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Broadcast Engineering

the technical journal of the broadcast-communications industry

Sweep Frequency Techniques

Page 12

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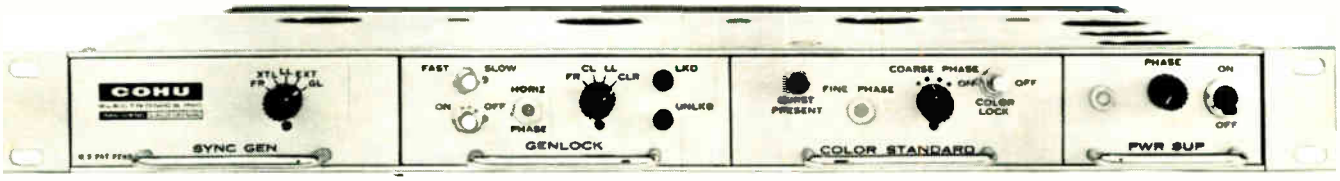

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June, 1969 • Volume 11, No. 6

Broadcast Engineering

The technical journal of the broadcast-commuuications industry

in this issue...

Sweep Frequency Techniques in Broadcast Measurements. A discussion of the applications of the sweep and comparisons with other measurement methods. **D. W. Sargent.**

A Redundant Remote Control Loop For TV Transmitters. A control loop utilizing subcarrier transmissions for both the control and telemetry signals is described. **Evert A. F. Anderson.**

AM Proof of Performance, Part 2 of a 3-part series on Proof of performance. In the wake of numerous FCC fines for violations concerning the Proof, this series seeks to improve signals and avoid costly station fines. **Patrick Finnegan.**

A Wide Range Light Level Control. A discussion of some considerations and conditions for overcoming problems that evolve from complex lighting situations. **Walter Jung.**

PSA Audio Compensator. An inexpensive "compensator" that saves daily adjustment of the modulation monitor at KNIT. **Dick Fletcher.**

Reducing Co-Channel Interference. Author tells how signals from WWV may be used in order to work with the principles of offsetting TV transmitter carrier frequencies to reduce visibility of co-channel interference. **Glenn A. Brown.**

ABOUT THE COVER

D. W. Sargent is shown with a test setup described in his article on the Sweep Frequency Technique in broadcast measurements. See Page 12.

DEPARTMENTS

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LETTERS TO THE EDITOR

Dear Editor:

I enjoyed reading the article "Pennsylvania Power-House," in the April issue of **Broadcast Engineering.** I do believe someone was in error though, in describing the photo (Fig. 5 on page 18) as that being a photo of a TTU-110A. I recognize it as a photo of a TTU-50C. Best regards.

Al Petzke
Chief Engineer, WTVO
Rockford, Ill.

Ed. Note:

Al is correct. The picture in question is of the TTU-50C. The difference in the two transmitters is that the TTU-110A uses a higher power klystron than the TTU-50C.

Requests

From other issues, requests continue to come in for extra copies and copies of articles only. In order to save handling and mailing time, send requests for issue copies to the Circulation Manager and requests for copies of articles to the Editor.

Early Paper Call

Hugo Bondy, WAGA-TV, and program chairman of the January, 1970 SMPTE conference in Atlanta has issued a call for paper ideas.

"No commitments are being either requested or accepted at this time," writes Bondy. He went on to say, "I am, however, asking for an expression of what you (readers) would like to have covered at this conference. Don't feel inhibited: let your suggestions be as free-swinging as you wish."

Send your suggestions to: Hugo A. Bondy, WAGA-TV, P.O. Box 4207, Atlanta, Georgia, 30302.

New Column

Harry Etkin assumes a new role with **Broadcast Engineering** as of the June issue. Harry will write the "Scanning the CATV Scope" column, which will appear monthly.

Harry A. Etkin

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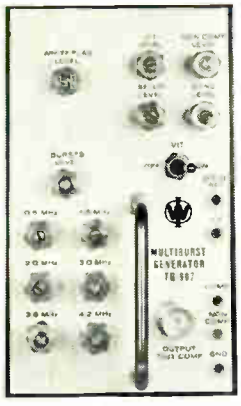

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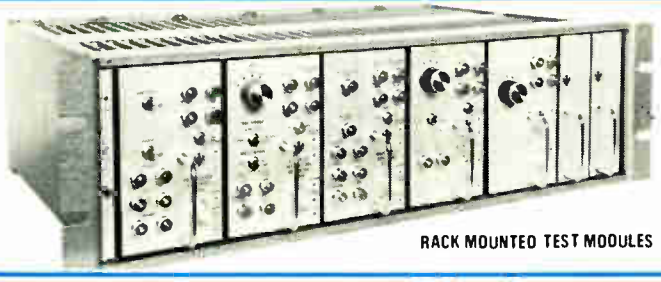

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INDUSTRY NEWS

FCC Seeks Renewal Note Change

The FCC has proposed rules which would require broadcast licensees to give public notice of license renewal applications before rather than after the application is filed. In conjunction with this, applications mutually exclusive with the renewal application would have to be submitted at least 15 days before the license expiration date, instead of up to the day before action on the renewal application, which is the present procedure.

Changes would be made in Sections 1.227, 1.516, 1.571, 1.580 and 1.591 of the FCC Rules on practice and procedure. A new note would be added to the renewal sections of rules governing the various broadcast services (Parts 73 and 74), referring to the new cut-off provision.

In its Notice of Proposed Rule Making, the Commission stated that although the changes will not be made until it considers comments and acts on the proposal, stations with licenses expiring August 1 may observe the proposed procedure instead of the existing requirement.

The FCC explained the need for the proposed amendments in its view, by stating that there had been numerous cases of delay on renewal applications because Section 1.580 requires public notice of the application to be published and broadcast after the application is filed. The FCC said that the present sequence was not necessary and that "it would make for more expeditious processing and timely action on license renewal applications if the required public notice were given during the six-week period before the application is filed, and if verification of such public notice were filed with the application."

Also in the proposals are the need for amending procedures for filing applications for new stations that are mutually exclusive with license renewal applications. The FCC stated along these lines: "The orderly and timely processing of such renewal applications requires that there be a date certain, prior to the expirations of the current license term, by which the Commission and the license renewal applicant may be informed concerning the filing of mutually exclusive applications."

The change, the FCC noted, should cause no difficulty since persons interested in filing applications mutually exclusive with license renewal applications would have ample notice of the fixed dates when all broadcast station licenses in given geographical areas regularly expire. Also notification would be given of the requirement for the filing of license renewal applications 90 days before the expiration of the current license term.

More Power to WCCB

Station WCCB got the green light recently from the FCC to increase its power from 1 million to 5 million watts effective radiated power. Cy N. Bahakel, president of the Bahakel Broadcasting Company, expects WCCB to be at full power as soon as the transmitter and tower are completed later this year.

WCCB is located in Charlotte and broadcasts on Channel 18.

WEVD Cable Burned

Foreign language station WEVD was forced off the air last month by a four alarm fire that started in an adjacent building. The fire burned its way into the WEVD cable.

Another New York station, WPOW, turned over their facilities to the WEVD staff until near noon the next day. The two stations share the same frequency during different hours of the normal broadcast day.

KPIX On - ASH Smoked Out

The Commission has denied the petition of John F. Banzhaf III and ASH (Action on Smoking and Health), opposing renewal of the license of Westinghouse Broadcasting Company's television station KPIX, San Francisco. The station's license renewal had been opposed for its alleged failure to comply with the FCC's Fairness Doctrine on cigarette advertising.

Westinghouse was ordered to submit within 60 days "a statement of its future policies with respect to informing its audience during the hours of maximum viewing the health hazards of cigarette smoking" and after four months to submit "a report on its efforts to implement such policies."

License renewal application BRCT-17 for KPIX-TV was granted to Westinghouse in the same action by the FCC, subject to the following conditions: "(a) that if and when there is a definitive decision to effect the proposed merger between the licensee and MCA, Inc., the Commission shall be immediately notified and, (b) that the Commission reserves the right to take such further action (e.g. imposition of further appropriate conditions, setting aside of this renewal action and designation for hearing) as may be appropriate in light of the public interest considerations concerning the said merger."

In the petition opposing the license renewal, Banzhaf and ASH charged that Westinghouse had deliberately and willfully refused to obey the FCC's order in its decision on **Applicability of the Fairness Doctrine to Cigarette Advertising.** Data was provided by Banzhaf and ASH concerning cigarette and anti-cigarette smoking announcements broadcast by KPIX-TV from about 6 p.m. through 11:30 p.m. on dates between November 25 and December 1, 1968.

The Commission stated that on a general overall basis, there would be no foundation to the complaint in view of the Westinghouse demonstration as to the number of anti-smoking messages during the year 1968 and of documentaries and other news items. But the FCC said in recognizing that there can be no parity of presentation of commercials and anti-smoking messages in the light of the policy determination set out in **Applicability of the Fairness Doctrine to Cigarette Advertising,** and without establishing any pat formula, that it believes greater effort is called for during the maximum viewing period. Comparatively few anti-smoking messages were presented in the maximum viewing time slot during the sample period even though a great number of cigarette commercials were shown in these hours. The FCC went on to say that in view of Westinghouse's efforts to meet its obligations "there is no basis for designation of the Westinghouse renewal application for hearing on this score."

The Commission renewed the license of KPIX-TV "upon a finding that the public interest, convenience and necessity would be served" by the grant.

EDUCATIONAL BROADCASTING

Looking Inside Non-Commercial Broadcasting

The Ford Foundation has continued its support of educational broadcasting by laying out $5 million to 15 ETV's around the nation on the basis of their proposals for local broadcast programs.

WETA, Washington, D.C., came away the big winner with over $749,000 to aid in the development of a nightly local one hour news analysis. San Francisco's KQED received nearly as much for continuation of its nightly "Newsroom."

Other high dollar winners include WNDT in New York, WTTW up in Chicago, and on the west coast, KCET, Los Angeles.

New Cameras

The recent IEEE and NAB conventions saw the addition of many new pieces of broadcast equipment. Judging from the number of one, two and three tube cameras and the price ranges now available, it seems the manufacturers are ready to put more time in on developing cameras that are suited to ETV, CCTV and CATV applications and pocketbooks. Even with the stall on CATV, there looms that potential in origination. And the number of ETV stations continues to grow. Now 182 are on the air, 16 permittees are not yet on the air and 30 applications have been filed. That's a possible static total of 228.

College Radio

John Thayer of Pepper & Tanner told a group of instructors in Memphis that campus stations are falling short of their potential because they are either too tightly controlled by faculty or too loosely run by students.

Speaking on "Is College Radio Serving Its Market?", Thayer pointed out that stations given over to students often turn into little more than juke boxes. He said, also, that too much attention is given by faculties to the "how" of broadcasting technique rather than the "why."

However, Ronald Stenlake, advisor to WJRH-FM, said in the March issue of **College Radio** that, "The educational broadcaster is remiss in his duty if he feels he is delivering an audience to anyone for any purpose." Thus Thayer's remarks on station direction may warrant further thought, but such a term as "market" in the college radio context is an indication that the field is still misunderstood.

New FM Transmitter

A 10/20 watt FM transmitter designed for college and university radio stations was placed on the market at the NAB convention in March. It meets all current FCC 10 watt specifications, and if a 20 watt unit is accepted by the FCC in the future, this unit will meet those specifications, according to vice-president Lawrence Weiland.

The solid-state transmitter features modular design with maintenance and power consumption as considerations. Operating functions are performed by two controls accessible from the front.

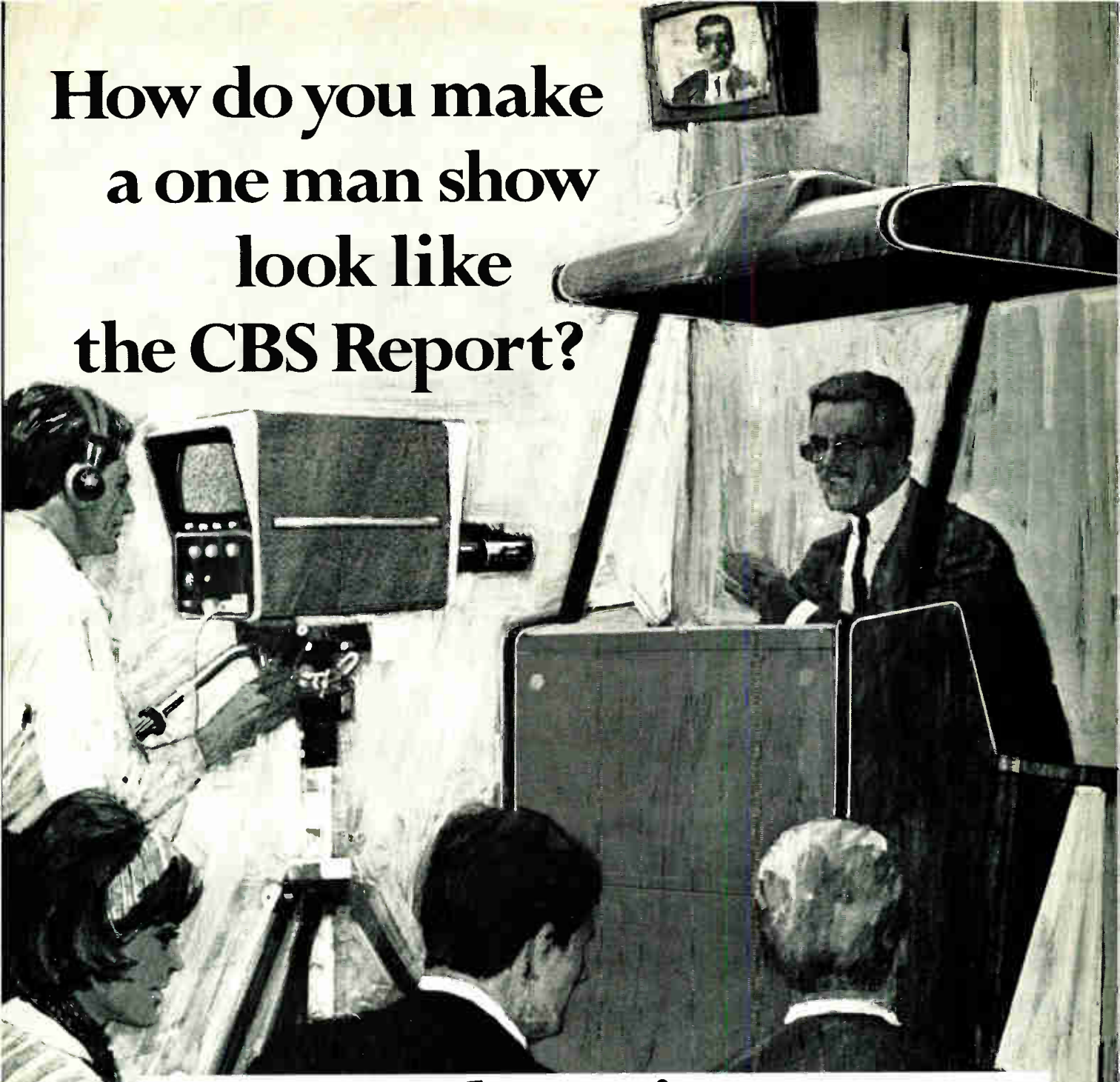
Down Under ABC

Educational television and radio are playing an increasingly important role in Australia. In ten years the coverage has gone from a handful to 4,274 schools equipped with television.

The Australian Broadcasting Commission (ABC) education department provides the programs that average five hours for each school day, or 60 programs a week. The TV system is complemented by the use of radio. More than 92 per cent of the schools have radio equipment capable of picking up ABC's daily school radio broadcasts.

The ABC has assisted a number of Asian and African countries, including Indonesia, Malaysia, the Philippines and Thailand in the establishment of educational radio and TV services.

How do you make a one man show look like the CBS Report?



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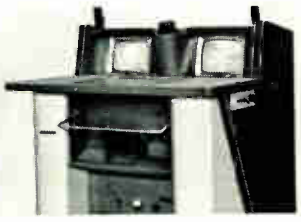

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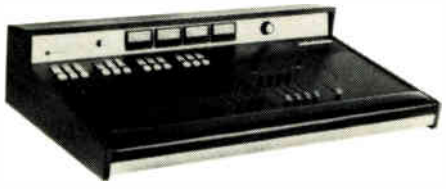

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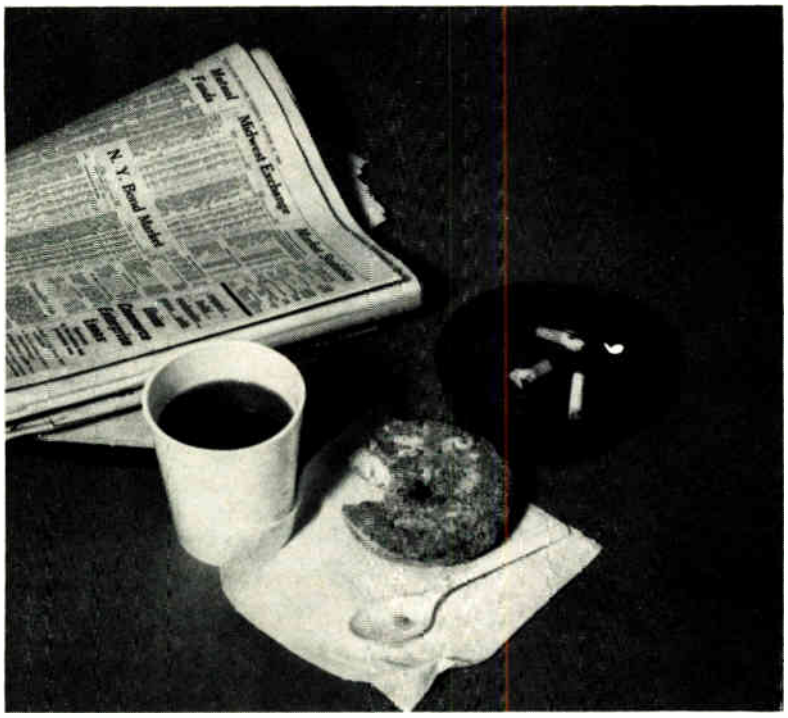
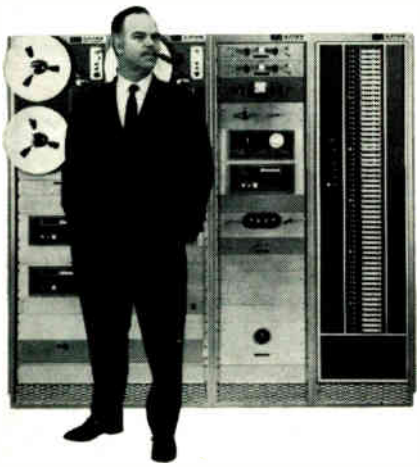
Ben Levesque automated coffee breaks, lunch hours and vacations.



He bought a Gates automatic tape control system.



"Our Gates Automatic Tape Control System does the work of two people. We just tell it what to do and when. It automates programs for 4, 8, 12 hours or more and joins the CBC Network," says Ben Levesque, President, CHRL-AM, Roberval, Quebec, Canada.

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Swept Frequency Techniques in Broadcast Measurements

By D. W. Sargent*

■ It is generally accepted that measurements made using sweep frequency techniques "is the way to do it." Read the ads in any magazine. The biggest names use the statement—"Now our products swept-frequency tested for best accuracy." It is difficult to dismiss this technique when so many are using it.

Just to say "Let's use the sweep method to check our antenna and transmission line," is not enough. There is a right and wrong way to do anything and this is no exception. There are limitations to the method just as any other, and a complete understanding of the system is necessary if it is to be accurate. Let's take a look at this system.

Several basic concepts are common to all sweep-frequency measurements. In each system, three basic functions are performed: 1. Signal generation; 2. Detection; and 3. Readout.

A block diagram of a basic system (one type) is shown in Figure 1. Reduced to its simplest form, the output of the directional coupler is shorted while the sweeper sweeps between the channel end frequencies. This reflects all power back and is detected in the detector and displayed on the scope. Reference is established. The short is removed, the device to be checked is attached in its place, reflected signal is compared with the reference and VSWR computed. Unfortunately, it is not that simple. Let's start in the middle and examine the detection portion.

*D. W. Sargent Broadcast Service, Cherry Hill, N.J.

Detection

If our measurements are to be accurate, we must use the square law portion of the diode. An unloaded diode will be square law over about 20 db. This corresponds to a VSWR of about 1.22—hardly worth setting up the equipment. If we load the diode for best square law response, we can gain an additional 10 db or 30 db dynamic range. Now we are about 1.065 VSWR.

Later on we will see how we can get an additional 6 db, or 36 db dynamic range, for a VSWR of 1.03, which is better than a slotted line in field use. Looking at the detector further, we find that the maximum RF power it can accept and retain by square law is approximately −3 dbm. This determines the power required from the sweeper and the coupling factor of the directional coupler.

A look at sweeper data sheets shows that they are not transmitters by any means. A power of 20 milliwatts is a good starting point. Assume +13dbm out the sweeper into a 10 db directional coupler with a short on its output. This gives us +13 dbm minus +10 dbm or +3 dbm at the input of the detector. Already we are 6 db too much. Here is where we can get our additional 6 db mentioned above. By inserting a 6 db pad between the directional coupler and the detector, we come up with −3 dbm into it, which is just right. This then is our 100% reflected reference.

