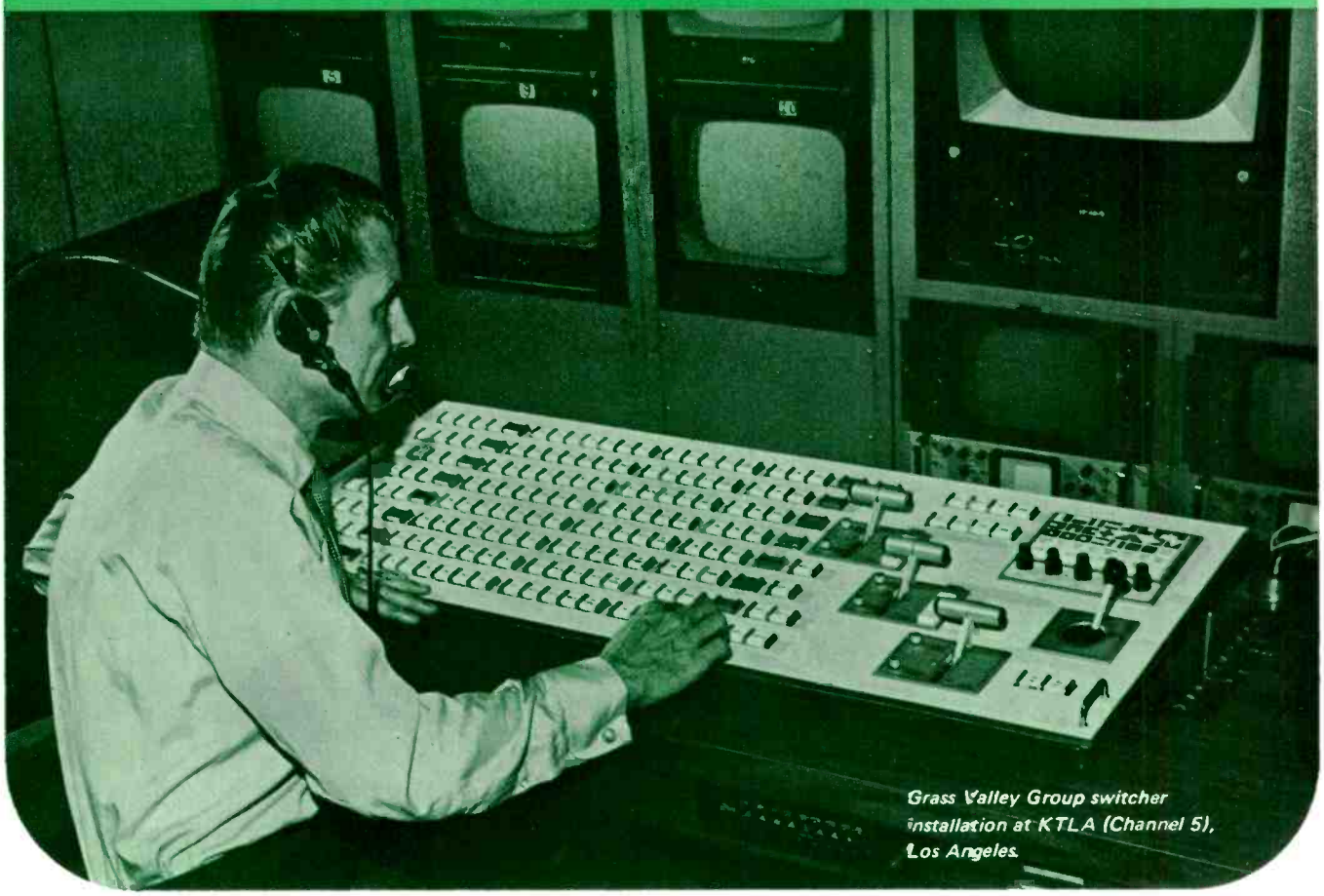


cludes video camera, remote monitor, and a two-way audio intercom between the two points. Price is $379.50.
Circle 283 on Reader Service Card

Our best advertisements...

are our satisfied customers!*

*COMPLETE LIST ON REQUEST



Grass Valley Group switcher installation at KTLA (Channel 5), Los Angeles.

We could spend a lot of money telling you that the Grass Valley Group manufactures the finest production and routing switching systems in the world. We know it's true. But why take our word for it? Ask the people who have them.

On request, we will be happy to send you a complete user list. Not a select few but a total user list. To receive this information, just contact your nearest Gravco Sales office.

Sold exclusively by **GRAVCO SALES, INC.** Regional Offices:

6515 Sunset Blvd.
Los Angeles, Calif. 90028
(213) 462-6618

2626 W. Mockingbird Lane
Dallas, Texas 75235
(214) 352-2475

1314 W. Northwest Highway
Arlington Heights, Ill. 60004
(312) 394-1344

Station Plaza East
Great Neck, N.Y. 11021
(516) 487-1311

THE GRASS VALLEY GROUP, INC.