Now we can substitute the load to be measured, remove the pad and add 6 db to our reading. Our directional coupler must have a directivity figure better than 36 db. A minimum of 40 db is required for accuracy. If it isn't high enough, forward power will feed through and give us an error. A quick check of catalogs shows that most 40 db directivity couplers have 20 db coupling. That diode used as a detector **must** have a couple of other features—flat frequency response and low reflection coefficient over the band of interest. You don't get all this and square law, too, over 30 db range in 1N34's. We now have a detection system that will read to 1.03 VSWR without strain and with accuracy.

Readout

Ignoring the generating system for a while, let's look at readout. We can use a conventional oscilloscope for readout, but it is a linear device, and the lower the VSWR the harder it is to interpret (remember the detector is square law). As it "smashes" the lower we go in VSWR. Also a look at the detector characteristics again show about 50

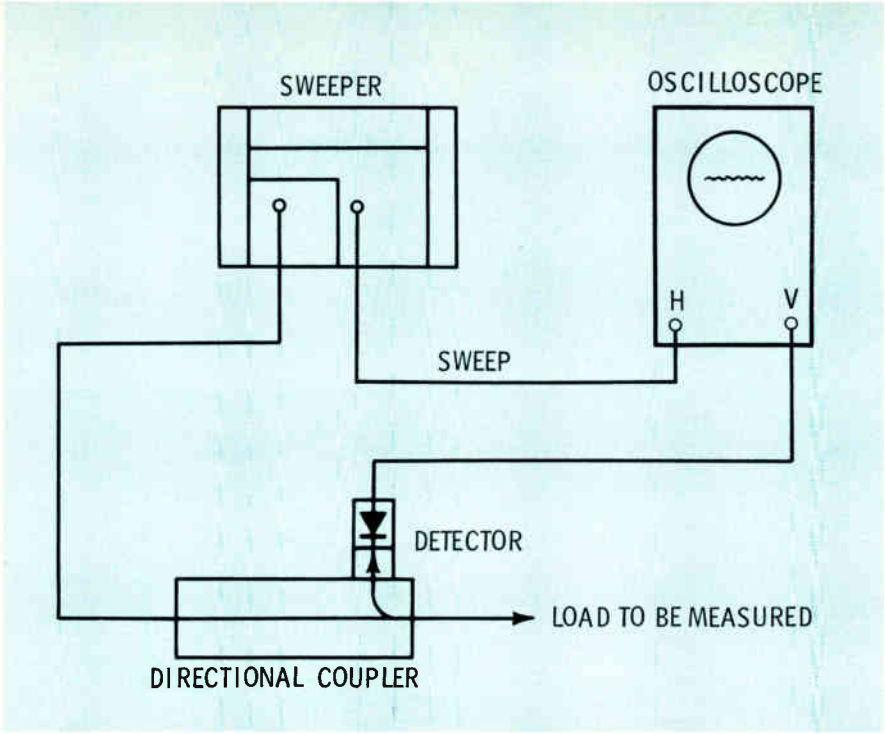

Fig. 1 Block diagram of a basic system.

millivolts at reference and 50 microvolts at 1.03 VSWR, so we need a high gain scope. A better solution is the Hewlett-Packard 140/141 series oscilloscope with the 1416A swept frequency indicator plug-in.

This unit is designed to work over the desired range and also has a log amplifier to work with the square law detector giving a linear presentation. The unit also has a calibrated variable off-set from 0-30 db for high resolution readout. Horizontal sweep for this unit is derived from the sweeper. Here is another requirement. If the scope graticule is to be able to indicate frequency (i.e. 1 MHz per CM, for example), the sweeper must provide a linear sweep voltage (sawtooth).

Let's look at the sweeper for this lash-up now. We have previously determined we need 20 milliwatts of power and a linear sweep to the scope. Stability of frequency is a necessity. Markers must tell where band edges and carriers are, spurious output and harmonic output must be low. If we are to maintain accuracy, it is mandatory that the swept RF amplitude across the band be **flat.** Not so easy when you look at all the components in the circuit to keep those harmonics and spurious signals down.

The sweeper now goes through a low pass filter and an isolator. The isolator presents a good match for the filter and prevents reflected signals from going back into the filter and sweeper. However, both units have response characteristics of their own, and the signal at the input of the directional coupler may not be flat.

In Figure 3 a power sampler is placed just before the directional coupler. This power sampler is a 10 db directional coupler which reads forward power, rectifies it in a diode and sends an automatic leveling control signal back into the sweeper to maintain a flat amplitude over the swept range. Another requirement for the sweeper: built-in circuits for external leveling.

Automatic leveling serves another purpose. If you are sweeping something with cavities, as you sweep through the frequency the impedance changes from resonance to non-resonance and loads the sweeper (or any generator). This may change its level, giving a false indication. Reflections from connectors, cables, etc., within the leveling loop are compensated by the ALC system so that ideally, source mismatch is cancelled and system accuracy improved.

Another advantage to closed loop leveling (in conjunction with flat frequency response in detectors) is that readout-calibration remains constant with frequency, eliminating the need for grease pencil markings and comparison with VSWR mismatch standards.

We now have a system that really reads VSWR accurately, shows the entire channel at once, and shows both line and load, not just what it is at end of line.

As we are interested in looking at a given channel and not your competition, we add one more item —a counter to set the frequency of the sweeper.

What degree of accuracy can we expect with this system? In the frequency range up to 2 GHz, overall accuracy of the measurement is as follows:

$\pm (.01 + .07\ PL + KPL)$.

Where PL is the load reflection co-

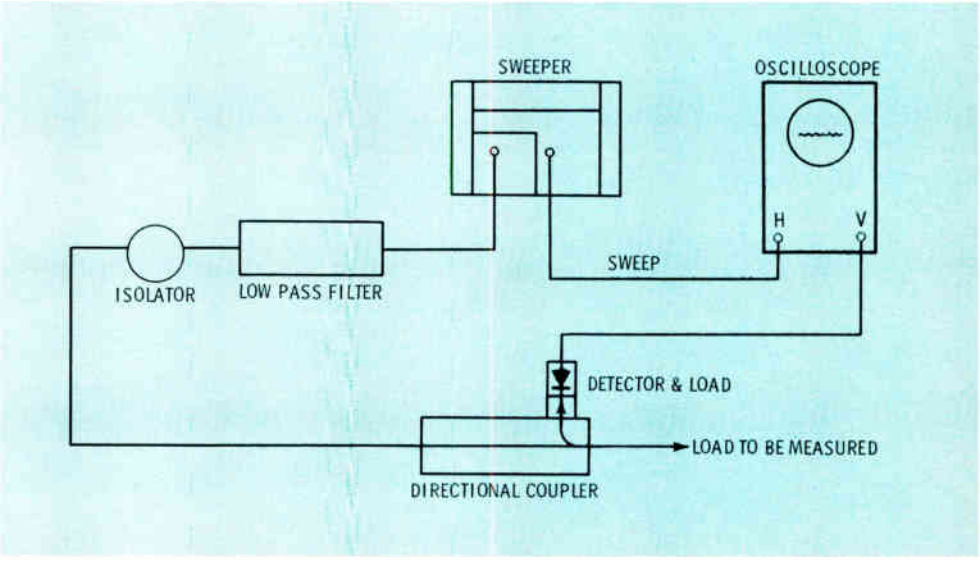

Fig. 2 The sweeper now goes through a low pass filter and an isolator.

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efficient, K is the decimal readout error of readout device.

For a VSWR of 1.05 and a 3% readout accuracy

$$\pm (.01 + [.07 \times .0245] + [.03 \times .0245])$$
$$\pm (.01 + .001715 + .000735)$$
$$\pm (.01245)$$

or a VSWR of 1.05 ± .012.

If a VSWR reading to 1.03 isn't good enough and you want to go to 1.01, we can do that too, with the accuracy of an attenuator. Look at Fig. 4.

The sweeper is amplitude modulated with 1 KHz square wave and a short placed on the directional coupler output. The variable attenuator is now set to "crank in" various amounts of attenuation, and the scope calibrated by marking the CRT face. With this system the calibration lines may not be linear, but the accuracy of the measurement will be the same as the attenuator accuracy. VSWR of 1.01 is possible with this method. You will note that none of these systems use or require delay lines, and all work from VHF to microwave.

This equipment is not limited to VSWR measurement. A technique referred to as frequency domain reflectometry, used for checking and locating faults at RF frequencies is also possible. This technique is extremely useful for checking of transmission line during installation. It also gives an indication of the magnitude of any mismatch but not as accurately as the methods just discussed. Let's look at this technique.

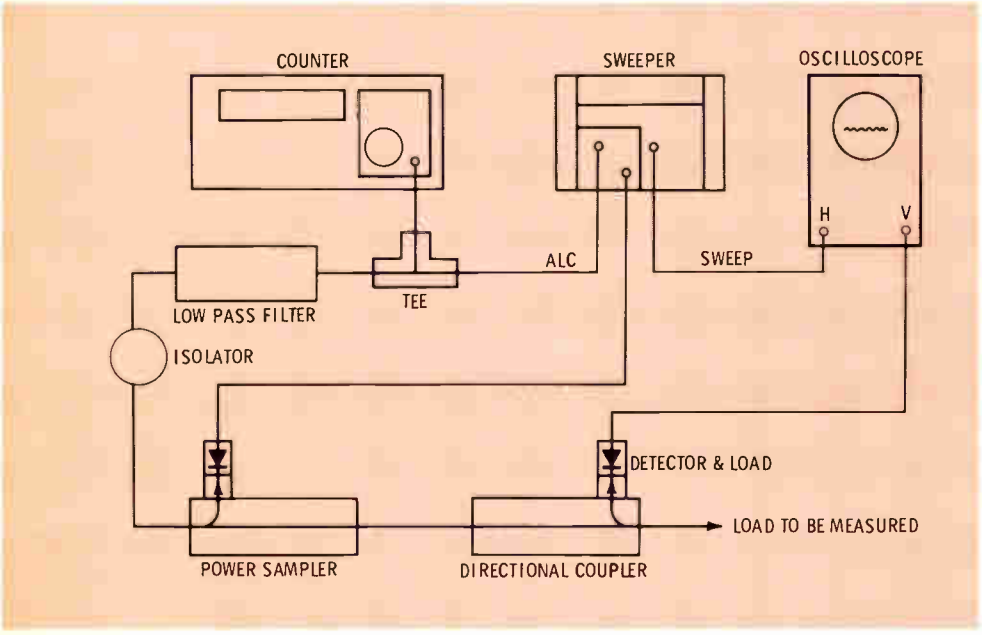

Fig. 3 Placing a power sampler immediately before the directional coupler.

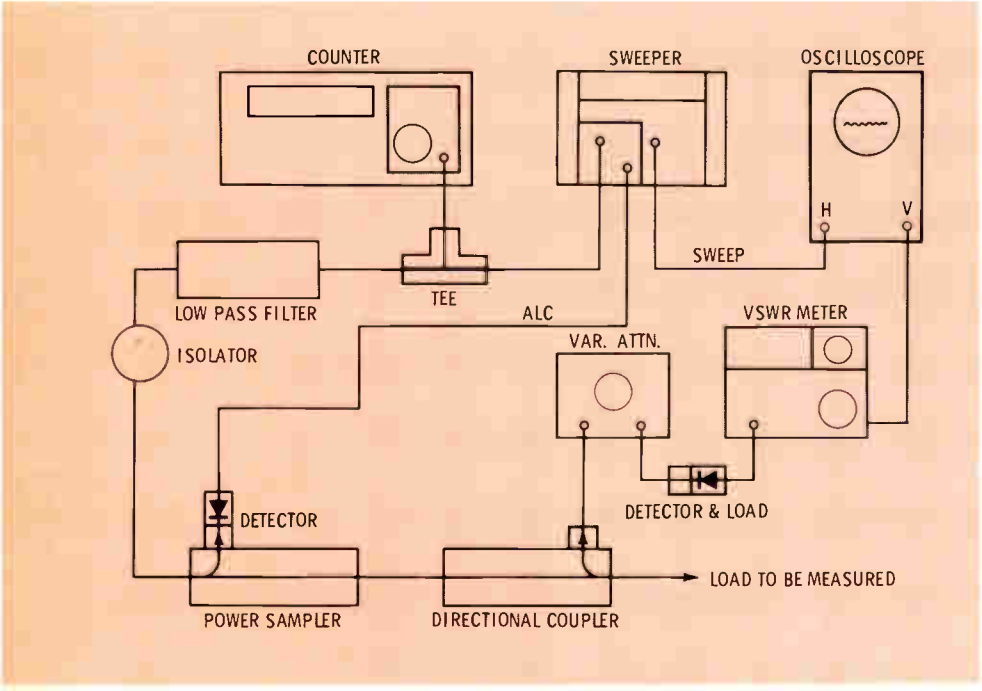

Fig. 4 In this layout the variable attenuator is added, making the measurement accuracy dependent upon the attenuator accuracy.

Locating Faults

At TV frequencies, a portion of the input power arriving at a defect or mismatched termination is "reflected" toward the source. The frequency is so high that there are many wavelengths between the source and the defect.

As the frequency is swept, it changes the number of wavelengths which occupy the fixed path length from the tee to the point of reflection and back. Thus, there will be a continuing smooth transition from an out-of-phase to an in-phase relationship between the incident and reflected signals at a detector which is tee-connected to both the source and the transmission line input. (See Fig. 5). The sum of these two signals, as found by the detector, is displayed directly on the oscilloscope CRT.

During each sweep there will be one or more frequencies in which a positive-going cycle of the reflected sine wave will coincide with a positive-going cycle of the incident sine wave at the point of summation (the detector), thereby providing a maximum (peak) power input to the oscilloscope.

Similarly, there will be one or more frequencies where the positive-going cycle of the reflected sine wave will coincide with the nega-

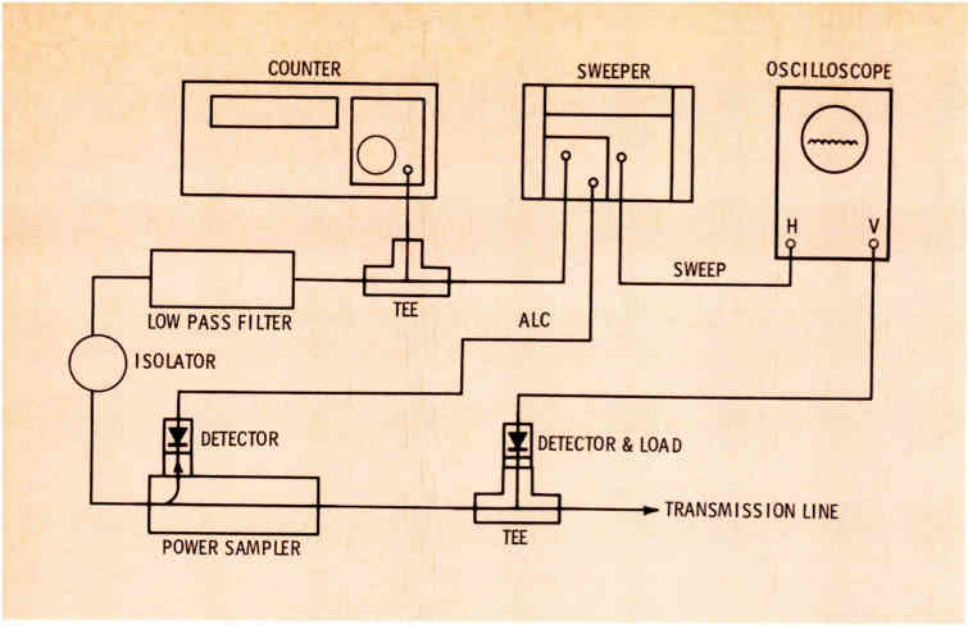

Fig. 5 The sum of the two signals is displayed on the oscilloscope.

tive-going cycle of the incident sine wave at the detector, providing a minimum power input to the oscilloscope. At frequencies between the two limiting conditions, the two signals will be between the in-phase and out-of-phase conditions at the detector, providing a varying intermediate level power input to the oscilloscope.

The end result is a "peak-and-valley" ripple display on the oscilloscope CRT. This display can be calibrated in "feet per ripple" or "ripples per foot," for direct readout of the distance to the fault. The greater the length of line to the fault, the more cycles of phase reversal that will be provided for a given sweep width, since even a small difference in wavelength over a long distance will alter the return path by a full cycle. So, the number of ripples observed for a fixed ▲F swept frequency excursion is proportional to the distance down (or up, if you prefer) the transmission line to the fault or mismatch. The ripple amplitude gives an indication of the magnitude of the mismatch.

A typical test setup is shown in Fig. 5. The sweeper output is connected to a tee junction to which the transmission line under test and a crystal detector are also connected. Discontinuities in the transmission line under test (and/or termination mismatch) will produce reflections which combine with the incident signal at the crystal detector with a phase relationship that varies with both the distance to the discontinuity (L) and signal frequency. As the frequency is swept, the display will show "ripples" resulting from the vectorial addition of the signals at the crystal detector.

The number of ripples appearing across the full width of the display (which is inversely proportional to the frequency separation of adjacent ripples) is a measure of the distance, L, from the discontinuity to the crystal detector. Therefore, when the sweeper is operated in the sweep mode, ▲F can be chosen to provide an appropriate display calibration in terms of "feet per ripple" in accordance with the length of the transmission line under test.

The proper ▲F sweep width control setting can be determined initially by attaching a 20 feet length of transmission line, and adjusting ▲F for one ripple (▲F will be approximately 24 MHz or ± 12 MHz from carrier).

The distance to the discontinuity equals the number of full-cycle ripples and fractional ripples in the display times the display calibration feet per ripple. The formula for the discontinuity distance, L, represented by each full-cycle ripple is:

$$L = \frac{492\ d}{\blacktriangle F}$$

L is the distance, in feet, from the tee to the discontinuity.

d is the propagation constant (one for air line).

▲F is sweep width in MHz.

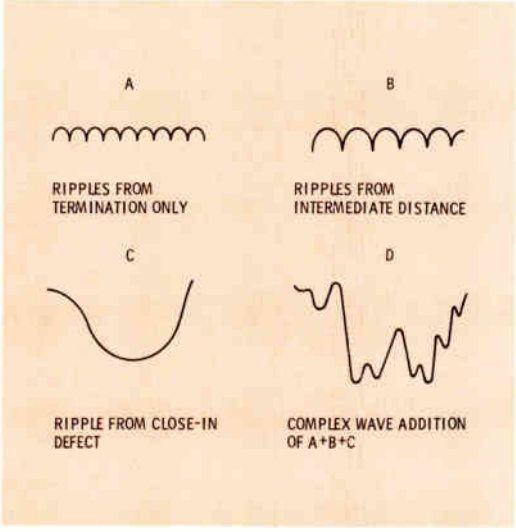

Fig. 6 The analysis becomes more difficult as the number of discontinuities increases.

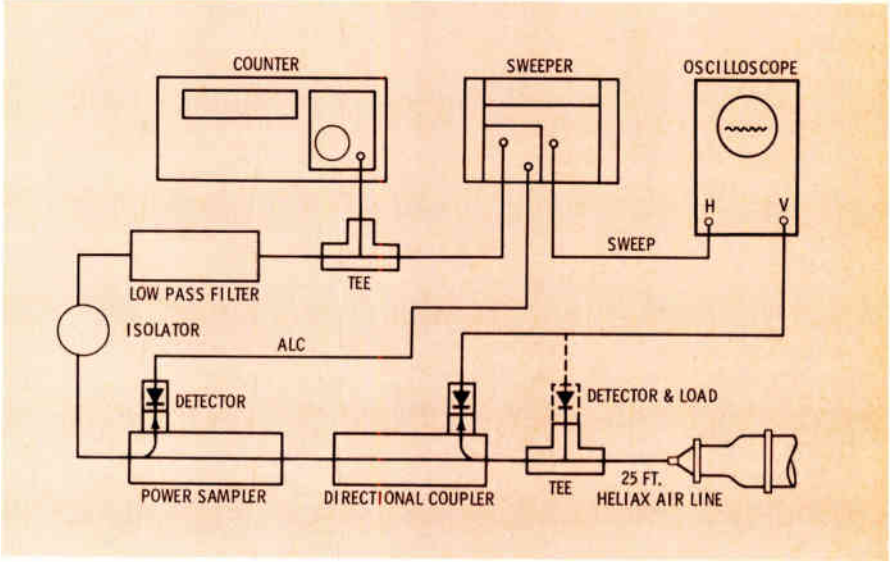

Fig. 7 Test setup for field testing an antenna.

In practical cases where multiple faults (or one or more discontinuities plus an imperfect termination) are present, the display must be broken into its component parts by visual analysis in order to obtain the proper ripple quantity values to use in determining discontinuity distance. The reflections will add to produce a complex display. Such a display can be broken into its component parts by analyzing it in terms of the following rules, as illustrated in Fig. 6. Note that analysis becomes more difficult as the number of discontinuities increases.

a. Complex wave is the sum of the individual return loss indications.
b. "Ripple Frequency" increases with source distance.
c. Ripple amplitude of each component of the complex wave is related to its mismatch magnitude.

As in any system, experience makes the difference. It takes patience and practice to interpret the waveforms.

A practical test setup as used in field testing an antenna and 6 inch transmission line using the preceding description is shown in Fig. 7. This setup uses a 25 foot length of air line (flexible Heliax) to attach a directional coupler output to the transmission line through the adapter cone and transformer. The transformer is required to convert to both 6-⅛ inch line and also to 75 ohms (impedance to 6 inch line) as our test setup is 50 ohms. The 25 foot length of Heliax cable does two things—it gives a cable for hookup that has the same dielectric constant as the transmission line and allows us to back off 25 feet from the line under test to enable us to better see any discontinuities at the input. The counter is used to set the frequency of the sweeper. To check the frequency it is necessary to set the sweeper to "manual sweep" and check the lowest frequency, and then manually move the frequency to highest frequency and check it also.