P.O. Box 1114 • GRASS VALLEY, CALIFORNIA 95945

Circle 121 on Reader Service Card

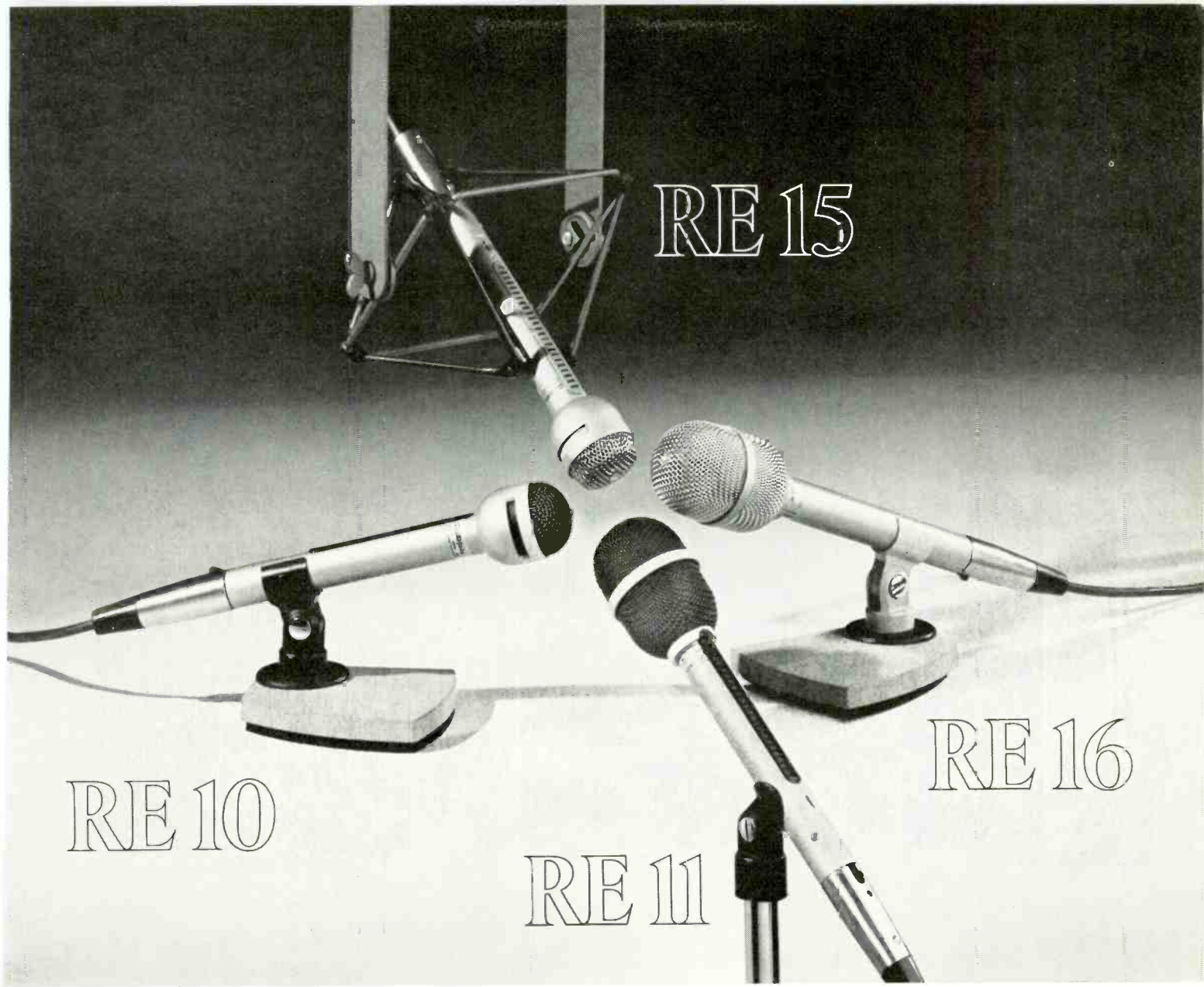
Continued from page 55

wouldn't bother to bring up an objection unless it is a point which might be vital to his needs. The boomerang, of course, is to suggest that the objection is the very reason he should buy, thus cushioning your answer and immediately bringing in facts, benefits and evidence.

Quite often a salesman will hear "I'm just not interested." This is a clear-cut indication that he has not succeeded in interesting the prospect. Another objection is, "I've heard that your station doesn't get results," in which case he may be asking you to prove that it does. And of course, the toughest objection of all is obvious prejudice, perhaps based on an unsuccessful or poorly handled advertising campaign with your station or another station. How can such roadblocks be overcome?

- The boomerang or reverse method. This is the technique of turning the prospect's objection around to the very reason why he should buy. It works because an objection indicates interest on the part of the prospect. When you point out that the very factor he is concerned about is beneficial to him, you're in a much stronger position.
- Explain it. The most frequent thought in the prospect's mind when he brings up an objection is, "I would like to know the real explanation to this." What he is asking for is more information.
- Admit it. All advertising campaigns aren't successful, for a variety of reasons. In this case the best thing to do is admit the fact, then point out why and come back with a strong explanation of how you've eliminated those faults from your presentation.
- Deny it. If the objection is an attack on the integrity of the station or broadcast advertising in general, you had better deny it or he will think it is true. Of course, your denial should be courteous and should try to establish the truth.
- Ask why. You'll never know why unless you ask. In so doing you'll have an opportunity to find out what he really means.

Many times salesmen think the prospect said "no" when he may



NEW Model RE10 $90.00, shown on Model 421 desk stand $10.50. Model RE15 $153.00, shown with Model 307 suspension mount $20.70. NEW Model RE11 $96.00, shown with Model 311 snap-out stand adapter $3.90. NEW Model RE16 $159.00, shown on Model 421 desk stand $10.50. All prices suggested net.

Freedom of choice!

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

Unaffected by Distance . . . Angle

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

Whether performers almost swallow the microphone, wander far off-mike . . . or even move around to the back . . . you'll still get the same smooth response. Only the level changes.

Once you set equalization it remains constant. You have full assurance that tonal balance won't change between the dress rehearsal and the final performance, no matter what the talent does.

Improved Cardioid Pattern

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

Now Select from Four Models

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

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

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

*U.S. Patent No. 3,115,207. Trade mark registered.

ELECTRO-VOICE, INC. Dept. 1291-EM
614 Cecil Street, Buchanan, Michigan 49107

high fidelity systems and speakers • tuners, amplifiers, receivers • public address loudspeakers
microphones • phono needles and cartridges • space and defense electronics

Electro-Voice®

A SUBSIDIARY OF GULTON INDUSTRIES, INC.

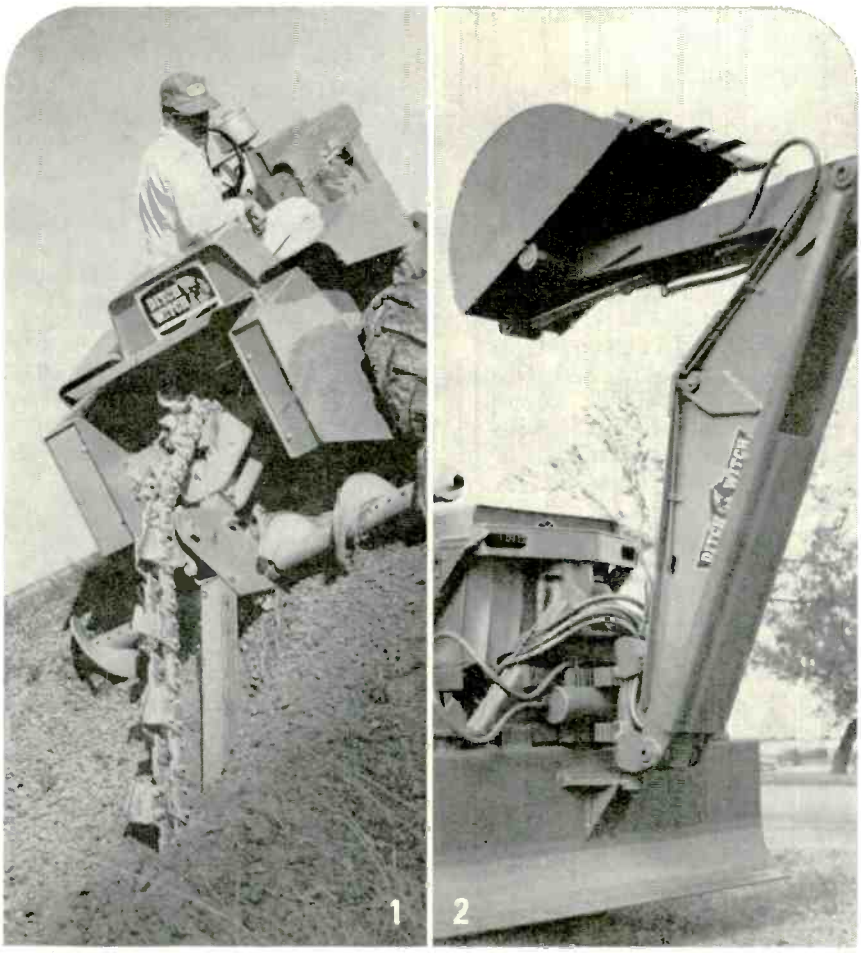
Circle 123 on Reader Service Card

have said "yes, if you show me." So, you're well advised to listen carefully to what the prospect *means* instead of *what* he says.

In the customer resistance indicated by objecting and also in the final resistance of having to say "yes," the prospect often tries to wriggle off the hook by giving all sorts of excuses for not buying. If you've attempted to answer all excuses as they are thrown at you, you may wind up wallowing in a hopeless mire. The prospect doesn't buy because we answer his objections or excuses, but because he wants to advertise. What we need to handle the barrage of excuses is some method of determining the real reason and then go to work on that. There are six magic questions designed to determine a prospect's *real* reason for not buying and to bypass the excuses. In using these questions, don't be too aggressive or they may backfire and arouse resistance. Your role should be that of a consultant genuinely trying to help the buyer.