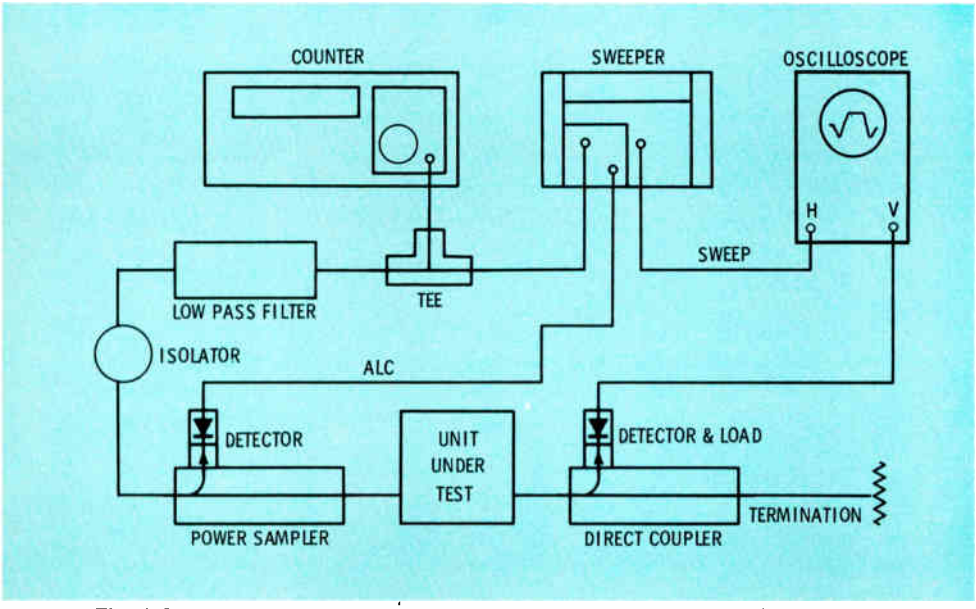

Fig. 8 Setup for visually displaying the response curve of a filterplexer.

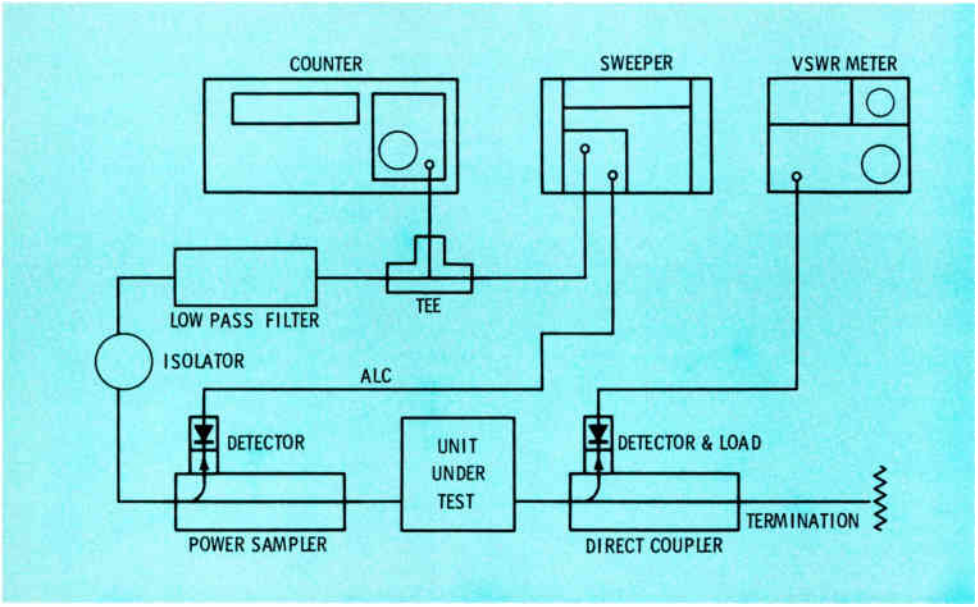

Fig. 9 A second method for checking response.

The manual mode on the sweeper is the same as the repetitive mode except that the frequencies are swept by manually rotating a potentiometer from full CCW to full CW and at any speed. If pot is not moved, signal from sweeper is a CW signal allowing measurement of frequencies with ease. This gives extreme accuracy of center frequency and sweep width. Another plus of this feature is the accurate calibration of oscilloscope CRT for the frequency.

The setup shown in Fig. 7 is for VSWR. To use frequency domain reflectometry, move the crystal detector from the directional coupler to the coax tee and proceed as described previously. You will note that all power delivered to the transmission line is flat over the swept range because the power sampler providing the leveling voltage is right at the load, not back at the sweeper.

So much for transmission lines and antennas. Now let's take a look at filterplexers or VSBF. We make use of the same setup as Fig. 7 to measure VSWR. To measure response, we use the same equipment but hook it up differently. Figure 8 shows the setup for visually dis-

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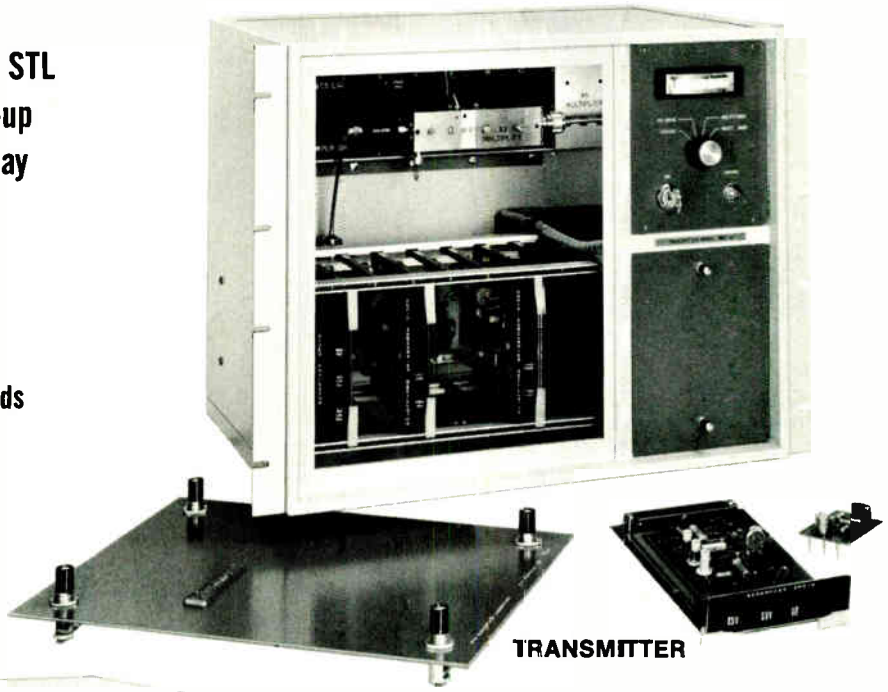
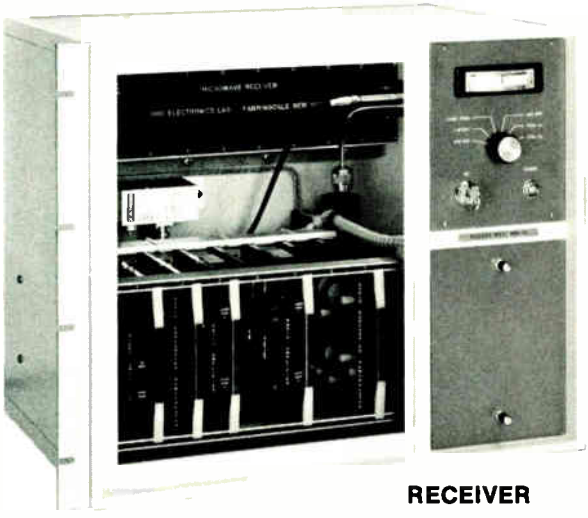


TRANSMITTER



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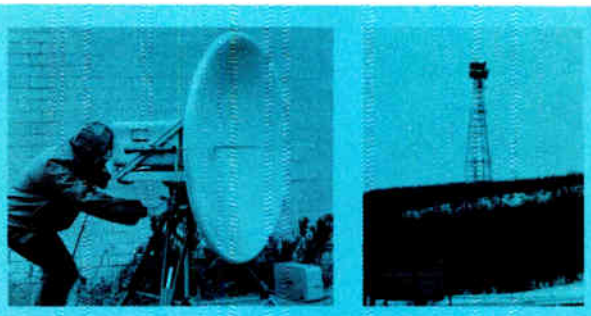

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Circle Number 13 on Reader Reply Card

playing the response curve of a filterplexer.

Using this test setup we can display the response of device under test on the oscilloscope CRT. The detector is used to "look" at the forward wave rather than the reflected wave as in VSWR measurements. If a Hewlett-Packard 1416A sweep frequency indicator is used, a log amplifier in conjunction with the square law detector will present a linear display on the CRT.

A second method of checking for response is shown in Fig. 9 In this setup the sweeper is used in the CW mode (any signal generator with 1 KHz modulation). The frequencies of the channel are set using the counter, and the detected signal read out on the VSWR indicator meter. The points or frequencies are set at 100 KHz intervals and the response is plotted.

This method, while more time-consuming, gives greater dynamic range and increased accuracy over the sweep method. For detailed checks where it is desired to make adjustments of response, the sweep method is preferred . Both systems have their merits.

Another application of the sweep method is using the setup in Fig. 8 to initially tune the klystron in a TV transmitter which uses sideband shaping ahead of the klystron. In this system, the sideband filter would "limit" the sweep width, making tuning of the klystron extremely difficult as it could be tuned too "wide" rendering it impossible to generate power. By using the Fig. 8 setup, the klystron can be pretuned at RF frequency of the channel and to the proper bandwidth .(See **Maintaining Modern TV Transmitter Performance,** RCA BROADCAST NEWS, April, 1967, by D. W. Sargent.)

Both sweep frequency testing and frequency domain reflectometry open up new possibilities to broadcast measurements. ▲

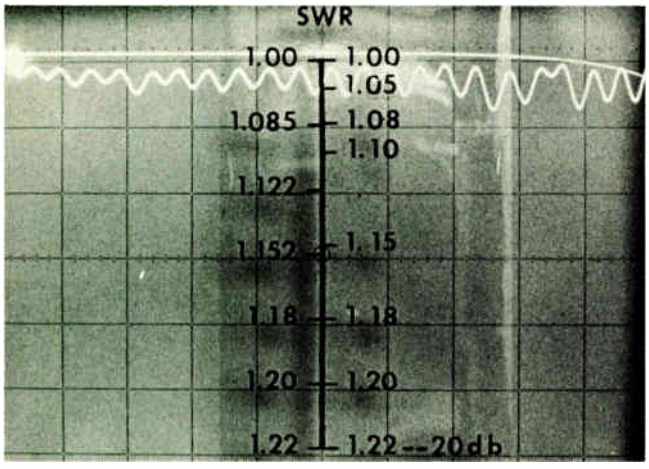

Fig. 1 SWR of air filled transmission line using test setup of Fig. 3. Transmission terminated with "perfect load."

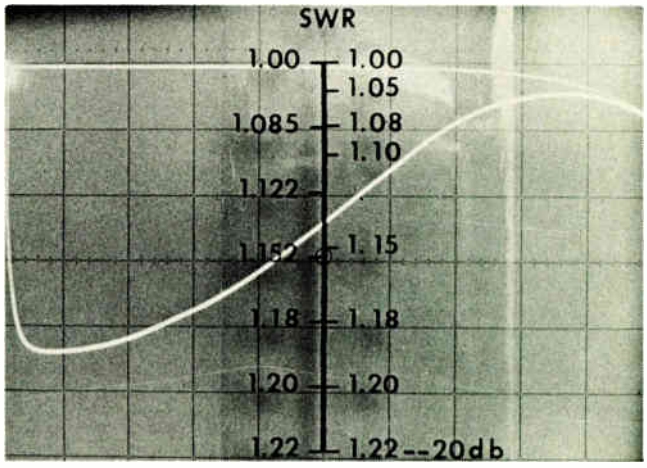

Fig. 2 SWR of test load (not load used in Photo 1 to terminate line). Test setup of Fig. 3 used.

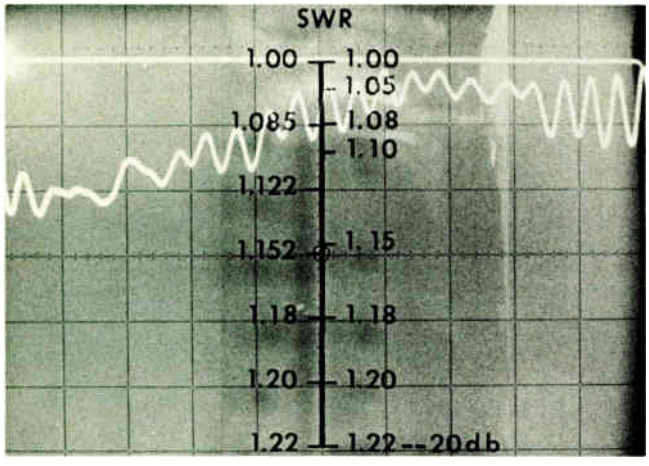

Fig. 3 SWR of transmission line in Photo 1 with load of Photo 2 at end of line. Test setup of Fig. 3 used. In Photo 3 we see the general SWR pattern of the transmission line (low frequency ripple) superimposed on the load SWR (high frequency ripple). Both patterns follow the general shape of each but are much modified in their amplitude.

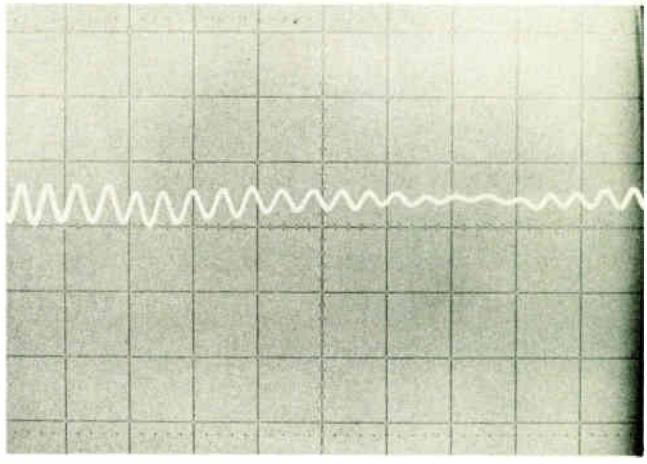

Fig. 4 Using the test setup of Fig. 7 and the detector attached to the tee we get a ripple pattern. This pattern follows the load SWR and by calculation we find it follows the SWR values. This setup is useful in checking the load at the end of our transmission line.

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To anyone not familiar with the Stanton 681, this might seem to be an extraordinary statement. But to anyone else, such as professional engineers, these results simply confirm what they already know.

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The 681EE, with elliptical stylus, is $60.00. The 681T, at $75.00, includes both an elliptical stylus (for your records) and an interchangeable conical stylus (for anyone else's records). For free literature, write to Stanton Magnetics, Inc., Plainview, L.I., N.Y.

Circle Number 14 on Reader Reply Card

A redundant remote control loop

By Evert A.F. Anderson*

After installation of the remote control of KCET'S transmitter (see Broadcast Engineering, July 1967), one problem that arose was the failure of the telephone line for the control circuit, usually due to intense mountaintop electrical storms.

*La Crescenta, Calif.

This failure was caused by high current surges that would open the line fuses of either the telephone company or the Moseley unit.

Each outage resulted in the loss of approximately one and a half hours of air time while an engineer was dispatched to the transmitter to assume control. In an effort to reduce the loss of air time, permission was obtained from the FCC to use a redundant control loop utilizing subcarrier transmission for both the control and telemetry signals.

Switching

Reference to the block diagram (in Fig. 1) will give the operating details of the system. A 3 kHz sensing unit at the transmitter switches to radio control when the control tone is interrupted for more than nine seconds. If the sensing unit does not switch in nine seconds, the normal 25 second fail-safe unit of the Moseley unit will operate to remove the transmitter from the air. However, after the nine second failure, switchover will automatically

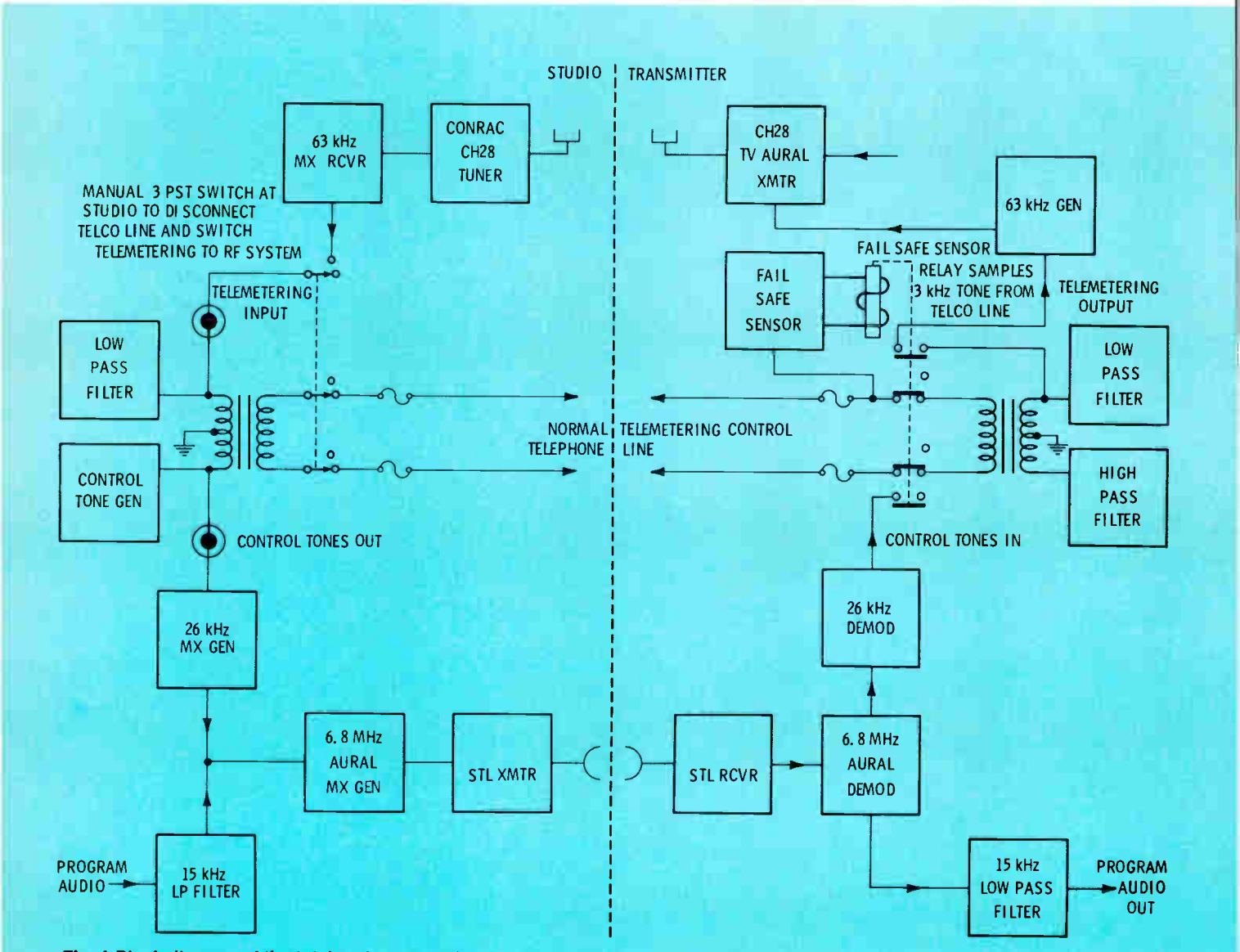


Fig. 1 Block diagram of the total system operation.

for TV transmitters

put the telemetry tones into the subcarrier modulator which is multiplexed into the aural transmitter FM exciter, utilizing a varicap modulator.

These tones are picked up on a subcarrier receiver at the studio control point. The operator has only to manually switch to telemetry from the Conrac receiver to maintain full control of the transmitter.

The normal control tones to the transmitter are multiplexed on the 6.8 MHz audio diplexer unit of the microwave transmitter and receiver. This multiplex unit operates at 26 kHz. As indicated on the block diagram, the program audio lines utilize 15 kHz low pass filters to isolate the 26 kHz from the normal audio circuits.

Before the systems were installed, tests were made utilizing the transmitter subcarrier unit to determine the reliability and accuracy of the telemetry circuits. The Schmidt trigger unit used at the studio Moseley unit gave accurate and reliable readings over an amplitude variation of more than 20 dB. When the signal became unusable, the meter reading would immediately go off scale, indicating a problem.

The Conrac tuner used a subcarrier receiver manufactured by Audio Systems Inc. of Glendale, California and is a MX-3 Wood Multiplexer. The 26 kHz and the 63 kHz units were purchased from Moseley Inc.

With a great part of the system composed of existing manufactured units, the only problems that remained were the construction of the changeover fail-safe sensor and modifications of the Moseley unit board F. (See Fig. 2).

There is sufficient room on the board for the addition of the three transistors and associated components. This is a relay driver similar to that used in the fail-safe circuit with the exception of the time constants which are modified to give a 9 second time delay. The input is sensed at the same point as the 25 second fail-safe, and utilizes a 1N1669 diode to provide isolation between time delay circuits. Voltage is taken from the existing board F bus. Transistors and diodes are the same type used in the other board "F" circuits.

Changeover Operation

The relay and associated interconnection circuits were mounted on a small bathtub chassis. The logic of the changeover circuit operates as follows: (See Fig. 3). Normal 3 kHz control is sensed from pin 20 of board "F" through K1 relay contacts to the relay driver that keeps K1 energized. This lock-up was utilized so that in the event of intermittent line problems, the circuit would not cause a switching back between two control systems. Therefore, once the line fails, radio control is locked in until manually reset either at the transmitter control or by remote control.

After a nine second line failure, K1 will de-energize and switch the multiplexed control tones into the normal 600 ohm line input of the Moseley transformer. At the same time, the telemetry picked from the +5dB tap is routed through a bridging transformer to the 600 ohm line input of the SCG-4 and subcarrier unit. The presence of telemeter audio keys the SCG-4 on and subcarrier modulation of the aural transmitter starts.

The operator, by manually throwing a three-pole switch at the studio, connects the T/M into the studio unit and disconnects the telephone line from the studio unit. Included in the changeover relay circuit is a bypass switch that can be utilized to bypass the auto changeover function in event of trouble with that unit. Wiring was straightforward with no critical areas involved. Once the remote telco line problem has been corrected, depressing either the reset button at the transmitter or Step 2 (lower) at the studio will shift the whole control loop back to the telephone facilities.

Modification of the microwave units (RCA) to provide for 26 kHz subcarrier operation was very simple. At the MW transmitter diplexer, 26 kHz is injected across the cathode resistor of the first audio stage. At the RCA demodulator, the 26 kHz is recovered from the 6AL5 detector as seen in Fig. 4. The 26

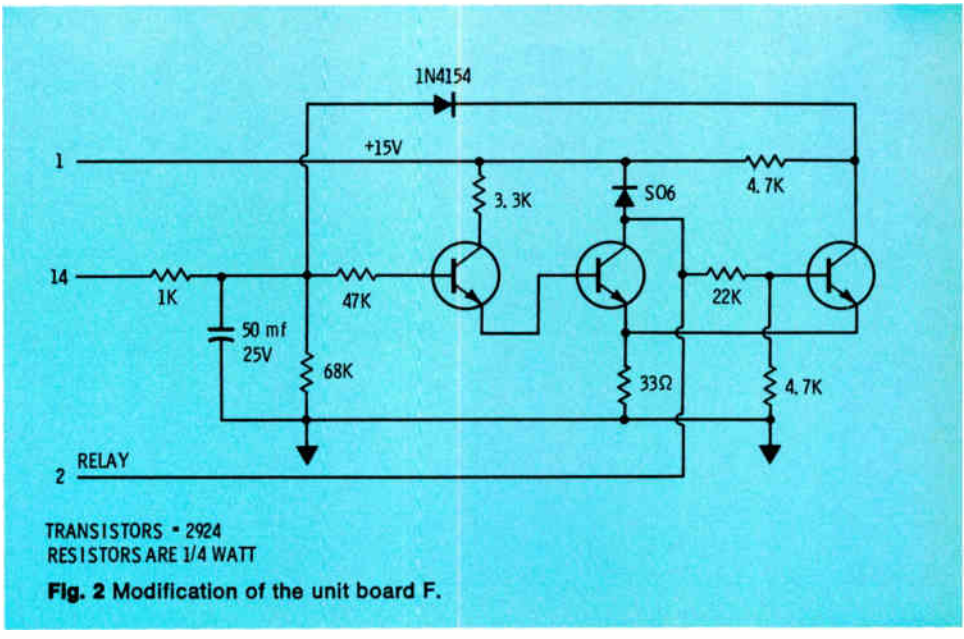


Fig. 2 Modification of the unit board F.

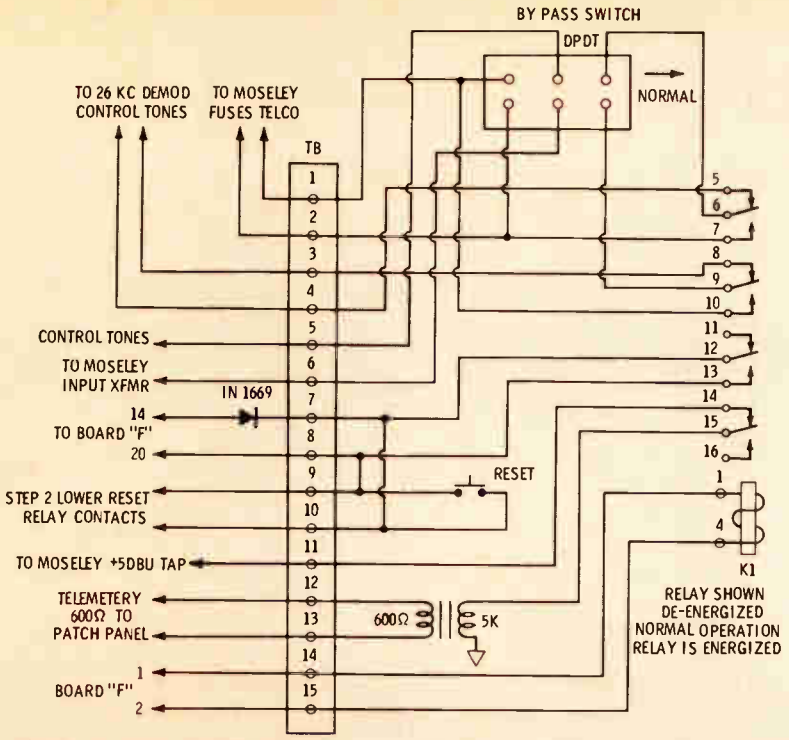


Fig. 3 The relay and associated interconnection circuits.

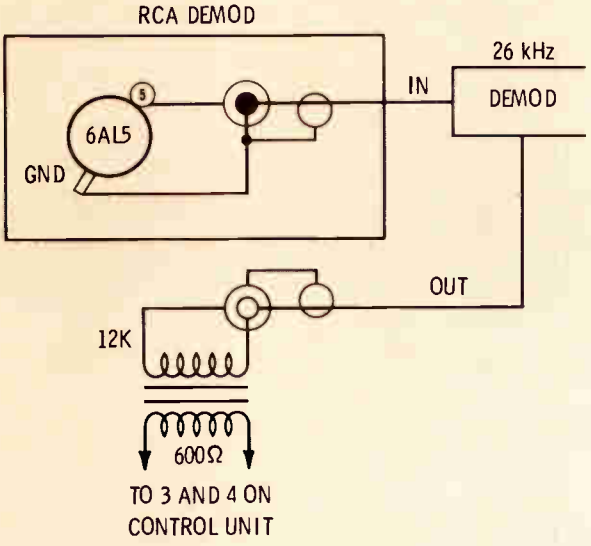


Fig. 4 Signal is recovered from the 6AL5 detector.

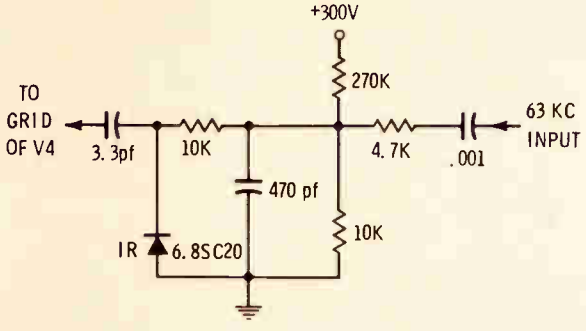


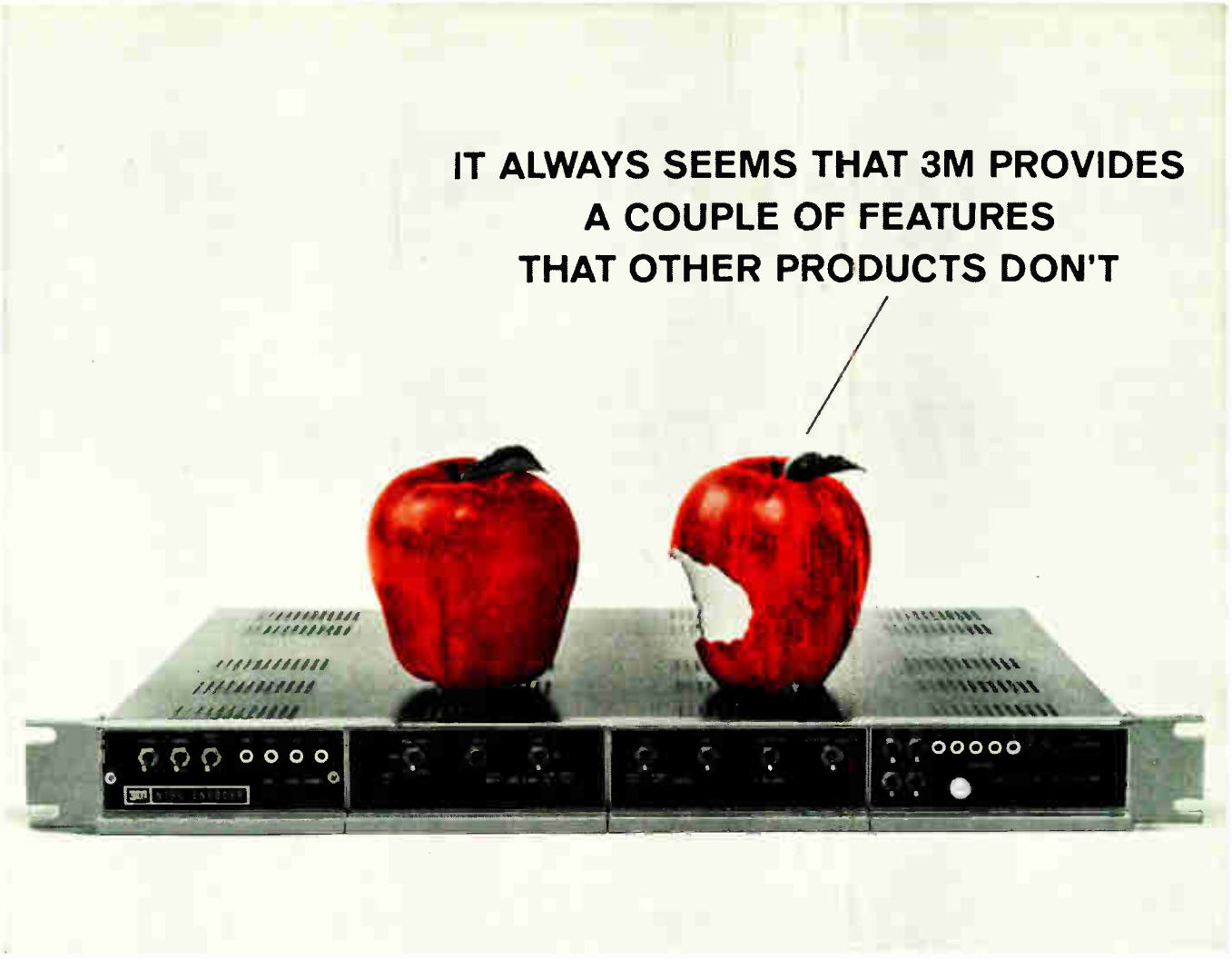
Fig. 5 Modification for SC modulation.

kHz units are solid-state, and no problems have been encountered with them.

In discussing the subcarrier modulation of the aural transmitter, one obvious handicap should be pointed out. There is no TM data available if the aural transmitter is off the air. However, the system was visualized as only a backup in the event a failure occurs while the transmitter is on the air. Utilizing a separate transmitter studio link would give continuous telemeter information. The aural transmitter is part of a GE TT57A UHF transmitter, and the FM exciter was modified at the 20MHz grid with the addition of a varicap modulator. (See Fig. 5). Subcarrier injection was set to 10 per cent and maximum deviation of the subcarrier is held to plus of minus 7.5 per cent. There was adequate room on the FM exciter for the few components in the subcarrier varicap modulator circuit.

The method of measurement of the subcarrier injection was as follows: With no subcarrier injection, modulate the aural transmitter 100 per cent with a 1 kHz tone. Using an oscilloscope at the Conrac tuner ahead of the de-emphasis network, set for a 100 per cent scale. Remove the 1 kHz tone, inject subcarrier and set for a 10 per cent reading on the oscilloscope. The SCG-4 is calibrated with a meter on the front for the 7.5 per cent deviation.

The operation of the radio control unit has been straightforward without any problems to date. In general it is tested once a week during test pattern time. This test accomplishes two results: 1) it verifies the reliability of the radio control; and 2) it trains the operators in the use of the backup system. So far we have utilized the system during three telco failures with no loss of air time. So the system has proven valuable in increasing the reliability of remote control systems. Of course, this radio control can be used with any group of remote control units that utilize non-critical audio tones for control and metering. If the decision is made to use a redundant back-up system for control of your transmitter, permission must be obtained from the FCC before installation of the radio control. ▲



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NCTA Looks To Future At San Francisco Meet

When the NCTA met for their national convention last year, the cable direction was all progress and promise. Convention attendance hit an all-time high. Across the battleground, there were a few brush fires still burning between interests. In fact, there was little indication that explosive FCC proposals within six months would shake the industry.

The convention this year gets under way June 22 in the San Francisco Hilton Hotel. And because of the Rx: Cable/'69 format, it should offer CATV a chance to solidify its direction and point to some specific answers that may be used later in a long hot summer.

This year's convention will include:

- Reports, analysis and panel discussions of problems regarding the FCC, copyright considerations, labor relations, public utility control and telco problems.
- Latest information and techniques regarding management, technical and financial aspects of CATV operation.
- Discussions of CATV's future role in a national telecommunications system.
- "Eye-Opener" discussion sessions every morning.
- Exhibit areas featuring the latest in equipment.

At the convention last year, NCTA national chairman Robert H. Beisswenger predicted sharp gains in cable growth across the nation. Fredrick W. Ford, NCTA president, said it had been a year of decision. And FCC chairman Rosel H. Hyde told his audience, "There is obviously a challenge and opportunity for regulatory leadership and for industry statesmanship."

So it is that with the opening of the 18th annual convention, the cable industry is still laboring to achieve a solidified position in the communications industry. Here are the session schedules from which the direction will come. (See Broadcast Engineering's new column "Scanning the CATV Scope" for coverage of recent CATV developments.)

Convention Schedule

Sunday, June 22

10.00 a.m. Registration
1.00 p.m. Exhibit Areas Open
6:00 p.m. Reception

Monday, June 23

8:00 a.m. Eye-Opener Discussion Sessions
9:15 a.m. General Session
12:30 p.m. Luncheon
2.30 p.m. Management and Technical Session
6:00 p.m. Social function—to be announced

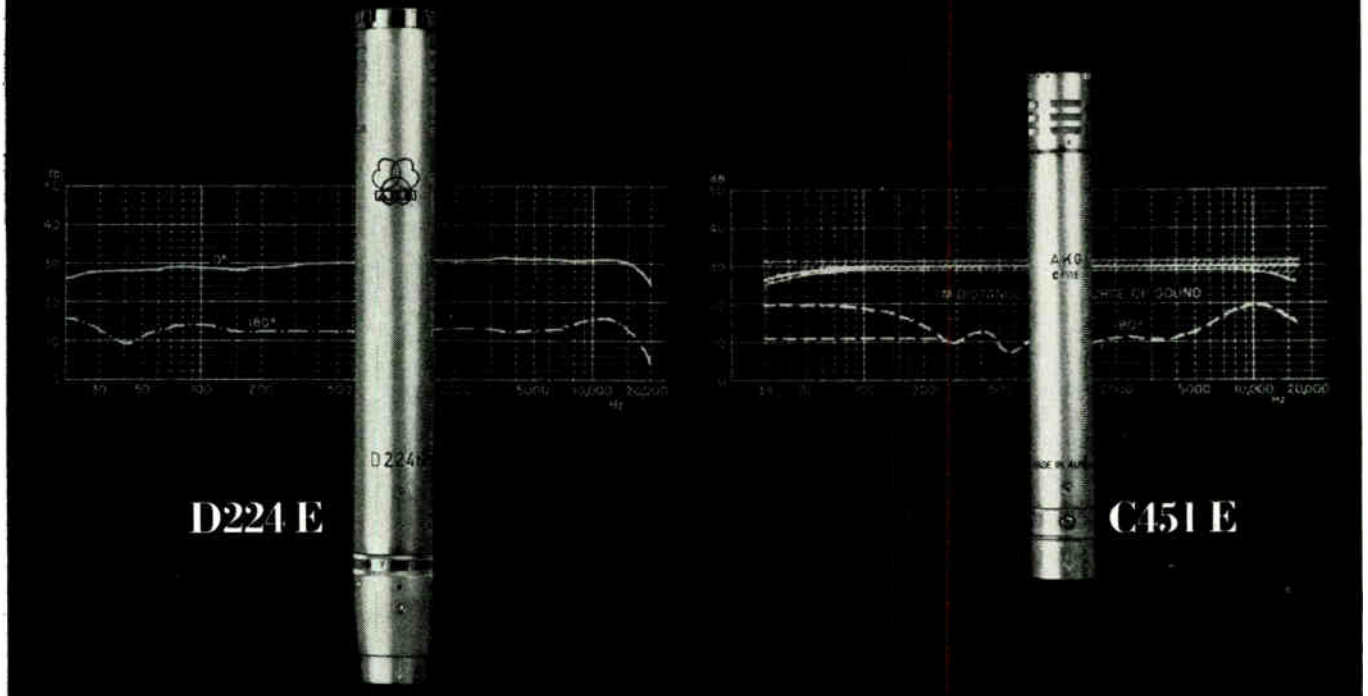
Tuesday, June 24

8:00 a.m. Eye-Opener Sessions
9:15 a.m. Management and Technical Sessions
12:30 p.m. Luncheon
2:30 p.m. 18th Annual Business Meeting
6:00 p.m. Chairman's Reception
7:30 p.m. Annual NCTA Banquet

Wednesday, June 25

8:00 a.m. Eye-Opener Sessions
9:15 a.m. Management and Engineering Sessions
12:30 p.m. Luncheon
2:30 p.m. Management and Engineering Sessions
5:00 p.m. Convention Closes

When your dynamics are this good... you have to make the best condensers



With the invention of two-way microphones **AKG** improved the quality of cardioid dynamic microphones drastically in many areas: *Flat frequency response* over the entire audible range. *Linear off-axis response:* 90° off-axis is reproduced as natural as 0° on-axis response. *Uniform front-to-back discrimination* of 20 db, even in the critical low frequency response and upper mid-range area. And in addition: *No proximity effect.*

In fact, the two-way microphones are out-performing some condenser microphones.

The next **AKG** step was the development of a new condenser microphone capsule. It consists of a gold-vapored *ceramic* electrode and a permanently mounted *metallic* alloy diaphragm. Both materials have the same expansion coefficient, thereby increasing the *longevity* of the capsule. In addition it is impervious to a wide range of temperature and humidity fluctuations, and it is free of deterioration and hysteresis.

The preamplifier of the C-451E requires 7.5v operating voltage, which is supplied via Phantom circuit. It permits central feeding via a two-conductor plus shield cable and *eliminates* the use of *power supplies.*

Of course, we also have AC and DC power supplies to operate the C-451E. Most important of all, it permits *interchanging* of *pick-up* capsules to CK-2 omni-directional, CK-6 variable pattern, and CK-9 shot gun (interference tube) attachment. AKG-39

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AM PROOF OF PERFORMANCE

Part 2 of a 3-part Series

By Patrick Finnegan / Muncie, Indiana

After World War II, many new AM stations went on the air and many older stations rebuilt their facilities. The new FM Band opened up, and the majority of construction permits for FM Stations were obtained by the AM Stations. The newer studio audio equipment was superior to the previous offerings, so the AM stations used the AM studio equipment to program the FM stations. For the most part, this was simply simultaneous programming of the AM and FM transmitters. It was only a logical step from the FM Proof requirement to the AM Proof requirement. Thus, the AM Proof came into being, but with less strict tolerances than for FM.

Need For Proofs

Throughout the year, station engineers make many partial Proofs, either on a regular basis or during periods of technical problems. Normally, after replacement of transmitter modulator or PA tubes, the engineer will make a few spot checks for response, distortion and noise, just to make certain the new tubes are performing correctly. The same type spot checks may be done after major component replacements in the console or other amplifiers in the program chain. The required Proof, however, covers the entire system at the same time. It is nothing more than putting the system through its paces under controlled conditions and measuring the results electronically to see if the system at least meets the minimum requirements.

FCC Rules

The AM Proof requirements will be found in the FCC Rules, Parts 73.40 and 73.47. Besides the change of term "annual" to "calendar year" and the maximum of 14 months between Proofs, there is one other change that is an important time-saver. Those stations which operate on more than one power are now required to make the Proof only at the highest power of operation that their license calls for. The

experimental period is from 12:00 midnight local time to local sunrise.

Preliminary Tests

Making spot checks throughout the system is a good practice before trying the full run of measurements. These preliminary checks can be stretched out over several days if needed and especially if problems are indicated. A daytime only station has the advantage of the time from sign-off to midnight to make these tests. The engineer can run the transmitter on a dummy load and check it out, but the Proof, must be done on the antenna.