- Mr. Prospect, you probably have a very good reason for not going ahead right now. Do you mind if I ask what it is?
- This is certainly an important consideration. In addition to this, is there any other reason for not buying right now?
- Mr. Prospect, just supposing we were able to completely satisfy you on this point. Then you would certainly want to go ahead right now, wouldn't you? (Here, you meet the condition the customer brought up in his reason and use the "just supposing" technique.)
- (If the prospect said no to the previous question.) Then there must be some other reason. Do you mind if I ask what it is?
- (You come back with a meeting of the condition of the new reason, but in addition you bury the former excuse.) Just supposing we could answer to your complete satisfaction this point, then you would be ready to go ahead now, wouldn't you?
- Well, what would it take to convince you? (or) What do you suggest?

Selling is not an easy job—it's clearly not for the amateur or the untrained. If you would be successful, or if you would have your sales staff be successful, the importance of proper training can't be overemphasized. Then, when sufficient training is combined with a well thought-out plan, it just can't miss. **BM/E**

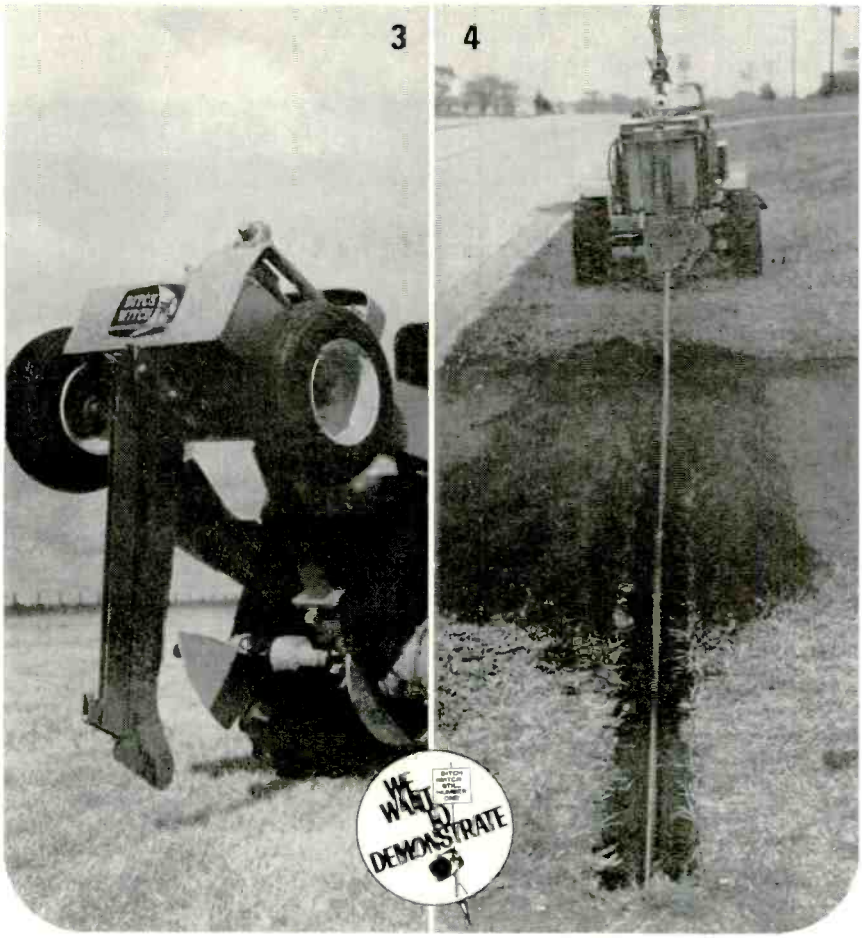


DITCH WITCH

1 Versatile is the word for Ditch Witch . . . because Ditch Witch allows you to quadruple your basic job capability without investing in four separate machines. Start with a powerful V30 or R60 trencher that incorporates all of the famous design advantages that have made Ditch Witch the sales leader in its class. Ditch Witch attachments convert your basic trencher into Backhoe, Vibratory Plow or Boring Unit — or all three!

2 Both the Model 110 and 210 Backhoe Attachments feature the revolutionary Ditch Witch "breakover" design, providing greater safety, and mobility through greater balance, compactness and stability. Both models feature an elevated sidemounted operator position, and fingertip controls for panoramic visibility and safety. You get a digging reach up to 9½ feet, digging depth up to 7 feet, 180° swing.

STRETCH YOUR EQUIPMENT DOLLAR 4 WAYS!



DITCH WITCH ATTACHMENTS OFFER 4-in-1 DIGGING POWER

3 VP30 and VP60 Vibratory Plow Attachments for the 30- and 60-horse trenchers make possible direct burial of service lines for underground utility installations . . . will handle cable, copper tubing, plastic and steel pipe up to 1½-inch diameters. You get a plow depth of up to 30 inches, a capability of up to 1,200 fph.

4 The Roto Witch Boring Attachment* lets you go under surface obstructions without expensive restoration. Roto Witch works in tight areas — only a 4-inch-wide approach is required. You'll get an initial bore of 2¾ to 4 inches, and enlarge it to a variety of sizes by backreaming. Perfect for use under residential driveways up to superhighways.
*Available for all Ditch Witch models except C Series

COMPLETE LINE OF TRENCHING EQUIPMENT FROM 7 - to 60 - HORSEPOWER

DITCH WITCH

a Division of
Charles Machines Works, Inc.
1854 Ash Street
Perry, Oklahoma 73077 U.S.A.

Circle 125 on Reader Service Card

Convention Log

Continued from page 26

pounds, the locator is a boon to engineers trying to eliminate noise at CATV antenna sites.

A good discussion of the problems of working with inferior signals was covered by Frank Ragone in the paper "Performance Measurement of Modulators and Demodulators for CATV." (Some five good papers on CATV were delivered, but most were repeats of those given at the June NCTA Convention.)

In the category of how-to-do-it-easier were papers on automatic logging by Howard Ham, Jr. of Moseley Associates and microwave STL by Walker Walczak of Granger Associates.

Not a great deal of equipment was on display in the suites and that which was there was familiar. An exception was the Granger suite: On display there was a new 20-kW fm transmitter which uses a strip-line concept borrowed from microwave technology, a new circularly polarized fm antenna featuring and unusual dipole twist and an ultra-compact microwave STL system. The strip-line fm transmitter is broad band and the grid is grounded. There are no front panel tuning or adjustment controls—the unit is tuned once and it stays put. (Watch *BM/E* for more details on the new transmitter.)

Engineers attending the symposium were treated to an inside report on the television systems of Apollo 11. James T. Raleigh of Bellcomm, Inc. reported that the communication system used by the moon men did more than relay TV pictures back to earth—the back pack camera carried by Astronaut Neil Armstrong was a vital part of the life support system. Another vital element was a new 8-foot dish antenna in Australia. The Apollo 11 television complex included 60 cameras never seen by the public. These 60 units helped control the lift-off rocket. In commenting on the 7½-pound Westinghouse camera, Raleigh stressed its amazing environmental capability which included the capability of working over a a wide thermal range and the ability to pan from the moon's full darkness to full sunshine. No color is planned for the next moon landing, Raleigh reported, because the designs to date couldn't take the shock and vibration strains. **BM/E**

RCA Vidicons...

First in broadcasting, CCTV, space

RCA invented the Vidicon. So it's only natural that more TV cameras use RCA Vidicons than any other kind. More broadcast cameras. More CCTV units. Now they take off in NASA and ESSA project satellites where there's no margin for error.

Think of that when you replace Vidicons next time. Ask your RCA Industrial Tube Distributor how you can step up with RCA. Step up resolution with separately-connected mesh electrode types. Step up sensitivity by selecting Type II photoconductor types. And step up over-all performance with RCA Vidicons—made in the same plant, with the techniques, controls, and quality assurance checks used to make the Vidicons that gave us our first close-up look at the moon.

RCA Electronic Components | Harrison, N. J. | 07029

RCA

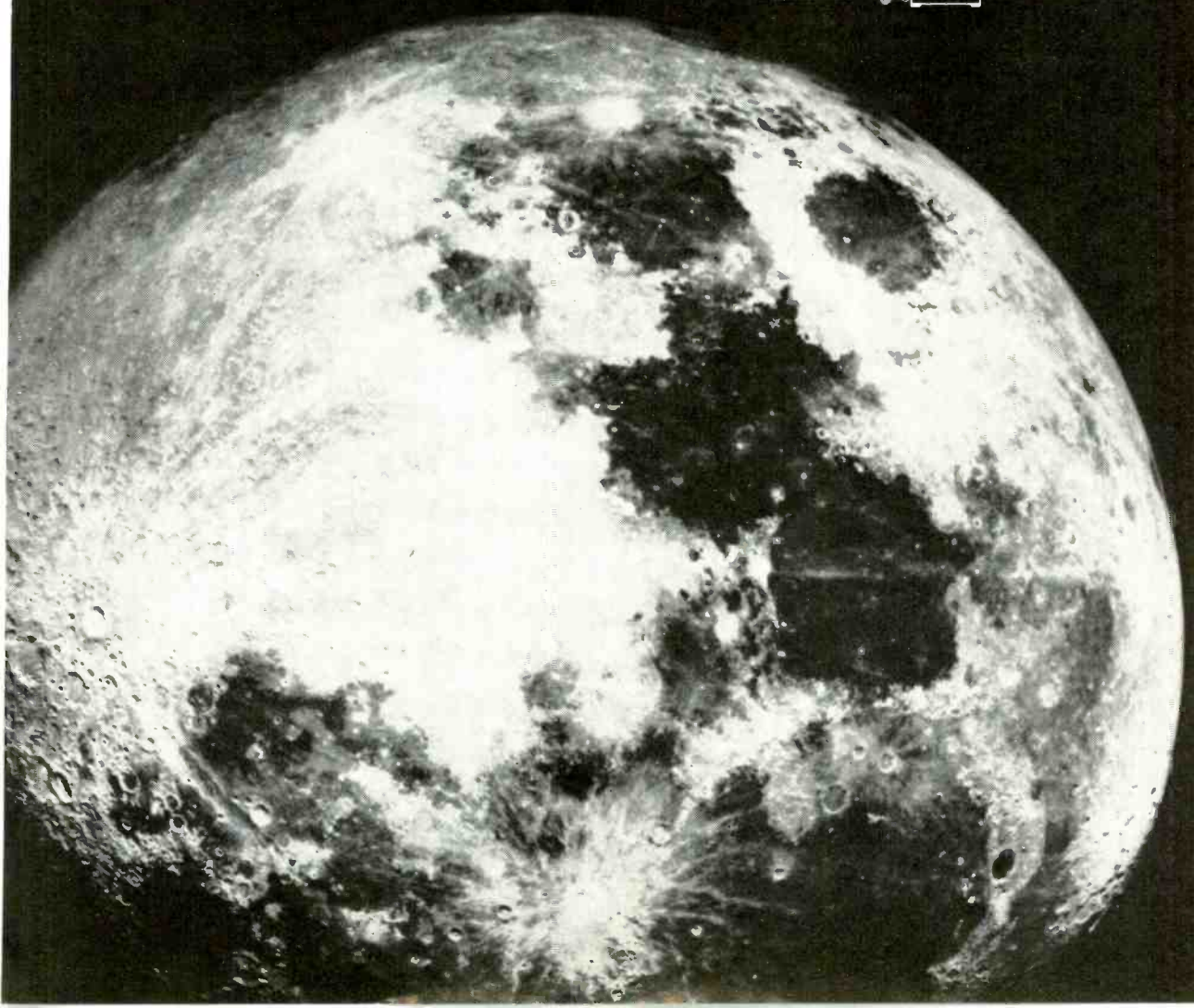
Use This Short Form Step-Up Selector

For Color Film Pick-up	For B&W Film Pick-up	For Live Color In RCA TK42 Cameras
RCA-7038 RCA-7735B* RCA-8134/VI*†) in RCA RCA-8480/VI†) TK27 RCA-8507A*† RCA-8572A†	RCA-7038 RCA-7735B* RCA-8480† RCA-8507A*† RCA-8572A†	RCA-4493*† RCA-4494*† RCA-4495*†

NOTES: †types feature separate mesh electrode construction
*indicates Type II photoconductor

And, RCA has many other types for industrial, commercial, and educational closed circuit TV—such as 4478, 7262A, 7735, 7735A, 8134, and 8573A.

Join the Big Phone-In. Call your RCA Industrial Tube Distributor. He supplies dependable RCA Vidicons—plus technical data in the newly revised catalog CAM-700A.



NEW LIT

For copies of these literature offerings, circle numbers for appropriate items on Reader Service Card.

16mm optical sound projector with Marc 300 high intensity light source and power pack combo—from $1240 to $1490—is presented in bulletin 2702 by The Kalart Company. **200**

Automatic cartridge tape equipment —monaural and stereo models—is described in Visual Electronics Corporation brochure. **201**

Week-long closed circuit TV workshop conducted by Ampex Institute is explained in 12-page brochure V69-4 from the company's education-industry division. **202**

Logarithmic amplifiers—temperature stabilized LLT Series amplifiers—priced from $825 by RHG Electronics Laboratory, Inc., are described in new bulletin. **203**

Radio equipment list of acceptable items for licensing has been issued by the Commission and is available for reference from FCC offices at 1919 M Street, N.W., Washington, D.C. and at FCC field offices. Copies may be purchased from Cooper-Trent, 1130 19th Street, N.W., Washington, D.C. 20036.

Rf, i-f and microwave components' price and technical information is included in new 100-page catalog from Merimac Research and Development Inc. **204**