PA Efficiency And Carrier Shift

These are normally observed during the required daily transmitter inspection, along with other meter readings. Poor efficiency and carrier shift are usually an indication of the PA tubes or power supply rectifiers going bad, either of which can cause high distortion and noise readings.

Modulator Tubes

Bias and balance adjustments will affect both the required audio input level to the transmitter as well as higher distortion measurements. Trouble may occur here if the modulator tubes are not balanced. Generally, the modulator tubes should be as nearly balanced in both age and performance as possible so that bias and other balancing adjustments will not need to be strained to obtain good output and performance. The original manufacturer's checkout sheet should indicate what the audio input to the transmitter should be. Any great deviation from these figures will indicate problems or maladjustment in the modulator section.

Telephone Lines

Transmitters separated any distance from the studios ordinarily lease telephone company lines as the connecting link. Since maintenance on these circuits is outside the control of the station engineer,

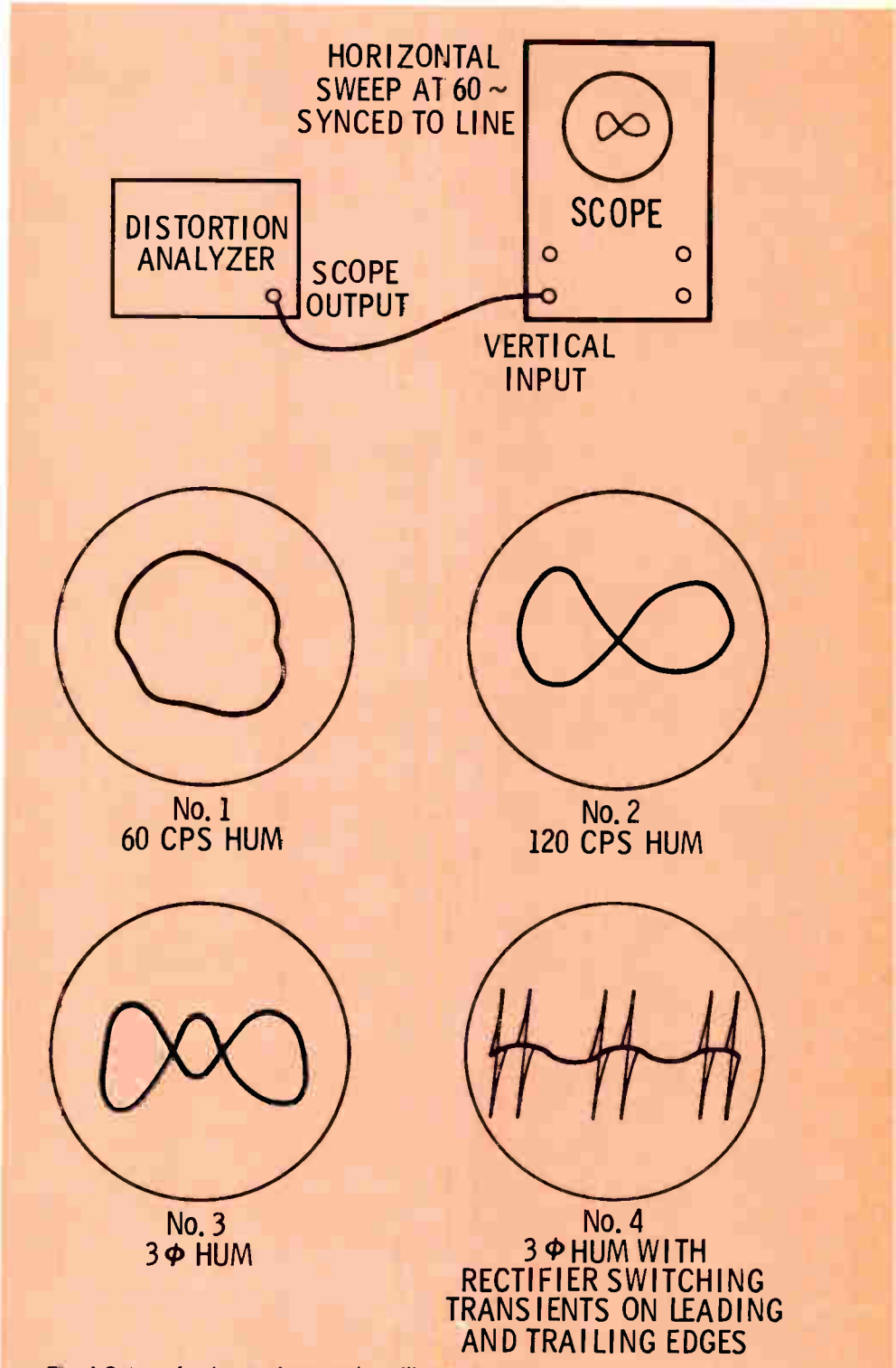

Fig. 1 Setup of noise analyzer and oscilloscope.

(1a) 60 Hz hum.
(1b) 120 Hz hum.
(1c) 30 Hz hum.
(1d) 30 Hz hum with rectifier switching transients on leading and trailing edges.

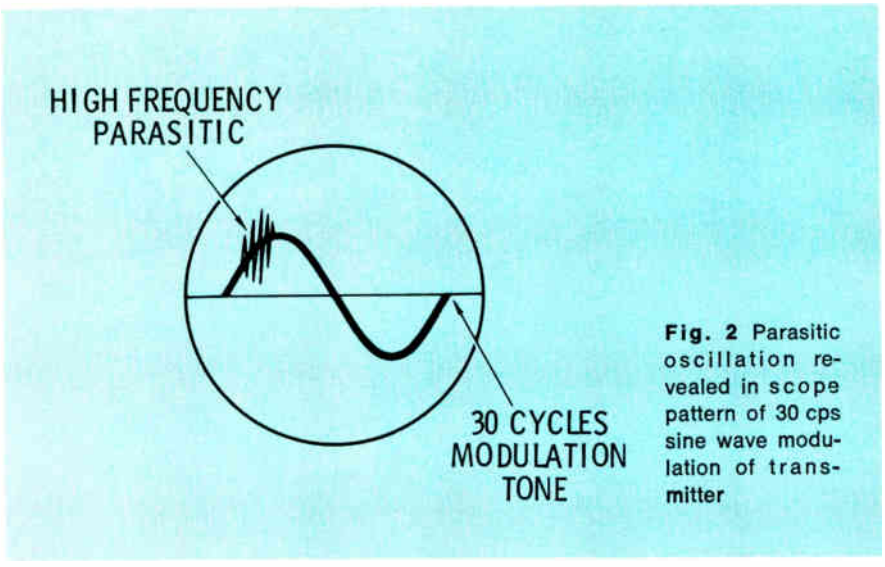

Fig. 2 Parasitic oscillation revealed in scope pattern of 30 cps sine wave modulation of transmitter

they should be checked out first. Trouble here can cause the engineer to waste time, and then he will have to wait until Telco engineers clear up line problems before he can continue with the Proof.

Noise Level

A spot check of noise is important. A high noise level will cause the distortion measurements to indicate high. This is caused by the general type of distortion analyzer in use today. The analyzer nulls out the fundamental of the audio frequency being measured and then reads whatever is left over as distortion. This reading can include distortion elements, high frequency noise and plain hum.

An oscilloscope, attached to view what the meter is actually reading, will quickly help identify whether the meter is reading distortion or if noise is the problem. A good noise figure on the spot check will assure that noise is not a significant part of the distortion readings. Much time could be wasted looking for distortion problems when it is really a noise problem.

To set up the oscilloscope for use, feed the vertical amplifiers from the Fig. 1 distortion analyzer output. (These usually have a scope feed on them). Set the horizontal sweep to 60 cycle power line and set the trigger to power line. 60 cycle hum will then give a single oval if phased correctly. This may be caused by a cathode to filament short, pickup from transformer windings, open shields. A figure of 8 or double loop pattern will be from 120 cycle source, generally from a full wave single phase power supply.

Look for rectifiers or poor filters in the power supply, although it can come from poor bypassing of the DC buses within the chassis. Three loops will be from a 3 phase power supply, usually the high voltage supply in the transmitter. You can be deceived when the power supplies are solid-state rectifiers. These usually generate sharp spikes on the leading and trailing edge, and may be all that shows up on the oscilloscope pattern. In such a case, the number will be doubled.

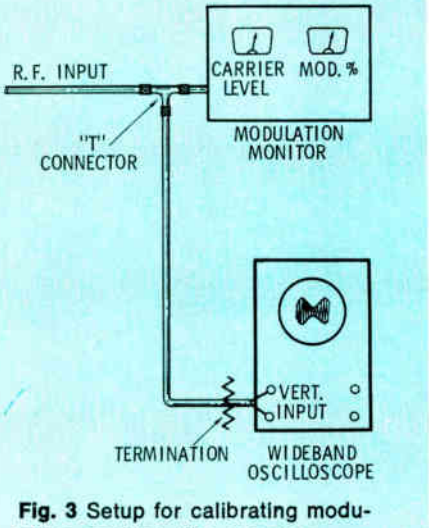

Fig. 3 Setup for calibrating modulation monitor with a scope.

Parasitics

One of the required response readings for the Proof is to be made at 30 cps. Be careful here especially wtih high power transmitters. Quite often high levels of sustained low frequency modulation can trigger off parasitic oscillation. If this is allowed to continue for any length of time, severe damage can be caused to the components in the modulator section. The author has heard one theory advanced for this condition: defective iron in the cores of the modulation transformer. A parasitic can be seen on an oscilloscope and can be heard in the monitor as a high-pitched squeal.

Required Equipment

- Audio signal generator, one of good quality with low inherent noise and distortion.
- Noise and distortion analyzer of good quality.
- Transmission measuring set, unless it is a part of the audio generator.
- Wide band oscilloscope, although not an essential instrument, the most effective method of calibrating the modulation monitor and identifying noise.
- A good communications receiver for checking harmonic radiation. It should have very good shielding, manual gain control of the RF stages, switchable AVC, and include the broadcast band. During other times, the receiver can prove useful, for example, checking the time accurately with WWV (National Bureau of Standards Stations). If the station also operates an FM station, the receiver can check the modulation monitor.

Required Measurements

- System audio response at 30 cps, 50, 100, 400, ikc, 5kc, 7.5kc. (ikc reference). Set of measurements to be made at 100%, 85%, 50%, 25% modulation. Limits: + or — 2 db from 100 cps to 5kc.
- Distortion measurements at 50, 100, 400, ikc, 5kc, 7.5kc. A Set of measurements to be made at 100%, 85%, 50%, 25% modulation. Limits: 5% from 85% modulation and lower. 7.5% above 85% modulation.
- Carrier shift to be measured at 100%, 85%, 50% 25% modulation, using 400cps. Limit: 5%.

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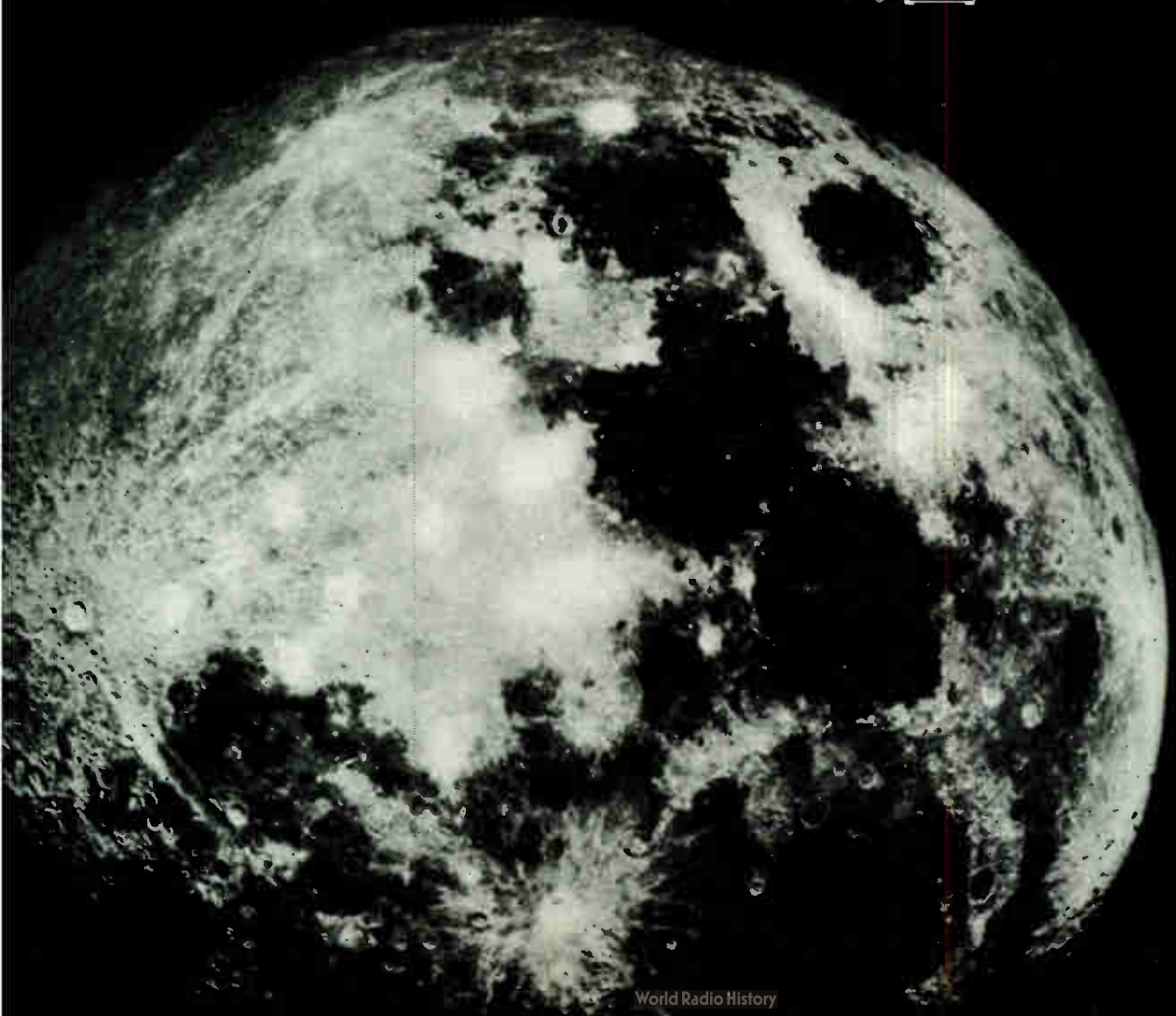

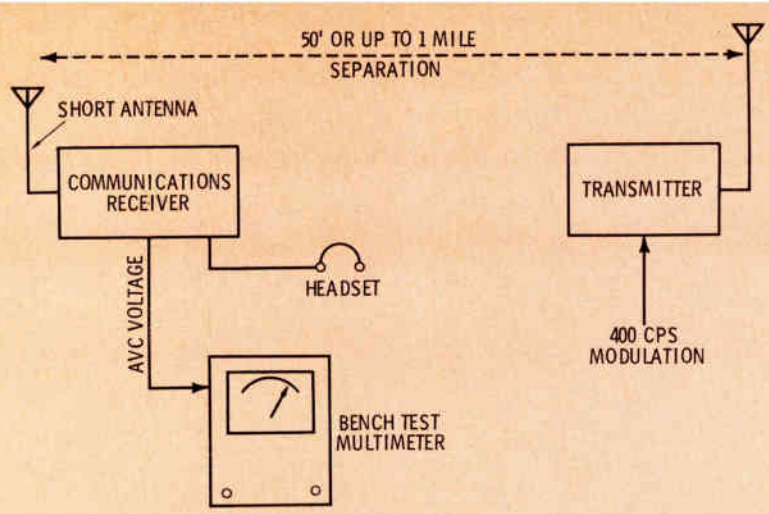

FIG. 4A

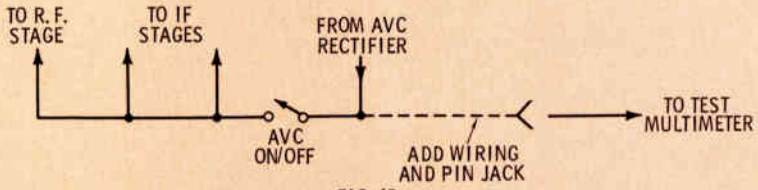

FIG. 4B

Fig. 4a Communications receiver can be used to check harmonics.
Fig. 4b Circuit in receiver to pick up the AVC bus.

- Spurious radiations and bandwidth; Limits: emissions 15kc and 30kc away from carrier must be down 25db below unmodulated carrier level.
- Emission between 30kc and 75kc away from carrier must be down 35db below unmodulated carrier.
- Emission above 75kc from carrier must be down at least 43 $+10\log_{10}$ (power in watts) below unmodulated carrier.

Making Measurements

The modulation monitor should be checked first for correct calibration. Monitors sometimes have a tendency to drift off calibration. Most present-day transmitters are capable of 100% modulation, but unless the monitor is reading correctly, the actual modulation percentage may be something else. The modulation meter should be flat over the audio band or the readings will be erroneous. An oscilloscope is the only accurate method for calibration and check at the 100% readings. The oscilloscope should be connected to the RF and left on the circuit all the way through the measurements. Make it the final authority, especially at 100% modulation.

Notice that the FCC Rules allow for the discrepancies that can occur at 100% modulations by adding the words **if obtainable.** Any transmitter, however, should be able to hit 95% modulation without any difficulty.

High levels of modulation, especially at the higher modulating frequencies, are developing some high sustained voltages in the modulator and modulated PA stages. The high power transmitters must especially take care as the voltages consist of several thousand volts. Ball gaps on transformers must be clean and properly set for protection to these units.

The modulator and PA tubes should be carefully observed. Under sustained tone modulation, plate currents can run quite high and plates will overheat. Tubes by different manufacturers, even though the same type number and specs, can react differently under these conditions.

Be on a sharp lookout for parasitics at tones below 50cps modulation as discussed earlier. If you have left the oscilloscope hooked up to the RF as for monitor calibration, you can see the oscillation get ready to break. A safe method when making the 85% to 100% measurements would be to leave the tone on the carrier only long enough to make the measurement and then take it off. Give the transmitter tubes and components a breathing spell between tones so they can cool down and recover.

Response and Distortion

These measurements are straightforward, observing the cautions just mentioned. Make certain the audio generator or gain measuring set driving impedance matches the preamplifier impedance. Correct impedance matching and correct terminations throughout the system is a cardinal rule. Input levels to the preamplifier should be about -50 to -55db, the normal operating range of the preamplifier. Too high an input level can overload the preamplifier and cause response and distortion measurements to be erroneous. If the input level is too low, then trouble may be experienced with noise measurements. Limiting and AGC action should be disabled in these amplifiers.

Carrier Shift

Modulation monitors are ordinarily equipped with a carrier level meter which is calibrated in percent. This meter should be adjusted to 100% carrier without modulation, and then carrier shift read directly from this meter in percent, as modulation is applied at 400 cps. While a probable cause of poor carrier shift figure can be either the power supply or PA tubes, it can also be caused by mistuning of the PA stage and IPA stage for enough drive, or overmodulating the transmitter (above 100%). Thus the importance of correct calibration.

Band Measurements

A good, well-shielded communications receiver will give generally accurate enough results for these measurements. Should any dispute arise though, the FCC could require that actual field strength measurements be made. Ordinarily, the station does not own such equipment and the consulting engineer would have to be called in to take the measurements with his equipment.

A few precautions taken will eliminate these radiations. First, check on the transmitter specifications for harmonic radiation, especially if you

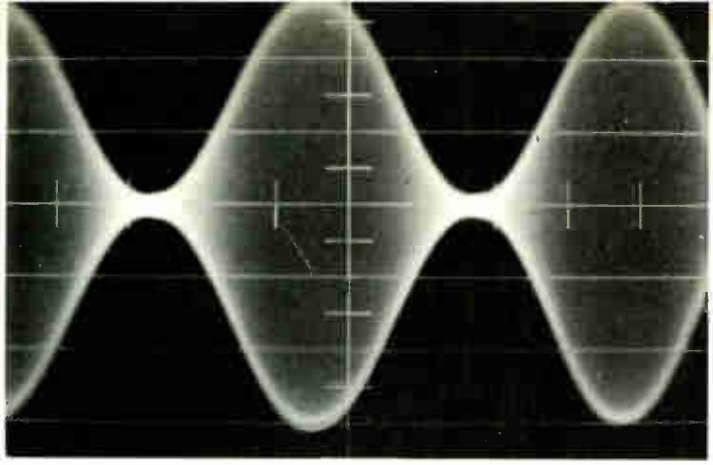

Fig. 5 Using the oscilloscope to check for 100 percent modulation.

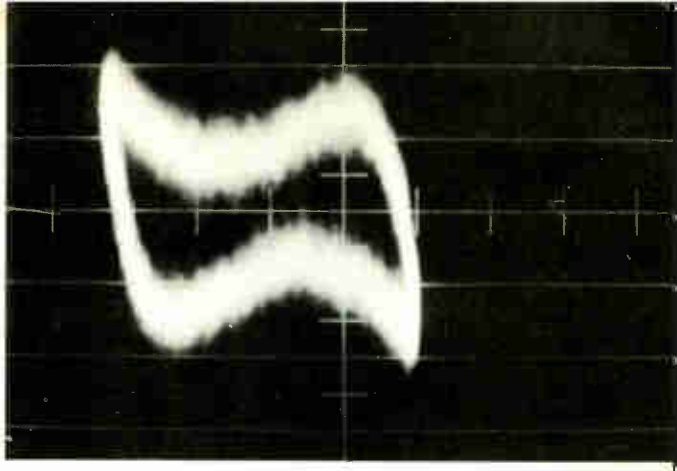

Fig. 6 Using the oscilloscope output of the noise distortion analyzer to help identify noise components. Here scope shows 120 cps hum and fine grain shot noise.

are getting a new transmitter. While some transmitters incorporate the necessary traps within the transmitter itself, others require that external traps be installed. Even so, a transmitter that incorporates internal traps may be inadvertently misadjusted while matching the output to the line or when components have been replaced. After any such changes, a check of radiations should be made.