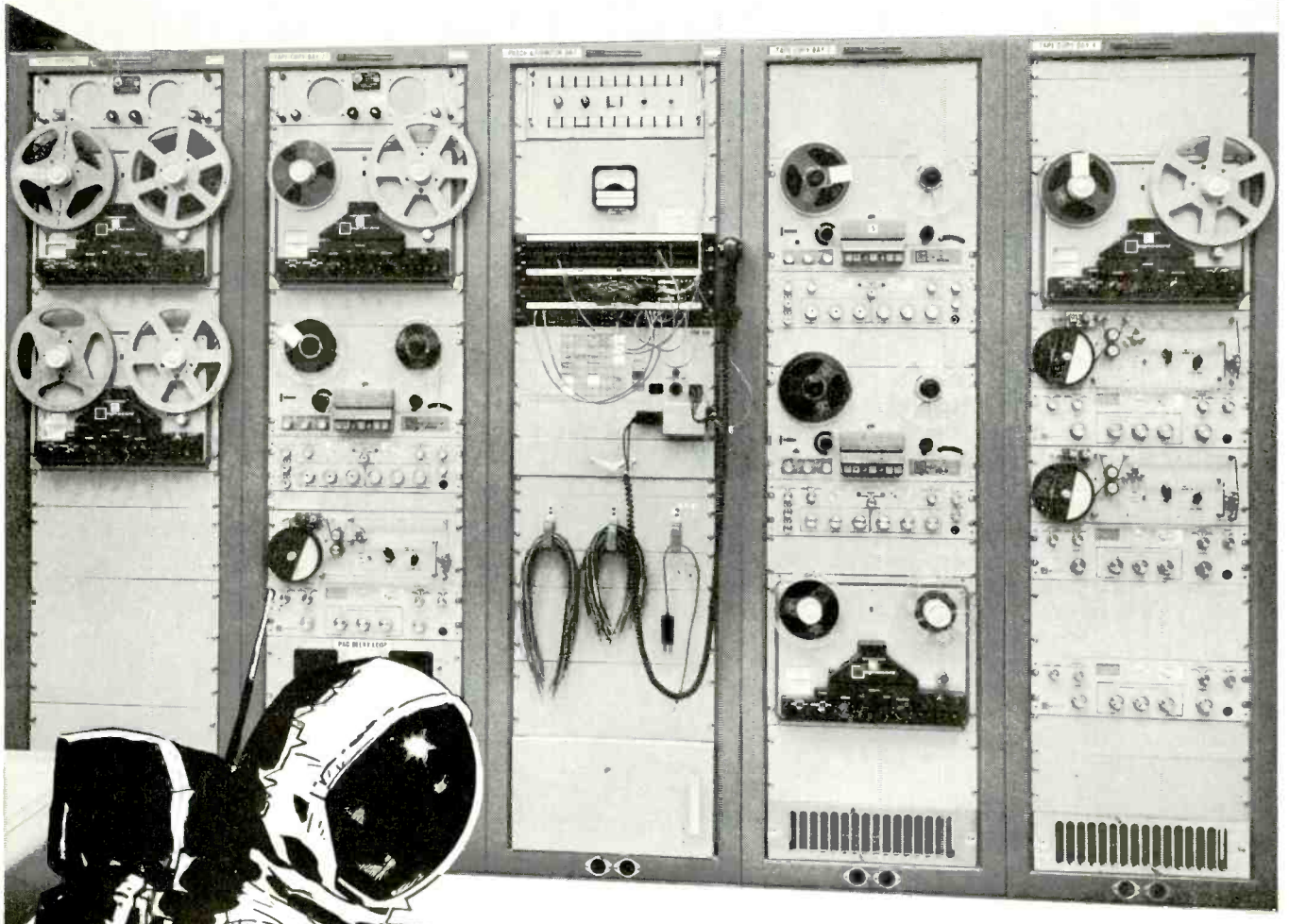
"Mole-Richardson Lighting" is the title of an eight-page newspaper size pictorial book from Mole-Richardson Company. **205**

Tong test ammeter—in ten varieties —is presented in TT-969 catalog from Columbia Electric Manufacturing Company. **206**

Subminiature rfi/emi filters ranging from 80 to 100 dB at frequencies above 100 KHz, are presented in Genisco Technology data sheets. **207**

Closed circuit videotape recorders, cameras, monitors/receivers, video tape, TV camera lenses and video accessories are delineated in brochure V69-12 by Ampex Corp. **208**

Test instruments—VOMs, portable chart recorders, multi-testers—are included in Simpson Electric Company's latest test equipment bulletin 2080. **210**



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FCC ACTIONS

Call letter change of Taft Broadcasting's recently acquired Philadelphia uhf from WIBF-TV to WTAF-TV has been granted.

License renewal hearing postponement motion by Chronicle Broadcasting Company for San Francisco KRON-TV and FM has been denied, as has the company's request that Commissioner Nicholas Johnson be disqualified from participating in the hearing for allegedly receiving and responding to *ex parte* communications and failing to disclose them.

Application for voluntary assignment of license of WDBJ-TV, channel 7, Roanoke, Virginia, from Times-World Corporation to WDBJ-TV Television Inc., wholly owned subsidiary of the South Bend Tribune, South Bend, Indiana, has been granted for a $8,200,000 consideration.

Petitions by Anthony R. Martin-Trigona to revoke licenses of WNBC-TV, WCBS-TV and WABC-TV, New York City, and WRC-TV, Washington, D.C., have been dismissed. The Commission said that Martin-Trigona had failed to show any abuse, law violation or "discernible overriding public interest concern."

Applications by WPIX Inc. for renewal of license of WPIX (TV), New York City, and of Forum Communications Inc. for construction permit to operate on channel 11 at New York City have been designated for hearing, which will not take place until next year. Among allegations of Forum Communications is charge of news distortion (see *BM/E*, August, 1969, p. 11).

Decision against revoking licenses for WGWR AM-FM of Asheboro Broadcasting Company, Asheboro, N.C., has been adopted; FCC found that station manager and the son of the major stockholder had filed an application for a new standard broadcast station in nearby Mebane, N.C. in 1961, partly to obstruct or delay grant of a new standard broadcast application for Asheboro, but it concluded that this conduct didn't warrant forfeiture.

Application of Downe Communications Inc. for acquisition of control of Bartell Media Corporation, parent corporation of licensees of radio stations WOKY, Milwaukee, WADO, New York, and KCBQ, San Diego, has been granted subject to conditions that Downe show it has gained control of Bartell Media.

Petition by Muncie Broadcasting Corporation requesting rule making to amend Fm Table of Assignments to assign channel 244A at Muncie by removing it from Celina, Ohio, and substituting channel 228A at Celina has been denied.

Application for transfer of control of Cleveland Broadcasting Inc. by its stockholders to Atlantic States Industries Inc., transferee, has been granted. Acquisition of KFAC AM-FM, Los Angeles, and WERE AM-FM, Cleveland, by Atlantic States on condition that it "dispose of station WERE-FM as soon as practicable," is thus permitted.

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Or, at least, as close as he can ever get to perfection—even at Christmas-time.

The miracle worker is the EMT-156 STEREO Limiter / Compressor / Expander—the first such state-of-the-art device to be built in over 15 years! And high time, too.

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FROM THE EDITOR

The Engineer as Executive

Why are few managers ex-chief engineers? Is engineering a dead-end street? How far can an engineer advance?

There is no reason why engineering cannot lead up the ladder to higher levels of management. Those ex-engineers who now manage stations got and keep their present jobs because they know where the money comes from, and they are people-oriented rather than merely object-oriented.

No station stays on the air long without input. At a commercial station, input is advertising revenue; at a noncommercial, it consists of grants and public donations. Neither input comes without public support, which means the station must program to meet community needs. Thus, no manager or aspiring manager, can ignore his station's input.

A dead-end chief engineer simply keeps the station on the air, nothing more. A top-grade chief not only puts the best possible signal on the air, but also concerns himself with sales and programming. While engineering is obviously essential to station operation, it has little value by itself. Only when it contributes to successful station operation does engineering have value. Therefore a valuable chief provides well planned and executed support for both sales and programming.

This is not to say the chief should be merely a salesman with a first-phone ticket. An expert chief is aware of FCC rule changes, knows his equipment and takes care of it, and helps management budget operations. As the station's technical expert, he reads the technical press, attends engineering conventions, and keeps abreast of electronics.

But he also keeps in touch with other departments. He knows who the station does business with, and he helps alleviate production problems.

Theoretically the chief is a member of the management team along with the sales manager and program director. But when he loses sight of the goal of profitable operation, he isn't much of an executive. Lack of interest in overall station operation indicates a man who doesn't want to—and won't—advance. For advancement comes from the skill and ability to manage and use engineering as a tool.

Thomas R. Haskett
Associate Editor

It's BM/E Renewal Time

We know you have better things to do than filling out forms. But once a year we have to requalify everyone who wants to continue receiving a free subscription to BM/E. *(If you have a paid subscription, ignore this.) Our independent circulation auditing organization needs completed forms for every subscriber, verifying who you are and what you do. Take a minute now to fill out the attached post-paid card and drop it in the mail. Please do it today, so we can continue your free subscription. We promise not to ask again for another year. Thanks.*

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- ☐ CATV Facilities
- ☐ Telephone Company
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3. My primary area of responsibility is: (please check one)

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AM/FM Broadcast Station Planning Guide

Harry A. Etkin

Whether you plan to build a new station or remodel and update an existing one, "AM/FM BROADCAST STATION PLANNING GUIDE" is the "total" book . . . covering every aspect of planning, building, and equipping the facility. Not a single subject is ignored, from the initial frequency search to properly equipping and maintaining a station. This is truly the all-in-one manual for anyone interested in the proper design and operation of a broadcast facility.

Based on a lifetime of experience and intimate association with broadcasting, author Harry A. Etkin tells in detail how to find a frequency, including the "fine points" required in a frequency search. In today's competitive situation **this one subject alone makes the book worth its small price!** In addition, you'll learn how to prepare FCC Form 301 as Etkin does away with the mysterious veil surrounding this often dreaded document.

Also a part of the initial planning is choosing a site, selecting equipment, arriving at plans to house the facility, whether it'll be a combined operation with studio and transmitter under one roof, or whether each phase will operate separately. The large 8½"x11" pages contain literally dozens of actual, tested floor plans—from relatively simple ones for small-market stations, to those designed for larger, medium and metropolitan operations.

The subject of equipment, from microphone to antenna, is handled in a revealing manner—not just a repetition of manufacturers' statistics and specifications. The practical nuts and bolts information presented here is intended to bring you up to date on what is available and how it might be used in a contemplated facility. Subjects covered include: towers for AM and FM, FM antenna types and which is best for a given situation, ground systems, transmission lines, transmitters and transmitter facilities, studio-to-transmitter program transmission systems (including remote control), a thorough treatment on studio equipment (including program automation), and studio design from both operational and acoustic viewpoints.

This all-encompassing manual also includes detailed instructions on how to conduct proof-of-performance measurements, how often they should be performed, and what to do if quality isn't up to par. This problem-solving "trouble-shooting guide" will be of inestimable value to newcomers and "old hands" alike—and, please remember, this material is based on **actual experience,** not on vague generalizations or difficult-to-understand theory.

To keep you operating within the law, the author has mapped out a thorough preventive maintenance schedule, including actual examples of recommended maintenance log forms. The final chapter, to whet your appetite, describes a number of "prestige" stations and how they serve their audiences. And, finally, an extensive Appendix lists data needed by every broadcast engineer.

Yes, "AM/FM Broadcast Station Planning Guide" contains all you need to know about radio station facilities from start to finish—tested and proven data—information essential for both practical day-to-day operations and for future growth.

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PARTIAL LIST OF CONTENTS

The Basics of Broadcast Facility Design: general planning considerations; studio and transmitter site selection; studio and control room requirements; remote control provision; recommended guidelines—**AM/FM Frequency Searches & Channel Allocations;** frequencies used for broadcast stations; frequency verification; primary service coverage and interference; ground-wave intensity vs distance; ground conductivity variations; sky-wave interference; FM Channels—**Basic Floor Plans:** Layouts for small stations; plans for medium market facilities; separate AM/FM control facilities or dual control room operation; floor plans for larger stations—**Studio and Control Room Layout & Wiring:** typical designs—**The Transmitter Plant:** floor plans and wiring diagrams; AM/FM transmitter requirements; transmitter performance qualities—**Tower Types & Installation:** AM antennas; tower lighting; installing ground systems; tower feed systems and RF sampling; phasing; dummy loads—**FM Antenna Arrays:** horizontally and vertically polarized antennas; circularly polarized antennas; installing FM antennas; transmission lines—**Transmitter Remote Controls:** required control and metering functions; automatic logging; studio-to-transmitter radio links—**Control Room and Studio Equipment:** consoles; turntables; audio control equipment; monitor speakers; remote amplifiers; modulation and frequency monitors—**Tape Recorders & Studio Automation:** cartridge and reel-to-reel recorders; automatic programming systems; automatic program logging—**Microphones:** broadcast requirements; microphone types—**AM/FM Transmitters:** tubes vs transistors; transmitter reliability and economy; automatic considerations; FM power expandable transmitters; parallel-operated transmitters; FM exciters; solid-state power supplies—**Preventive Maintenance:** personnel training; inspection; tools and test equipment; maintenance logs—**Preparing Engineering Data for FCC Form 301:** application considerations; cost considerations—**AM/FM Proof-of-Performance Measurements:** FCC Rules; standards for proof measurements; test equipment; proof violations and troubleshooting—**Prestige Broadcast Operations:** ABC; KOOL AM/FM; WMJR-FM; WPHC; KRAV-FM; WRVA AM/FM; WPAA-FM—Appendix: Footage table for broadcast tower heights; FM DBK power charts; FM broadcast channels; telephone cable color code; cable attenuation tables; antenna current/modulation relationship; field intensity vs. radiator height; forward vs. reflected power; estimated ground conductivity map; numerous other useful charts and graphs.

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FCC Rules

Continued from page 19

with the applicant or not), the franchise holder must also make a showing like that mentioned in the preceding paragraph. If the franchise holder and the applicant are under common ownership, the showing may be either separate for each or joint. If the applicant and franchise holder are one and the same entity, or if the applicant intends to carry on all functions of the operation without franchise, the showing will, of course, be a single one.

It will be interesting to watch the growth of subscription television over the next several years. Having received the blessings of the Commission and the U.S. Court of Appeals, a burgeoning new source of television entertainment is likely to become available to the majority of American TV households.

The opponents of STV will probably not let the matter rest at the intermediate Court level. For the moment, however, the road appears clear for a new breed of television broadcaster. **BM/E**

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Dear BM/E:

We need help. We tell advertising prospects that stations on the lower end of the a-m band have better coverage than stations at the other end with like power. The attitude of the non-technically minded prospect is "show me."

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Dean Loudy
General Manager
WNNT-AM-FM
Warsaw, Va.

There's an old saying in a-m broadcasting: "Five kilowatts at 550 kHz is worth 50 kilowatts at 1600 kHz." Your primary coverage area is a measure of the extent to which your groundwave travels with enough field strength to be heard by listeners with typical receivers. The groundwave is attenuated due to propagation loss, which becomes more severe as the operating frequency goes up.

This phenomenon is well documented in the FCC Rules. Sec. 73.184, "Groundwave Field Intensity Charts," shows signal attenuation for various a-m frequencies.

Assuming two stations, each with a transmitter power of one kW, and antenna efficiency of 100 mV/m at one mile (inverse field) and a ground conductivity of 5. How far out are the respective 0.5 mV/m contours (secondary coverage area limits)? For 550 kHz, the answer is 58 miles; for 1600 kHz, the answer is 16.5 miles.

As you can see, the 550-kHz station's 0.5 mV/m contour goes out about four times as far as that of the 1600-kHz station. Thus, assuming equal transmitter powers, a lower-frequency station has greater coverage than a higher-frequency station.

One other point—on a transistor portable, it's a lot easier to tune in a station at the low end of the band than one at the high end.