When making the measurements, it may be necessary to move away from the transmitter some distance —even a mile or so. It all depends upon the receiver and how well it can handle the RF signal without overload. Overloading the receiver can cause spurious readings within the receiver itself which are not true readings. A very well-shielded receiver can usually operate in the transmitter room or nearby with the antenna terminal on the receiver as the only pickup.

The "S" meter can be used for the measurements, but a more accurate method would be to use an external meter measuring the AVC voltage inside the receiver. To make the hookup for this, the AVC bus is brought out to a terminal or pin jack on the chassis. This measuring point must be ahead of the AVC switch. The AVC voltage is switched off and the RF and IF stages of the receiver adjusted with the manual gain control. AVC control of these stages would make any reading observed meaningless.

Identity of the signal or harmonics is important as there will be all sorts of beat signals picked up while tuning across the shortwave bands. Low frequency tone modulation of 200 to 400 cps will help identify the signal on headsets. If using modulation, leave the BFO turned off on the receiver so there will be fewer beat notes. When a reading is observed or heard in the earphones, either turn the carrier on and off or take the modulation on and off. This will quickly help identify the signal.

Technique

Tune in the main carrier, and adjust the receiver manual gain controls (AVC switched to Off), taking care to prevent overloads. Set the scale on the multimeter to read about 40 volts or more on the AVC bus. This gives the zero db reference voltage. Do not adjust the receiver gain control setting after this or the reference will be destroyed.

Now tune the receiver throughout the various bands carefully, including the broadcast band. Tune slowly in the upper shortwave bands as the tuning is sharp. Any reading that is observed and identified should be measured on the multimeter, adjusting the meter scale for the reading. When tuning the upper bands, be on the watch for harmonic multiples of the carrier frequency. Any readings in between would be spurious frequencies caused by parasitics etc., while the others would be harmonics.

The limits for harmonic radiations may look a little confusing and need some computation. The Rules read: 43 + 10 $\log_{10}$ (power in watts) below the level of the unmodulated carrier or 80 db, whichever is the lesser attenuation. Thus, it is necessary to compute the value for the power of transmitter that is in question. The logarithm to base 10 for the different power broadcast transmitters are: 250 watts=2.398, 1 kw=3.0, 5 kw=3.699, 10 kw = 4.699. For example, the requirement for a 1kw station would be computed as follows: 43 + (10 x 3) = –73db; while a 10 kw station would be: 43 + (10 x 4) = – 83 db. However, the requirement in this case would be – 80db and not – 83db, as the Rules state "that which is less."

To measure with the external meter, as described earlier, tune in the carrier and set the meter to read 40 volts or higher on the AVC bus. This will then become the reference voltage. As high a voltage as possible here without overloading the receiver will be helpful, depending upon the low meter scales of the multimeter in use. The 1kw station has a requirement of – 73db, which means that if the reference voltage is 40 volts, any harmonics must be less than 0.009 volts. To compute the limit on the harmonic voltage as per the AVC bus), use the formula db = 20 $\log_{10}$ $\frac{E_1}{E_2}$ • Example:

$$-73\text{db} = 20 \log_{10} \frac{40}{E_2}$$

$$\frac{73}{20} = 3.65 \quad \text{antilog } 3.65 = 4470$$

$$\text{then: } \frac{40}{4470} = 0.009\text{v}$$

Packaging

The whole Proof should be bound

together after assembling in some logical manner. As a suggested method use a sheet showing a block diagram with audio levels at various points; show the test equipment setup and identify the various items of equipment in the diagram. The response measurements at the four different modulation percentages may be plotted separately on one sheet of paper—the distortion measurements for the four modulation percentages on one sheet, etc.

For special setups, such as the out-of-band measurements, draw a block diagram showing the setup and method. The engineer may either sign and date each sheet or a title page at the front of the bound Proof. As a final touch, buy an inexpensive binder and make a neat package.

The Rules not only require that a Proof be made each calendar year, but the Proof results must be filed at the transmitter and kept for at least two years. The author would recommend that they be kept longer, not for FCC purposes but for the record of past performance on the equipment. These can prove helpful later, especially on the first Proof made on a new transmitter installation.

There have been an increasing number of fines to stations for either failing to make a Proof, not having it available for the radio inspector when he makes the station inspection, or not keeping the Proof for the required minimum of two years. These fines have been running about $200.00. The smaller stations, particularly those who have a first class license engineer on a contract basis only, should make certain that the Proof is filed at the transmitter. For his own records the engineer could make a copy of it, but there must be a copy available for the radio inspector.

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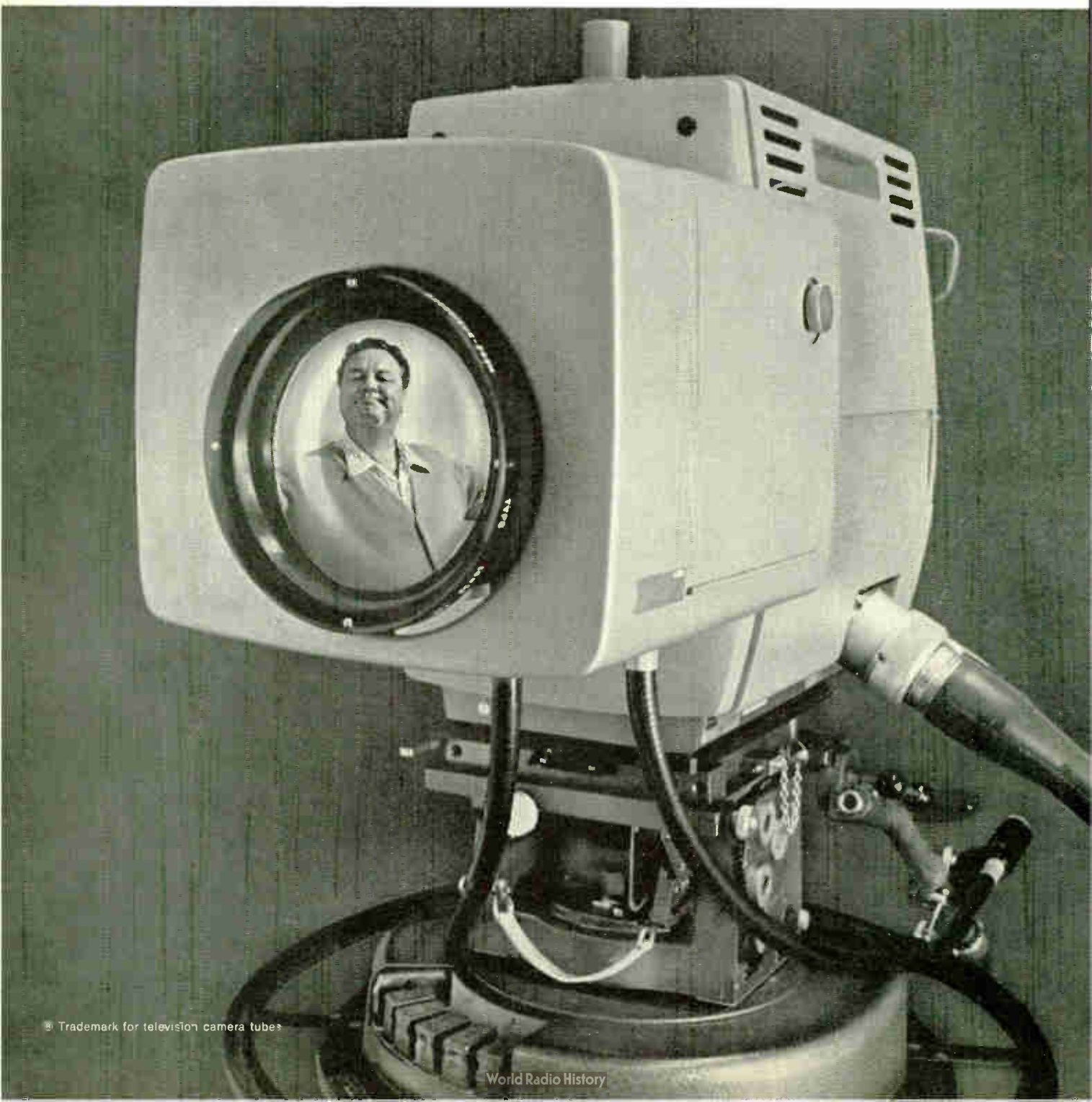

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A wide range light level control

By Walter G. Jung*

The use of vidicon pickup tubes in television under widely varying conditions of incident illumination has been characterized by the incorporation of what is popularly known as "automatic light level control." In practice this amounts to nothing more than a quasi-constant current source to average the vidicon target voltage (See Block 1).

A quasi-constant current source, through a 100-1000 megohm resistor, develops a target voltage inversely proportional to scene illumination. Bright scenes develop a large voltage drop due to high signal current, thus lowering the target voltage and decreasing sensitivity. Dim scenes develop a small voltage drop and raise the target voltage, thereby increasing sensitivity. The net effect is a tendency toward a constant average video signal level; typically, 400 to 1 light variations are reduced to 4 to 1 video level changes.

*MTI, Maryland

For a simple system this works quite well. However, like most simple systems it has its drawbacks. Examination of these drawbacks and the desire to improve the system led to the MTI Automatic Target Control.

The very nature of operation which makes the simple resistor scheme work, defeats it for critical use, involving widely varying contrast levels in the same scene. The scene in Figure 1 consists of a large, bright white object filling a major portion of the area (Item A), and a smaller, darker, more detailed object (Item B). This object might also have a very low contrast ratio, i.e., small variance between its light and dark areas.

With an appreciation of the scene-averaging characteristic of quasi-constant current system, it is easy to predict what will happen when the camera focuses on this scene. The large white object will constitute the major portion of the signal output, and the small, low contrast object will be suppressed by the averaging effect of the target resistor.

While this case may seem extreme, it is a practical problem. A similar condition typically arises in TV x-ray applications. The logical solution is quite simple, but gives rise to another set of problems. If the vidicon target is not allowed to average, the sensitivity can be adjusted manually to suit any discrete illumination level within a particular scene.

Using this method, object B of Figure 1 can easily be displayed by bringing up the system sensitivity to a suitable level and observing the desired information. Since item A

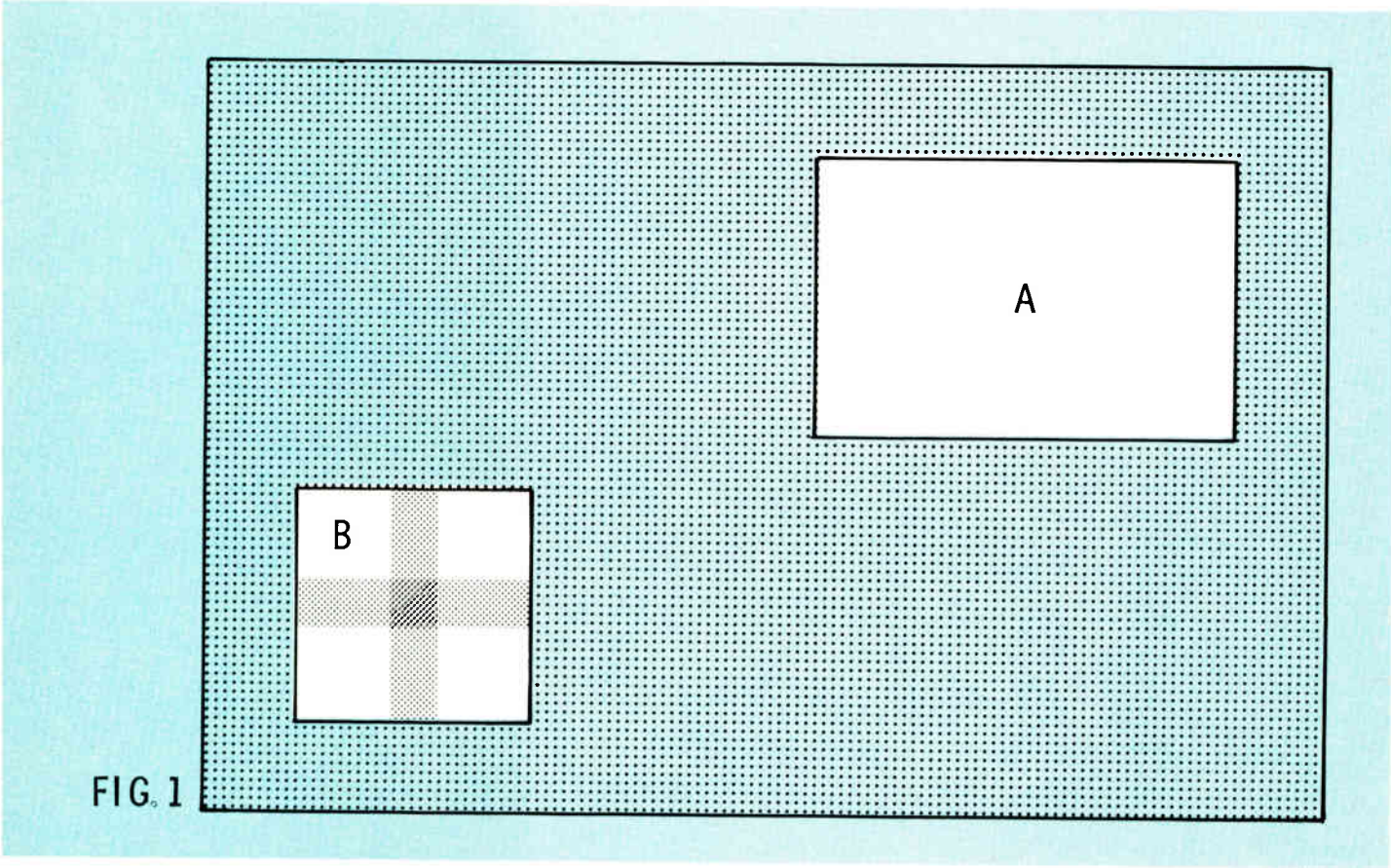


FIG. 1

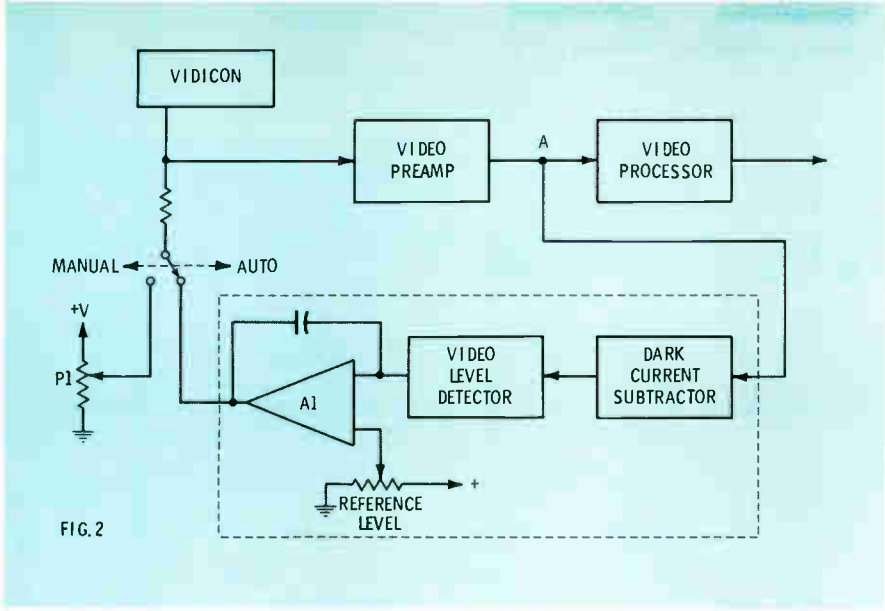


FIG. 2

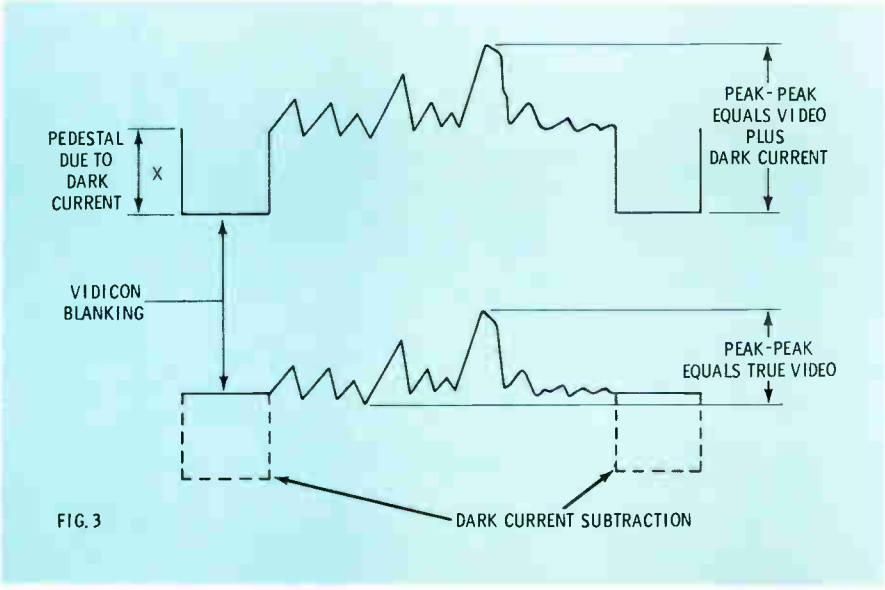


FIG. 3

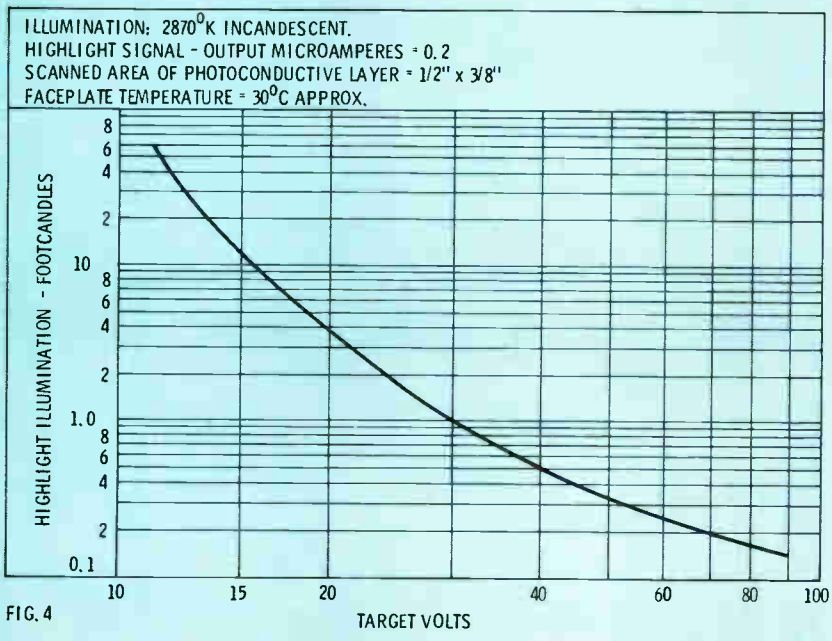


FIG. 4

is much brighter, its details will be lost, but this is of small consequence.

This, then, is a second system of very definite, but manually adjustable dynamic range. The two systems would seem to complement one another very well, and the combination would be desirable for a highly flexible, critical use camera system. The problem remains how to combine the two systems into a single system with both modes of operation accessible at will.

The initial approach might be to insert or remove the averaging resistor as required with a switch. This, however, becomes difficult when microvolt video levels are to be dealt with and the switch is on the far end of a remote camera cable. A desirable solution would be to provide the same function with a single electronic servo system. The modest performance of the simple resistor system could easily be improved upon in terms of dynamic range and systems response characteristics tailored at will.

Since the object of the electronic servo systems is to maintain a constant video level, a basic description of how this is accomplished is in order.

The average video level is compared to a preset reference level and a DC error voltage generated. This error voltage, after amplification, is fed back to the vidicon target as a control of sensitivity. The sensitivity control of the target automatically maintains the video signal at the preset level. The system is diagrammed in Figure 2. The automatic mode of operation encompasses that portion of the circuitry depicted within the dotted line. The sample of the video to be regulated is tapped from the input to the processing amplifier at point A, and fed to the input of the automatic target module.

Immediately within this module, we see a function labelled "dark current subtractor."[1] This is necessitated by a peculiarity of vidicons depicted in Figure 3. The desired video signal is that portion riding on the pedestal of height X. This pedestal, caused by the vidicon's residual conduction in the absence of light, must be removed and the true video signal extracted so it can be measured. If the dark current and video were

measured, a significant error due to dark current would be introduced.

Next the pure video is extracted and measured. A voltage proportional to the average video level is generated. This voltage is compared to a reference level (representing the desired level) and the resulting error signal amplified by a factor A. At the same time the signal is integrated and its response time controlled.