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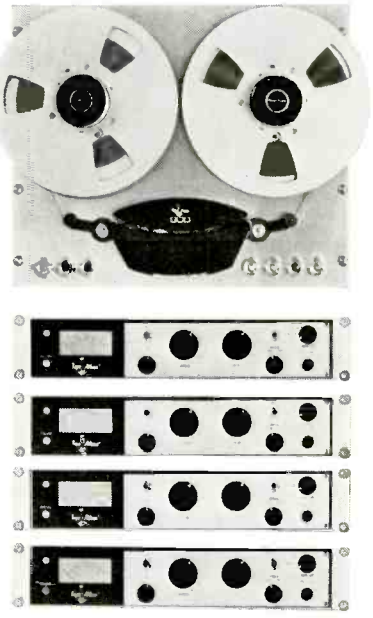

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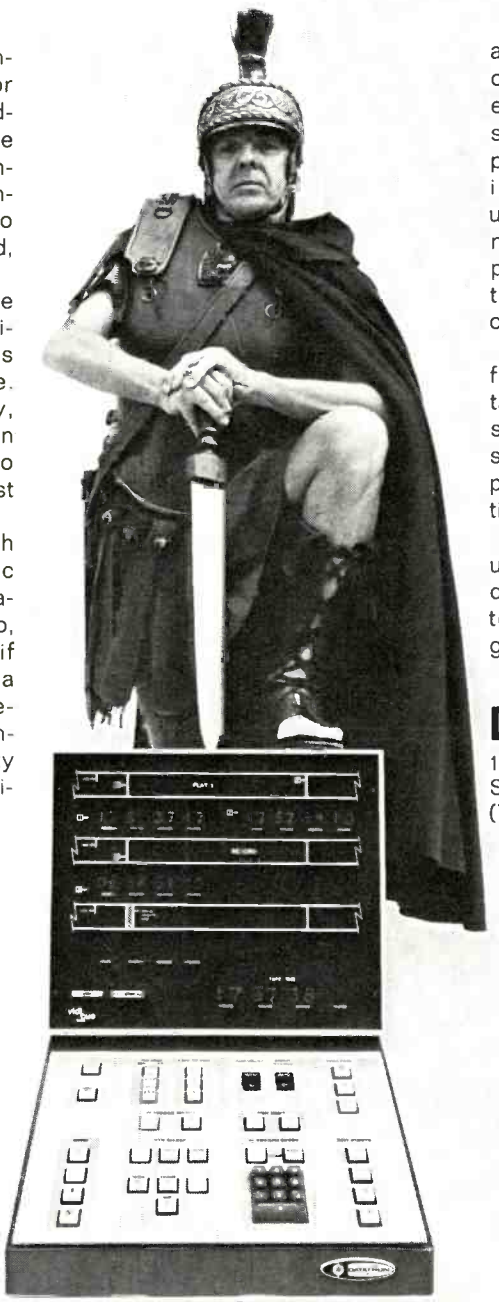

Four basic modes of operation are performed: **Cue/Preview** control of a single machine. **Sequential Edit** enabling the precise assembly of scenes on the record tape from the playback. **Insert Edit** of new material into a prerecorded tape. And a unique **A • B Roll** that eliminates the necessity of prerecording special playback tapes in proper sequence, thus saving a considerable amount of time and money.

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KWWL-AM-FM-TV, Waterloo, Iowa is expanding its engineering staff. Position is available at both studio and transmitter for 1st Class engineer having aptitude in the area of operations or maintenance. Contact E. M. Tink, Vice President of Engineering.

Need chief engineer who can do some announcing . . . prefer permanent person . . . also need news and operations manager who can run morning show plus one staff announcer. No drifters or loafers wanted. Paul E. Reid, Radio Station WBHB, Fitzgerald, Ga.

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TV Newsman, strong on air. Good salary. Great recreation area. Small University town. No floaters. "Over thirty preferred." Contact Lou W. Chappell, Station Manager, WLUC TV Inc. P.O. Box 460, Marquette, Mich., 49855. Phone number 906-475-4161. (A Post Corporation subsidiary).

Chief Engineer, immediate opening with full-time 5 KW directional, in northern Virginia. Send resume with references and salary requirements. Please reply Box 1269-3.

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Minneapolis-St. Paul, AM-FM stereo well established, respected, stable radio operation needs experienced, capable, competent, creative copy writer-producer-announcer with first-class ticket. Challenging position. Pleasant conditions. Contact Bill Stewart, President, WPBC, Richfield, Minneapolis 55423. 612-869-7503. Equal opportunity employer.

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EQUIPMENT WANTED (cont'd)

For Sale—150' self supporting antenna pole. Never been used. Available immediately. You pay freight $2500.00 WNRE, Circleville, Ohio, 614-474-3344.

TRANSLATOR POWER Now put your translator where antenna should be for best coverage not where power line happens to be. Use a TELAN thermoelectric generator. No moving parts, simple to operate, leave unattended 6-12 months. General Instrument Corp., Thermoelectric Division, Dept. BM, 65 Gouverneur St., Newark, N.J. 07104, 201-485-2100 ext. 481.

FOR SALE

ONAN 35Kw 3 phase Delta with 220/120 single phase takeoff. Gasoline powered, 150 hours running time, 1958 model. Generator, automatic line transfer switch, automatic battery charger. $2,000 F.O.B. Farmington, Conn. Contact: Gregory Fortune, WRCH, Farmington, Conn. 203-677-8521.

SOLID-STATE AUDIO PLUG-IN OCTAL (1" Dia x 2" H) modules. Mic preamps, disc & tape preamp-equalizers, tape bias osc. & record ampl., power amps & power supplies. Send for free catalog and audio applications. Opamp Labs., 172 So. Alta Vista Blvd., Los Angeles, Cal. 90036.

Electronic research type 425 25kw isolation transformer (AM tower isocoupler) used one year on 97.1 mc, Factory will convert to your FM frequency. Make reasonable offer—cost $2800.00—Frank Carman, KLUB-KWIC, Box 389. Salt Lake City, Utah 84110.

Jack Panels and patch cords, Audio and Video, new and used. Precision video coax cable and connectors (Belden 8281). Write for catalog. Gulf Electro-Sales, Inc., 6325 Beverly Hill, Houston, Texas 77027. Phone 713-781-3066.

AMERICA'S LARGEST STOCK AND CONSIGNMENT LISTING of new and used broadcast and recording equipment. We trade-sell and buy. THE MAZE CORPORATION, P.O. Box 6636. Birmingham, Ala. 35210.

Tower fabrication, erection and maintenance; used tower equipment. Coastal Tower & Welding, Inc., P.O. Box 984, Tallahassee, Florida. Phone 904-877-7456.

Protect your Lps. Heavy poly sleeves for jackets 5¢; paper poly sleeves for records 10¢; min. order $5.00. Record Supplies, Hillburn, N.Y. 10931.

Self-supporting & Guide Towers. Any type ground wires new 68¢ per lb. (919) 752-3040 Box 55, Greenville, N.C. 27834.

EQUIPMENT WANTED (cont'd)

FOR SALE ½" SHIBADEN, 2 head, B & W VTR with monitor. Takes 1-hr. reels. Ideal for CATV setups or educational institutions. Virtually new. Reasonable. Monoco Productions, Inc., Ridgewood, N.J. 201-652-2852.

Used RCA TTU-25 transmitter complete. Channel 42. Available immediately. $50,000.00. Contact Chief Engineer Tom Sleeman, WBMQ-TV, Birmingham, Ala.

MISCELLANEOUS FOR SALE

SIGNS, NAMEPLATES, LABELS, Decals, Badges, Trophies, Plaques. Seton Corp., Dept. BM/E, New Haven, Conn. 06505.

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We are expanding our distributor territories, and offer to those who qualify franchises for background music, with phone lines, FM Multiplex, or on-premise systems.

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Precision relapping of all heads and supporting posts, includes cleaning and testing. AMPEX VTR audio assembly . . . $75.00 complete. Brand new shelf stock replacement heads of our manufacture available when relapping not advisable. LIPPS, Inc., 1630 Euclid St., Santa Monica, Calif. 90404 (213) EX 3-0449.

CUSTOM STYLUS—cartridge retipping, rebuilding replacements. International Audio Stylus Corp., 111-D Lake Ave., Tuckahoe, New York, 10707 (Telephone: (914) SP9-1297.)

If your microphone does not make you SOUND THE WAY YOU WANT TO SOUND write THE SOUND DOCTOR, Box 3694, Birmingham, Alabama.

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R.E.I.'s famous (5) week course for the First Class Radio Telephone License is the shortest, most effective course in the nation. Over 98% of R.E.I. graduates pass F.C.C. exams for 1st class license. Total tuition $360.00. Job placement free. Write for brochure Radio Engineering Incorporated Schools. 1336 Main Street, Sarasota, Florida 33577—or 3123 Gillham Road, Kansas City, Missouri 64109—or 809 Caroline Street, Fredericksburg, Virginia 22401—or 625 E. Colorado Street, Glendale, California 91205.

First phone through tape recorded lessons at home plus one week personal instruction in Washington, D.C., Atlanta, Boston, Detroit, New Orleans, Minneapolis, Seattle, Denver, Portland, Los Angeles. Proven results. Our 17th year teaching FCC license courses. Bob Johnson Broadcast License Training, 1060D Duncan, Manhattan Beach, Calif 90266. Phone 213-379-4461.

FCC License in six weeks from the nation's largest license school. Compare reputations and success rates before you invest. Professional announcing training on the nation's only fully school-operated commercial station used solely for training. School locations in Dallas, Houston, Atlanta, Chicago, New Orleans and Minneapolis. Write Elkins Institute, 2603 Inwood Road, Dallas, Texas 75235.

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PRODUCT INDEX

A quick reference to products mentioned editorially or in advertisements. Page number is listed first (light face type) followed by reader service number (bold face).

TDA2D VIDEO/PULSE DISTRIBUTION AMPLIFIER

The now-famous TDA2 Distribution Amplifier, in use at most television stations and networks, has a recently added feature. The "D" stands for Differential Input, which we added to the TDA2. And not only did we add a differential input, we subtracted $30.00 from the price. Instead of $325.00, we're selling the new, improved TDA2D for $295.00 F O B Nashville. The compact TDA2D fits neatly into 1¾" of panel space and produces virtually no heat.

For complete information, write to:

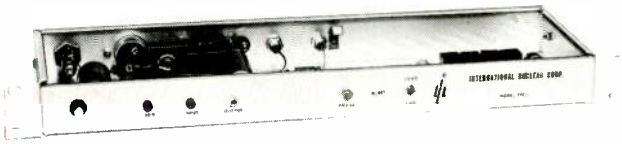
INTERNATIONAL NUCLEAR CORPORATION

608 Norris Ave. • Nashville, Tenn. 37204 • Ph.: (615) 254-3365

Circle 145 on Reader Service Card

MODEL TPC2 TRANSISTORIZED BURST PHASE CORRECTOR

The TPC2 permits rotation of the color burst phase signal driving a TV transmitter, without the necessity for extensive transmitter investigation and possible modification. It permits advancement or retardation of the color burst by 20 degrees, without affecting the amplitude or other characteristics of transmission. This completely transistorized unit has its own internal regulated power supply, and is constructed on a 1¾" by 19" panel. $795.00 F O B Nashville.



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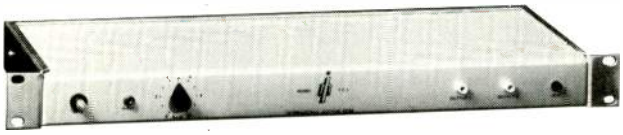
TC1 CLAMPING AMPLIFIER



The TC1 Clamping Amplifier employs tip clamping to remove low frequency signal deficiencies without disturbing burst and other chrominance information in or about back porch levels. The clamped stage utilizes a field effect transistor driven by a balanced bridge circuit. This advanced design technique produces highly effective and stable clamping. The TC1 Clamping Amplifier sells for $325.00 F O B Nashville.

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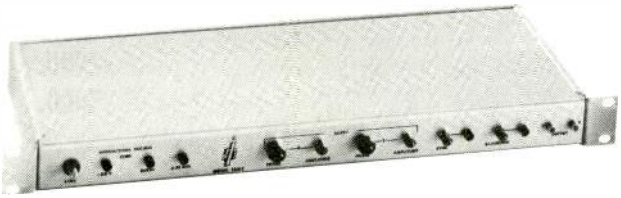
TBG2 BLACK BURST GENERATOR

The brand new TBG2 Black Burst Generator allows you to go black and back with perfection. The TBG2 has two outputs available for added versatility, and each has burst phase and burst amplitude adjustments so the two feeds can be matched under any condition. The TBG2 has the industry's only continuously rotatable phase control, and is accurate to within one degree. All the controls are on the front panel and can be locked. The unit is small, compact and lightweight. So is the price . . . $475.00 F O B Nashville.



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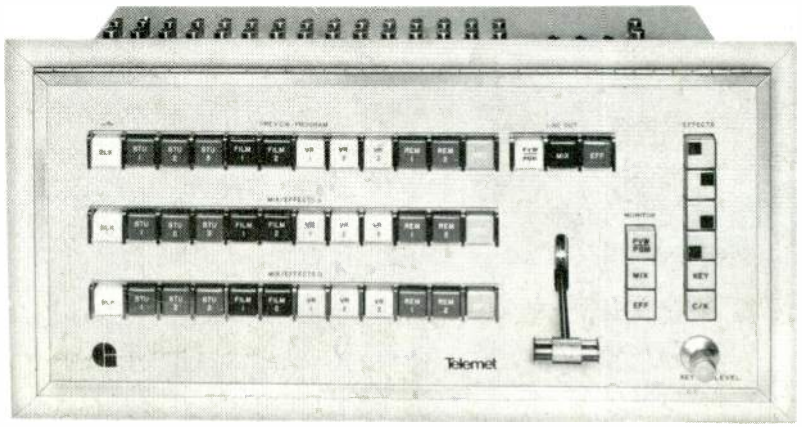

We're offering a brand new vertical interval switcher—with effects—for only $6500.

We figure that's a good way for us to get clipped

Our SS-36 vertical interval switcher is brand new ■ color or monochrome ■ 12 inputs and 8 special effects ■ perfect for broadcast, educational and CCTV transmission ■ mobile or remote operation, too.

Choose your system:

SS-36. Vertical Interval Switcher with three outputs, special effects, mixer and internal power supply . . . . . **$6500.**

SS-36R. SS-36 with remote control . . **$7600.**

SS-48. SS-36 with four outputs, mix effects A & B, preview and program included **$7500.**

SS-48R. SS-48 with remote control . . **$8600.**

☐ I'm all choked up. Give me a demonstration.

☐ Cool it. Let's see a spec sheet first.

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