The output of the module is fed to the operator's mode switch. The operator can select either manual or automatic mode of operation. If he selects manual, he has direct control of target sensitivity by control P_1. In automatic, the automatic target module output is fed to the vidicon to close the feedback loop as described above.

Specifically, the system offers several factors worthy of consideration. The manual system is, of course, adjustable over the full range of the camera's capability. The automatic mode far exceeds the simple resistor system in performance. Average video level is specified as constant over a 4000/1 light range.

Typically, the system will hold within about 6 db over a 20,000/1 light range. Response time is well damped; a 4000/1 change in light will not result in any picture loss. Correction is smooth and automatic. Operator attendance in the automatic mode is virtually nil, as excellent performance is usually obtained by opening the lens to maximum "f" stop, and fully advancing the beam control. Panning across wide contrast scenes will not result in picture loss due to light level changes.

The underlying principle of an automatic target light level control is illustrated in accompanying Figure 4.

For a constant signal current output, the target voltage required for various values of faceplate illumination follows the approximately logarithmic curve, which is typical of vidicons. To maintain a constant video output level, the target control must be able to traverse the full gamut of this curve as light level falling on the Vidicon varies.

The MTI VC-20 camera series video level changes, and amplifies minute variations to a full 0 to +100 volt swing, sufficient to fully control the vidicon. Since the DC open loop gain of the system is high ($\sim = 15{,}000$), the 100 volt target excursion can be fully excited by

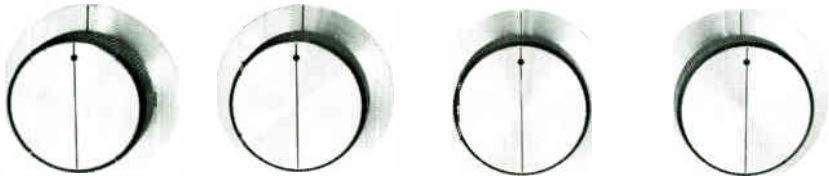
$$\frac{1}{15{,}000} \text{ of this or } 1.5 \times 10^{4} = 6.7 \times 10^{-3}, \approx 6.7\text{mv}.$$

The result is that very wide light variations are reduced to small variations in video level, generally small enough to be considered insignificant.

Summary:

Two types of vidicon target voltage control have been examined, and their important characteristics weighed. A system which combines desirable features of an automatic and manually controlled system described and its distinct advantages shown.

[1]Walter G. Jung, "Gated Amplifier Uses FET in Feedback Loop" **Electronic Design** January 4, 1968.



up to 4 subcarrier channels —including video— in STL's or intracity relays

One subcarrier channel for TV audio, two for FM stereo audio, and one for AM audio or SCA. With Collins microwave systems, that's what you get with color or black-and-white video in studio-transmitter links and intracity relay.

In the 6.8- to 7.1-GHz band, Collins offers this capability in the high performance 1-watt remodulating MW-408D for short systems, and the 5-watt IF heterodyne MW-409E for medium to long systems.

Both systems are completely solid state except for the 408D's transmitter klystron, and the 409E's traveling wavetube. Both meet NTSC color video transmission requirements. Both are available in non-standby or hot-standby space diversity configurations. And the quality of both is the same as Collins' broadcast quality.

Customer services are the same too: field survey, frequency planning, installation or installation assistance, financing, and training.

For details, contact your Collins sales engineer or Microwave Marketing Division, Collins Radio Company, Dallas, Texas 75207.

COLLINS

COMMUNICATION / COMPUTATION / CONTROL

FCC Briefs State Association Presidents on New Policies

Three staff members from the Federal Communications Commission told state broadcaster association presidents that some new policies are forthcoming soon on new station applications, license renewals and anti-smoking announcements.

During a panel discussion at the State Association presidents' 14th annual conference sponsored by the National Association of Broadcasters, those in attendance were told:

(1) The FCC hopes to have effective in August a new rule requiring applicants competing for a license up for renewal to file at least 15 days before the expiration date of the license. Since renewal applications must be filed 90 days in advance, this would give competing applicants 75 days in which to submit their own proposals.

(2) The Commission expects to issue soon—late this month or early next—rules that will make it more difficult to obtain a license for a full-time AM station. Stations now must show that 25 percent of their service would be in a "white area" with no AM service. Under the new proposal, AM and FM stations would be treated as an "aural service," and an applicant would have to show that neither AM nor FM service was provided in the 252 percent "white area."

The FCC will issue a new announcement soon spelling out the responsibility of broadcasters who air cigarette commercials to carry anti-smoking announcements. They now are required to devote "a reasonable amount of time" to such announcements and it is up to them as to the time they are aired.

The panel discussion, moderated by John B. Summers, NAB's assistant general counsel, featured William Ray, FCC's chief of complaints and compliance; Robert Rawson, chief of renewals and transfers, and Wallace Johnson, assistant chief of the FCC Broadcast Bureau.

NAB president Vincent T. Wasilewski, Paul B. Comstock, vice-president for government affairs, and Douglas A. Anello, general counsel, briefed the broadcasters on other pressing issues from cigarette advertising to the FCC's proposed one-to-a-market rule.

Wasilewski said the issues are of utmost importance and the manner in which they are resolved will affect the whole future of broadcasting. Meanwhile, Comstock stressed the need for grass roots support from broadcasters in personal contacts with their legislators in Washington. He described "government censorship" as perhaps the most important problem in Congress, a problem that "comes at us in a very oblique fashion."

Anello told the broadcasters the FCC expects them to make a "diligent effort" to employ Negroes and others from minority groups. He said the broadcaster must bend over backward, even hiring a less likely prospect if given a choice and, in effect, "discriminate in reverse."

The NAB counsel said CATV systems should remain a supplement to and not a substitute for commercial broadcasting. He dismissed arguments that CATV and broadcasters are "competitors," saying CATV is a "parasitic type of operation" that could not exist except for the broadcast signals it takes off the air.

Mrs. Marianne Campbell of AVCO Broadcasting Co., Cincinnati, president of the Association for Professional Broadcasting Education, told the delegates that 150 colleges and universities now offer broadcasting courses to prepare students to handle "the real nitty-gritty of a broadcasting job."

Clint Formby, KPAN, Hereford, Tex., a member of the conference program committee, and president of the Texas Association of Broadcasters, presided during the session.

In his address to conference delegates, FCC chairman Rosel H. Hyde made the statement that a broadcaster who operates his station in the public interest with "integrity and intellectual honesty" should be free to do so without any dictation from a government agency.

Hyde reviewed for the conference many of the controversial issues under discussion at the meeting and pending before Congress and the Commission.

Discussing the so-called one-to-a-market rule, Hyde said it was proposed to promote "diversity" and discourage a "concentration of interests" in the ownership of radio and TV stations.

In his personal opinion, he said, no industry can match broadcasting for its "broad diversity of interest." He added that he has seen nothing to date to substantiate claims by some of his fellow commissioners that there has been a "revolutionary change in ownership."

Turning to license renewals every three years and the problem posed by competing applications at renewal time, Hyde said the Commission cannot renew licenses automatically and has a responsibility to consider those filed in opposition. But he added that much can be said for maintaining "a going operation" and there must be a "very compelling reason" for the Commission to cancel a license and authorize its use by another.

He said the Commission soon will issue proposed new rules to shorten the period in which competing applications may be filed. As for proposed legislation to require renewals unless the FCC determines after a hearing that it would not be in the public interest, Hyde felt that a longer license—for a five-year term—would be a better approach.

August '70 Date Set For High-Speed Photo Meet At Denver Hilton

The 9th International Congress on High-Speed Photography will be held August 2-7, 1970, at the Denver Hilton Hotel, Denver, under the auspices of the Society of Motion Picture and Television Engineers. In addition to the Papers Program, an Equipment Exhibit featuring over 60 displays will be held through the week.

SMPTE Conference vice-president E. B. McGreal, Producers Service Corp., Los Angeles, 9th Congress chairman Carlos H. Elmer, engineering consultant, Scottsdale, AR, and local arrangements chairman John I. Newell, Western Cine Service, Denver, have had several planning sessions regarding the program and local arrangements.

New NCTA Center for Penn State

Recognizing that an organized educational effort is vital to meeting the future demands for trained personnel in the cable television industry, the National Cable Television Association recently provided funds for the establishment of a National Cable Television Center for Education and Training.

The new Center program will be administered as a Pennsylvania State University Continuing Education service under the direction of Harry V. Weaverling. An advisory council comprised of six representatives of the cable television industry and six representatives of Penn State's faculty and continuing education staff will guide the work of the Center in developing the types of training programs needed by the industry.

Serving on the council as industry representatives will be: Frederick W. Ford, president of the National Cable Television Association; F. Gordon Fuqua, executive vice-president, Television Communications Corporation; Amos B. Hostetter, Jr., vice-president, Continental Cablevision of Ohio, Inc.; James R. Palmer, president, C-Cor Electronics, Inc.; Douglas Talbott, general manager, Cox Cable Communications Corporation; and Roger Wilson, chief engineer, TelePrompTer Corporation.

Penn State council members include: Dr. Rocco Carzo, head of the Department of Management, College of Business Administration; Floyd B. Fischer, director of Continuing Education; Dr. LeRoy Marlow, associate professor of management training and head of Planning Studies in Continuing Education; Frank B. Moore, associate professor of electrical engineering; Dr. Carl Volz, professor of electrical engineering; and Harry V. Weaverling.

Through short courses, seminars, correspondence study, and workshops, the Center will provide continuing education in all phases of the cable television industry from basic electronics to advanced engineering and management. The various programs will be designed for installers, maintenance technicians, engineering technicians, construction personnel, professional engineers, and systems managers.

Two correspondence courses, CATV I and CATV II, are already available through Penn State's Correspondence Study Division of Continuing Education. Other study programs in such areas as cable casting, sales, promotion, and marketing are being developed by the University's Colleges of Engineering and Business Administration.

The University's Planning Studies division has also been designated by the advisory council to make a questionnaire-study of the self-perceived educational needs of personnel working in the more than 700 cable companies throughout the U.S.

The educational services of the new Center are to be extended on a nationwide basis. In addition to study programs, the Center will also provide an information service, gathering, editing, and disseminating technical information; and teacher-training for supervisors responsible for in-plant training programs.

Inquiries regarding the National Cable Television Center for Education and Training may be addressed to Harry V. Weaverling, Director, NCATV Center for Education and Training, J. Orvis Keller Building, The Pennsylvania State University, University Park, Pa. 16802.

Want More Coverage?

Send your news to:

The Editor
Broadcast Engineering
1014 Wyandotte
Kansas City, Mo. 64105

SRI Submits Recent Land Mobile Report

The interim land mobile report, "Study of Land Mobile Spectrum Utilization," by the Stanford Research Institute (SRI) has been submitted to the Federal Communications Commission and is now available for public inspection in the Commission's Reference Room. The Commission has announced that press copies may be examined in the Office of Information, and are also on public sale at the U. S. Department of Commerce.

The interim report is based upon SRI's preliminary evaluation of data obtained so far in an investigation of the possibilities of increase inter-service sharing of frequencies among the land mobile services and improved methods for assigning and using land mobile frequencies. The Commission awarded a one year study contract to SRI in June 1968. When the study is completed, final reports based on more complete data and further analysis, will be submitted.

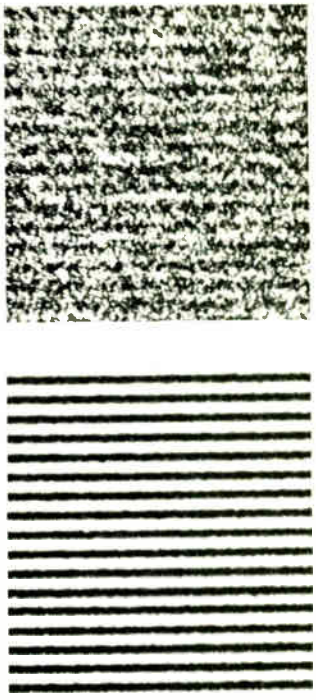
The report will be in two parts and will be sold for $3 per part. Microfiche copies of the report will also be available for $.65 per part. Part A is entitled "Requisition, Processing, and Analysis of Spectrum Occupancy Data." Part B is entitled "An Analysis of the Spectrum Management Problem." Orders may be placed with the U. S. Department of Commerce, National Bureau of Standards, Clearing House for Federal Scientific and Technical Information, Springfield, Virginia 22151. The following accession numbers have been assigned to the report and should be included when ordering the report: Part A—PB 182-792; Part B—PB 182-918.

Broadcasting Agreement Signed

On December 11, 1968, at Mexico City, officials of the respective countries signed an Agreement Between the United States of America and the United Mexican States Concerning Radio Broadcasting in the Standard Broadcasting Band (535-1605 kHz) and an agreement concerning "pre-sunrise" and "post-sunset" operation.

Both agreements have been brought before the United States Senate.

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 pictures 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, face-plate 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

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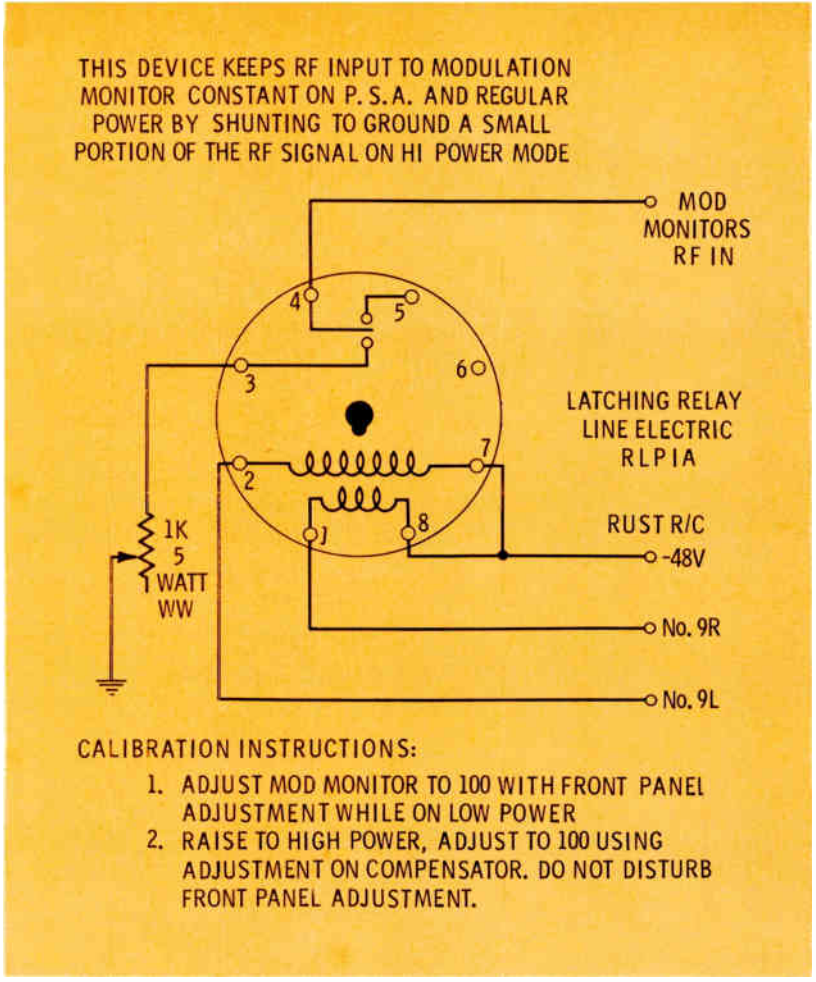


Compensator mounted inside equipment rack behind modulation monitor.

PSA Audio Compensator

By Dick Fletcher*

When the Pre-Sunrise Authority (PSA) was instituted by the Federal Communications Commission in 1967, hundreds of daytime AM stations in the United States were required to make modifications to their transmitting facilities if they planned to continue signing on before sunrise. Under the old rules, sign-on can be no earlier than 6 A.M. local time, and with no more than .5 Kw.

In many cases, after modifications were made to the transmitter and remote control systems (if used), a problem still existed with the modulation monitor. If adjusted to low power, it read high on normal daytime power, if adjusted to normal power, it read low during the pre-sunrise operation.

On commercial dual-power transmitters, this problem is solved by utilizing a latching relay and two pickup coils in the transmitter. Thus, taps can be made to pick up an equal amount of R.F. in either mode.

At KNIT, with an older model single power transmitter, we approached the situation from what we feel is a much simpler angle, and developed the circuit pictured here.

The components were assembled in a small mini-box and mounted inside the equipment rack behind the modulation monitor. Connection is made to the R.F. input of the modulation monitor with a short length of coaxial cable.

The modulation monitor is adjusted to 100 with the transmitter operating on the lower power. The compensator is automatically switched by the remote control and is out of the circuit on PSA power.

When the transmitter is placed in normal daytime operation, the control on the compensator is rotated to adjust for 100 on the carrier level meter—shunting the excess R.F. to ground. Once this control is set, no further adjustments are necessary under normal conditions.

Different values on R-1 might be required in certain circumstances. The circuit pictured is utilized in our operation where normal daytime power is 500 watts and PSA power is 322 watts. Other stations may have a wider variation since some PSA's have been granted for as few as five watts.

This device, which we call a "compensator," has served well for several months now, is inexpensive to build and has saved daily adjustments of the modulation monitor.

*KNIT, Abilene, Texas

Moon To Make Live Color Debut During Apollo Flight

The system which beamed the world's first successful color television broadcast 28 years ago from New York City will be used by Apollo astronauts to relay man's first color telecast from the moon's surface to a global television audience.

The tiny field sequential camera will transmit color images of the lunar environment to earth more than 238,000 miles away. It uses a spinning 3.5-inch disk with the primary colors of red, green and blue, which rotates rapidly in a sequential motion to produce images in their original hues. The field sequential system was first developed by Dr. Peter C. Goldmark, president of CBS Laboratories, a division of Columbia Broadcasting System, Inc.

Announcement of the plan to televise the lunar mission in color was made by the National Aeronautics and Space Administration in Houston. Officials at the NASA Manned Spacecraft Center said that color television coverage with a field sequential system is expected during the Apollo flights this year. The color coverage from a manned spacecraft marks a space first, they added.

The field sequential technique, which also forged the way for closed-circuit television in medicine and industry, and now enables physicians to transmit color pictures from inside the human body, is the only color system of its kind able to operate at such low light levels, according to Dr. Goldmark.

Ordinary color television systems require intensive light sources to relay distinguishable color images for home viewing, he stated.

A similar field sequential system incorporating several refinements over the original system used to telecast programs from CBS in 1940 has been developed by CBS Laboratories for the Fitzsimons Army Hospital in Denver. Physicians there are using the tiny 10-pound camera to probe the human body's interior and detect bladder cancer and other internal disorders. The "starlight" system also is being used to add a new dimension to the study of internal medicine.

The field sequential technique planned for the moon telecast requires approximately one-third as many components as a standard color television camera, Dr. Goldmark said. The camera can be used with only one television broadcast tube and there is no problem of color registration. Color information is transmitted as the color filters on the spinning disk pass in front of the tube in sequence.

A complete image is sent first in red, then in blue, then in green. The human eye's persistance of vision provides the complete color picture, Dr. Goldmark explained.

As the information is beamed, ground stations on earth equipped with electronic devices will pick up the signal in its sequential form. A magnetic disk with scanning converter will process the signals into a form suitable for standard television transmission techniques for telecast by all major networks to home receivers.

There is a better than 50-50 chance that the descent of two Apollo 10 astronauts toward the moon will be seen on home television in live color, NASA officials said.

The feat, in addition to providing the public with glimpses of awesome sights such as earth's blue and brown globe seen by the astronauts, would be of important engineering interest because of the added detail live color pictures could provide instantly, they added.

Reducing co-channel interference

By Glenn A. Brown
Engineer, WBBM-TV, Chicago

The principles of offsetting television transmitter carrier frequencies to reduce the visibility of co-channel interference are well known. They have not been fully exploited due to difficulties in generating and maintaining precisely known operating frequencies.

A general application of the advantages of offset carriers is found in the FCC assignment of nominal carrier frequencies to produce beats between closely spaced co-channel stations. These are 2/3 or 4/3 of the horizontal line frequency (third line offset). As the operating frequencies drift within the FCC specified limits, the visibiiity of the beat patterns may vary as much as 16 db. This is expressed in terms of the field strength of the interfering carrier for equal visibility. However, the average visibility of the interference is about 12 db lower than that which would occur if all stations were assigned the same nominal frequency.

If the beat frequency is an even multiple of the vertical frame frequency (29.97 Hz) and also nearly 2/3 or 4/3 of the horizontal line frequency (precision third line offset), the visibility of the beat pattern is at a minimum. The optimum beat frequency nearest the FCC offsets of 10 kc and 20 kc are 10,010.00 Hz and 20,020 Hz. These frequencies are the 334th and 668th harmonics of the vertical frame frequency and allow the narrow horizontal bars produced by the beat to alternate in phase on successive fields of the picture. That is, each darker bar is replaced by a lighter bar (and vice versa) every 1/60 of a second. The eye averages the light level so the visibility of the beat pattern is at a minimum.

If the beat frequency increases by an amount equal to an odd multiple of the frame frequency (say from 10,010 Hz to 10,040 Hz), the dark bars and light bars are aligned and the beat pattern has maximum visibility.

Optimum frequencies for precision third line offset operation on Channel 2 are: 55,239,990 Hz; 55,-250,000 Hz and 55,260,010 Hz.

If more than three stations attempt to mutually reduce interference by precision offset, some of the stations will necessarily have the same operating frequency. However, the geographic spacing of these stations will be greater than the immediate co-channel neighbors. These stations can also realize up to 17 db of reduction of their mutual interference if the carrier frequencies are synchronized, or very nearly so.

It is necessary for each station to maintain its frequency to a tolerance of $\pm$ 2.5 cycles in order to obtain full benefit of the precision offset. This requires a frequency stability of 4.5 x 10 - 8 total deviation.

The FCC Grade B Contour is at 70 miles for the following conditions: channels 2 to 6, 100 KW ERP, 1000′ antenna height, co-channel interference not greater than —28 db. A similar co-channel station with minimum space of 170 miles will reduce FCC specified Grade B coverage to a radius of 48 miles due to co-channel interference without precision offset.

If precision offset were used, and the full advantage of 16 db were obtained, the Grade B coverage would be moved out to 65 miles. If 10 db improvement is more likely to be obtained in practice, the coverage is extended from 48 miles to 59 miles.

This increase in coverage is equivalent to that obtained by increasing the transmitted power from 100 kw ERP to 1 megawatt ERP. If the interfering station also increased its power to 1 megawatt, the coverage would shrink back to 48 miles. However, if precise offset of carrier frequencies is employed, each station would benefit as though it had unilaterally increased power to 1 megawatt. The difficulties in achieving the required frequency stability have prevented widespread use of precision offset.

Recent advances in quartz crystal technology has permitted the manufacture of reasonably priced oscillators with a stability of less than 2 x 10—ten-day total deviation. These oscillators may be obtained for exact transmitter frequency (approx. 4.6 mc for 12x mutiplication in a Channel 2 transmitter).

The long term drift is due to the aging effect in the quartz crystal itself; it will decrease with time but does not disappear. If a group of oscillator crystals are processed at the same time, the aging rates will be similar so that the differential drift between pairs of oscillators will be less than 1.5 x 10—10-day. It would not be necessary to correct the oscillator frequencies oftener than once in seven months.

Further improvement in the stability of these oscillators may be achieved by phase locking the frequency to a very low standard frequency broadcast, such as WWVB (60 kc) or the Omega stations (10.2 KHz). This system would permit TV stations on the same assigned frequency to obtain full benefit of reduced co-channel interference. If groups of co-channel stations in diffrent locations were phase locked to the same VLF standard, the reduction of interference would also improve skip interference. The greater cost of a phase lock system is in part offset by elimination of the auxiliary equipment necessary to accurately set the frequencies of unsynchronized oscillators.

With the present availability of extremely stable crystal oscillators and the ability to receive WWVB almost throughout the U. S., it would seem the time has come to do something for those areas that have suffered from co-channel interference. ▲

JCIC Reports Study Progress

During the March NAB convention in Washington, the ad hoc committee on color television of the Joint Committee on Inter-Society Coordination (JCIC) released its current status report in a technical session.

The colorimetry task group of the committee has worked swiftly since its inception to outline a specific program of investigation. This outline was submitted to the SMPTE who, in turn, appointed a new SMPTE working committee to continue the investigation.

This appointment resulted in the development of a computer program which will be used to specify the appropriate idealized camera colorimetric performance to provide reproduction in accordance with NTSC specifications. Another result will be suggestions on instrumentation suitable for measuring the input and output colorimetric characteristics.

Color Film Study

The task group on motion picture films has reported the findings of their observations and measurements on more than 200 35mm and 16mm motion picture films which had been used for broadcasting.

As might be suspected, the 35mm films varied less than the 16mm, and program and news material varied less than did the commercials. In fact, of the 180 commercials used in the study, it was determined that 30 would not look good to TV viewers or to those seeing the commercials by direct projection. Another 40 films in this category were considered questionable.

The color film investigation report has been referred to the engineering committees on color and on television of the SMPTE for further study.

Video Tape

The task group on video tape assigned to study the effects of synchronizing signal and chrominance burst timing and waveforms on the signal reproduced has turned its findings over to the SMPTE video tape committee. *(Continued)*

What the task group found was that varying burst amplitude at the recorder input will be reproduced as constant burst amplitude. However, the variations are transferred to the amplitudes of the chrominance signal.

Also, the group reported that incorrect timing of the burst with respect to the horizontal sync pulse can also affect the color reproduced. Unless a recorder is carefully adjusted, level of the front porch less than that of blanking, or duration of the front porch less than that called for in the FCC Rules, may introduce distortion. But in this case, the reproduced colors may not be affected noticeably.

Field Tests

Field tests of 16 closed-circuit and 6 off programs were conducted in December. With Chicago as the testing grounds, the tests involved predetermined variations in signal specifications involving three television stations.

Using "top of the line" receivers from four manufacturers, five color slides were shown on all 16 closed circuits and on all 6 off-the-air tests. The slides were selected as representative of typical program material. This included low key, high key, indoor and outdoor scenes and involved judgements of flesh tones.

A total of 5139 ratings of the slides were processed, and a video tape of the tests was made for future reference and demonstration. The tests revealed the following:

1. They generally confirmed the work of those who originally determined allowable tolerances on signal specifications. The only exceptions were in hue and saturation. Data will be given to the EIA broadcast television system committee for further investigation and recommendations.
2. Receivers may be affected by burst amplitude and timing. Variations noted in the tests among receivers used pointed up different circuit designs reflected in trade-offs made by manufacturers. Findings were referred to the EIA receiver committee and to the IEEE broadcast and television receiver group for design considerations. Results were also sent to the EIA BTS committee for consideration that could involve revised standards.
3. The tests of transmitters and propagation paths showed definite color variations. The cause was not determined. Additional tests to determine variation causes are planned.

The EBU, CCIR and the SMPTE also are actively studying film transmission. They plan to recommend practices for greater color uniformity and higher quality.

The status report summary points out that there is a disturbing lack of uniformity color which is being investigated from several angles. While the problem is difficult to embrace in its entirety, the enthusiasm of those involved in the study will surely lead to significant progress in color broadcasting and reception.

Working on a suggestion of the SMPTE, the JCIC met last June to determine the most effective way to deal with improving the color uniformity of pictures on home television receivers.

The JCIC includes representatives of the Electronic Industries Association (EIA), The Institute of Electrical and Electronics Engineers (IEEE), the National Association of Broadcasters (NAB), and the Society of Motion Picture and Television Engineers (SMPTE).

These representatives agreed that an ad hoc committee was needed to (a) examine the entire television system from the original scene through all equipment to the home receiver, (b) to determine the origin of significant deviations in color in the home picture, and to (c) allocate to existing industry organizations questions for further investigation and resolution. It also was agreed that administration of the ad hoc committee would lie with the SMPTE.

Others who would become involved in the investigations were the NCTA, AT&T, CBC and the Canadian Telecasting Practices Committee.

The NEW RCA 70B is the first VTR to safeguard quality automatically!

In many ways, the 70B can make the VTR operator feel he has more command of tape quality than ever before. Because he can get the highest color fidelity ever achieved—with the most reliable automatic instrumentation ever devised for a VTR.

Automatically, the 70B eliminates costly replays. Sensing circuits just won't let you play tape on the wrong FM standard. Instead, the proper playback standard is selected for any tape—highband, lowband monochrome or lowband color—automatically.

Automatically, the 70B pinpoints problems through its visual-audible central alarm system and alerts the operator immediately.

Automatically, the 70B can save your operator time by eliminating the need for manual cueing. Now he can pre-cue several tapes so they are ready to roll automatically—eliminating tension during the critical station break period.

Automatically, the 70B can eliminate saturation and hue errors. Use the RCA exclusive Chroma Amplitude and Velocity Error Corrector (CAVEC), and the 70B will not only correct chroma errors between bands—but between each line of a band as well!

Automatically, you get better color. The 70B has broadcasting's highest specs—K factor of 1% with 2T and 20-T pulse; differential phase and gain 3° and 3%; moire down 43 db and S/N of 46 db.

The RCA 70B is the dream VTR come to life. For all the reasons why, call your RCA Broadcast Representative. Or write: RCA Broadcast Equipment, Bldg. 15-5, Camden, N.J. 08102.

IMPORTANT NEWS: The TR-70B can also be used as a master VTR with the world's first automated video cartridge tape recorder/player—the show-stopper of the 1969 NAB! Write for details.

RCA

Circle Number 29 on Reader Reply Card

FCC to Conduct Study On Microwave Systems

The FCC has announced a two-part study to be conducted on frequency assignment techniques of microwave radio systems. The study is part of the Commission's continuing research and policy studies program in which outside contractors aid the staff in developing and analyzing proposals dealing with communications policy issues.

The general purpose of Phase I is to analyze the present frequency assignment techniques and use of frequencies and to recommend changes for more effective utilization of the spectrum assigned to these services. Phase II would deal with examination and analysis of the results of Phase I, and consideration of the ways in which the data obtained can be used in developing better use of microwave frequencies.

NAEB Schedules Recorder-Reproducer 3-Day Institutes

The National Association of Educational Broadcasters has scheduled two Educational Broadcasting Institutes on the operation and maintenance of helical scan video recorders-reproducers. The first conference, a three-day meeting, will be held at the Philadelphia Marriott, Philadelphia, on June 22-25. The second meeting is set for August 17-20 at the Sheraton-Chicago, Chicago.

Institute plans are for an intense 30-hour course especially designed by the NAEB for the audiovisual technician responsible for the operation of helical scan hardware. According to James Fellows, NAEB director of Research and Development, the course assumes no prior training in video recording on the part of the participant, and only a basic knowledge of television systems in general. The Institute will provide the theoretical background which will equip the student to progress, through future self-study, to greater efficiency in the operation and maintenance of video recorders and related equipment.

DIRECT CURRENT FROM D. C.

June, 1969

Appointment of New FCC Commissioner Expected

The term of FCC chairman Rosel H. Hyde, a veteran of 45 years of government service, will expire on June 30 of this year. Informed sources expect that chairman Hyde will retire at the end of the current term, and that President Nixon will appoint both a new commissioner and a new chairman, with Republican commissioner Robert E. Lee being prominently mentioned for the chairman's post.

The President now has under consideration a list of candidates for a new seven-year term as FCC commissioner, including a number of prominent engineers. The increasing complexity of engineering problems in the electronics field in recent years has placed the FCC at a growing disadvantage because of the lack of an engineer in the Commission's ranks. Major problems confronting the Commission today and in the near future will include space communications, the relationship between the computer and expansion of television broadcasting, and numerous other problems.

AM Freeze to be Lifted?

Rumors persist that the Commission will shortly lift the current "freeze" on the acceptance of applications for new radio AM stations and power increases or frequency changes for existing stations. The freeze was imposed last July, 1968, to give the Commission an opportunity to study the optimum uses for the remaining frequencies in the standard broadcast band.

Although little information is available on policies and technical rules to be implemented, it appears likely that few, if any, changes will be made in the present Technical Standards governing the allocation of standard broadcast frequencies. The Commission's present Technical Standards were adopted in 1964, and from a purely engineering standpoint have functioned to the Commission's satisfaction.

More . . .

From the policy standpoint, however, it appears likely that any new allocation plan will include two innovations in the making of AM assignments. First of all, emphasis is certain to be placed on granting new or improved facilities only in areas which are presently considered to be seriously underserved. Second and even more novel, the Commission will probably for the first time lump together both AM and FM broadcasting in establishing aural radio service now available in determining the need for new AM assignments.

U.S./Mexican Broadcasting Treaty Up For Ratification

The Senate Foreign Relations Committee is expected to hold hearings in the near future on a new standard broadcast radio treaty between the United States and Mexico, which has been signed by both countries and transmitted by the President to the Senate for ratification. At stake are a number of important issues, including both daytime and nighttime power increases for 250-watt Class IV stations operating on the six local channels near the U.S./Mexican border, and presunrise (6:00 A.M.) operation for some 288 U.S. daytime-only stations operating on the Mexican clear channels.

No opposition to the treaty has developed in the U.S., and prompt ratification by the U.S. Senate is expected. The treaty must also be ratified by the Mexican legislature, which next meets in September of this year and traditionally takes up treaties for ratification only near the end of a legislative session. This makes it unlikely that even prompt ratification of the treaty can bring the new agreement into full force at any earlier date than the spring or summer of 1970.

Scrambled ETC Medical Programs Proposed

The Commission has invited comments on a proposal which would permit noncommercial educational television broadcast stations to present "scrambled" programs during part of the regular broadcast day. This proposal follows successful experimentation along these lines by an ETV station in California. The scrambled programming would be of a specialized nature, and used for such purposes as instructing doctors, nurses, and law enforcement personnel. The program material is generally considered unsuitable for viewing by the general public.

Although the Commission is proposing to permit this type of programming, comments are invited on the desirability of permitting such highly restricted use of channels primarily intended to provide service to the public at large.

Short Circuits

The first 2 GHz microwave translator relays have been authorized in Puerto Rico . . . A Modesto, California UHF television station has been authorized to undertake telemetry on the main carrier on an experimental basis . . . The Commission has imposed a maximum fine ($10,000) on a South Carolina radio station which had defied the Commission's authority to impose and enforce presunrise regulations . . . The 500 uv/m radiation limit for UHF television receivers has once again been extended to 1000 uv/m, but this time only to January 1, 1970, when compliance with the tighter limit is expected.

SCANNING THE CATV SCOPE

By Harry Etkin

CATV Technical Training Sessions

Some CATV equipment suppliers are conducting equipment technical training seminars where CATV customers and other interested personnel related to the CATV industry can learn how to get the very best performance from the CATV equipment. This available service is intended to assist them in getting the full capabilities from their equipment. The training center affords engineers and technicians the opportunity of learning how to get the finest CATV picture.

These courses give attending personnel an insight into the reasoning behind the complex CATV designs, as well as their capabilities. They show how CATV operators can best achieve not only fine pictures but attain operating efficiency and save money.

As an example the Jerrold Electronics Corporation provides a five day week long course covering:

1. Introduction, the decibel, the television TV signal surveys, antennas, systems design and layout.
2. Cable, system records, headend considerations and problems, solid-state transportation and distribution equipment.
3. Test equipment, system parameters, subscriber drops.
4. Equipment and system tests and measurements.
5. General review, question and answer session.

CATV's Quest For A Future

For what are the CATV operators and industry striving? Their major ultimate goal is that all together they offer you the greatest flexibility to meet the CATV public needs effectively and economically.

CATV systems are rapidly coming into their own as a prime moving force and as a profitable medium. Part of the new-found success can be attributed directly to industry interest in CATV and the legal and technical actions of the NCTA. Cablevision's major hindrance factor is that it is throttled by the unrealistic legal problems bedeviling the CATV industry.

The major stumbling blocks along the way are the FCC's proposals relating to non-duplication and copyrights. The main questions are: how can industry ultimately comply with current regulatory procedures and what could industry reasonably expect in the realm of new FCC regulations? It is certainly difficult to stay within legal and FCC restrictions and at the same time provide a dependable public service that CATV is capable of.

Copyright Policy Bill

FCC Chairman, Rosel Hyde, on February 17th, told Senate Copyright Committee Chairman, Senator John L. McClellan, that the FCC would retain its carriage and nonduplication policy and would probably adopt the major and minor market restrictions in the current CATV Rule-making proceeding unless Congress passes a copyright bill that specifically states it is a meld of both copyright and communications policies. Hyde further clarified that the Commission would continue to explore the desirability of adopting the proposed ban on leap-frogging and limiting CATV to providing three networks, one independent and one educational station in minor TV markets. He also stated that the Commission does not contemplate basic changes in the carriage and nonduplication rules.

In response to the release of a notice of this magnitude by the Commission, the Subcommittee on Patents, Trademarks and Copyrights, headed by Senator McClellan, asked the FCC to give every possible consideration to a revision of the Commission's rulemaking proposals. The Subcommittee submitted, at the beginning of the year, a revised bill that is in effect identical to the legislation considered in the last Congress. This bill, HR. 2512, S.543, contains provisions for the establishment of a "National Commission on New Technological Uses of Copyrighted Materials."

The Commission is aware that intensive negotiations and discussions between interested parties have been under way for some time in an effort to reach agreement on the draft of a copyright revision bill that will be acceptable to all concerned. At a final meeting in the very near future between the Subcommittee and the various interests involved, a draft of the proposed legislation will be made and submitted. McClellan designated that the CATV industry "should not be destroyed or seriously crippled because of pressures exerted by powerful interests."

NAB Viewpoint of FCC's CATV 'Overkill'

The FCC Rules discuss the small market nonduplication in a circular configuration with a diameter of 35 miles. The NAB version designates a protective circle whose diameter is 75 miles to surround stations beyond the top 100 market category, and a 60 mile circle for stations in the top 100 markets. It also recommends that the smaller market CATV's would be permitted to transmit the three networks, one independent commercial station and one educational station.

NCTA Chairman Open Letter

Mr. Beisswenger has published an open letter in the "NCTA Membership Bulletin" which listed charges against the FCC. Major points were failure to accurately report the significance and substance of its actions, such as the CATV freeze in the top 100 markets and the misleading assurance that CATV can indeed obtain "retransmission consent," "failure to accept the copyright legislation decision of the Supreme Court of the United States, and bringing about a **de facto** reversal."

Justice Department CATV Opinions

The Justice Department has recently forwarded comments urging the Federal Communications Commission to bar television stations and newspapers from owning a cable television system (CATV) in their local areas. The Department also urged the Commission to let the CATV systems originate their own programs and sell advertising time in direct competition with conventional television stations.

The FCC indicated that the Justice Department submitted the comments in connection wtih the Commission's inquiry into policy-making in the CATV field. FCC policy-making is the regulation which would define the role of CATV in relation to the existing TV broadcast industry.

The Justice Department said "CATV" can provide significant competition to existing local mass media, particularly if it is permitted to engage in program origination and accept advertising—two developments we believe would be in the public interest."

The Department also said that the FCC should let CATV systems bring in signals from distant stations and "permit market forces largely to determine the outcome of the portable competitive struggle between CATV and existing television stations."

Microwave CATV Systems

TelePrompTer transmission of 18 GHz microwave system for experimental commercial operation in New York City, Oregon and New Mexico communities were approved by the FCC.

The Commission also issued a Notice of Proposed Rule-making in the Community Antenna Relay Service (CARS) Rules to develop the service for use in the 12.7-12.95 GHz band.

Recent FCC Waivers Issued to Section 74.1107 (e)

Columbia, Tennessee

Hearing requirements of the CATV Rules on distant signals have been waived by the Commission to allow Middle Tennessee CATV, CATV operator at Columbia, Tenn., to carry two Huntsville, Ala., signals. Columbia is more than 35 miles from Nashville and smaller TV markets. Middle Tennessee will carry Huntsville Stations WHNT-TV, Channel 19 (CBS) and WHIQ, Channel 25 (Educational). Order (CATV 100-295).

Brookings, South Dakota

The hearing requirements of Section 74.1107 of the CATV Rules on distant signals have been waived by the Commission to allow KOTA Cable TV Company to carry the signal of WTCN-TV, Channel 11 (Independent), Minneapolis, Minn., on its proposed CATV system at Brookings, South Dakota (CATV 100-315). Brookings is in the Sioux Falls TV market. In addition, the CATV system proposes to carry the local signals of KELO-TV, Channel 11 (ABC/CBS). KSOO-TV, Channel 13 (NBC), Sioux Falls, South Dakota, and KESD-TV, Channel 8, Brookings.

Clayton-Mountain City, Georgia

Rabun CATV, Inc. has been authorized by the Commission to carry distant TV signals from Anderson, S.C., Atlanta and Athens, Ga., on a CATV system it proposes to operate in Mountain City and Clayton, both in Georgia. The distant signals to be carried are from WAIM-TV (Channel 40, ABC/CBS), Anderson; WGTV (Channel 8, Educational), Athens; WSB-TV (Channel 2, NBC), WAGA (Channel 5, CBS), WQXT-TV (Channel 11, ABC) and WJRJ-TV (Channel 17), CBS/NBC/ABC, on a per-program basis, all Atlanta. Local signals that Rabun will carry are those of Greenville-Spartanburg-Asheville Stations WFBC-TV (Channel 4, NBC), WLOS-TV (Channel 13, ABC) and WSPA-TV (Channel 17, CBS), Order (CATV 100-406).

New Hampshire, Vermont

Colebrook Cable TV, Inc., operator of a CATV system serving several towns in New Hampshire and Vermont, has been authorized by the Commission to import the distant signals of educational television station WLED, Channel 49, Littletown, New Hampshire, into the Portland-Poland Spring, Maine, television market, (CATV 100-367). The grant was made on the condition that Colebrook Cable TV, Inc., also carry the distant signals of educational station WEDB, Channel 40, Berlin, New Hampshire, when that station commences operation. The Colebrook CATV System presently carries the following local stations, WMTW-TV, Poland Spring, Maine (Channel 8), WCSH-TV and WGAN-TV, Portland, Maine (Channels 6 and 13), WCAX-TV Burlington, Vermont (Channel 3, Independent), WVTB St. Johnsbury (Channel 20, Educational), and CHLT-TV Sherbrook, Province of Quebec (Channel 7).

National Cable Television Association Convention and Exposition Highlights

The NCTA will hold its annual convention in San Francisco, California at the San Francisco Hilton Hotel on June 22-25, 1969. The convention conferences will delve into present and projected technical innovations which are influencing the CATV media. The sessions have been structured to appeal to both the engineers who design the equipment and the CATV businessmen who use the equipment in the systems.

ENGINEER'S EXCHANGE

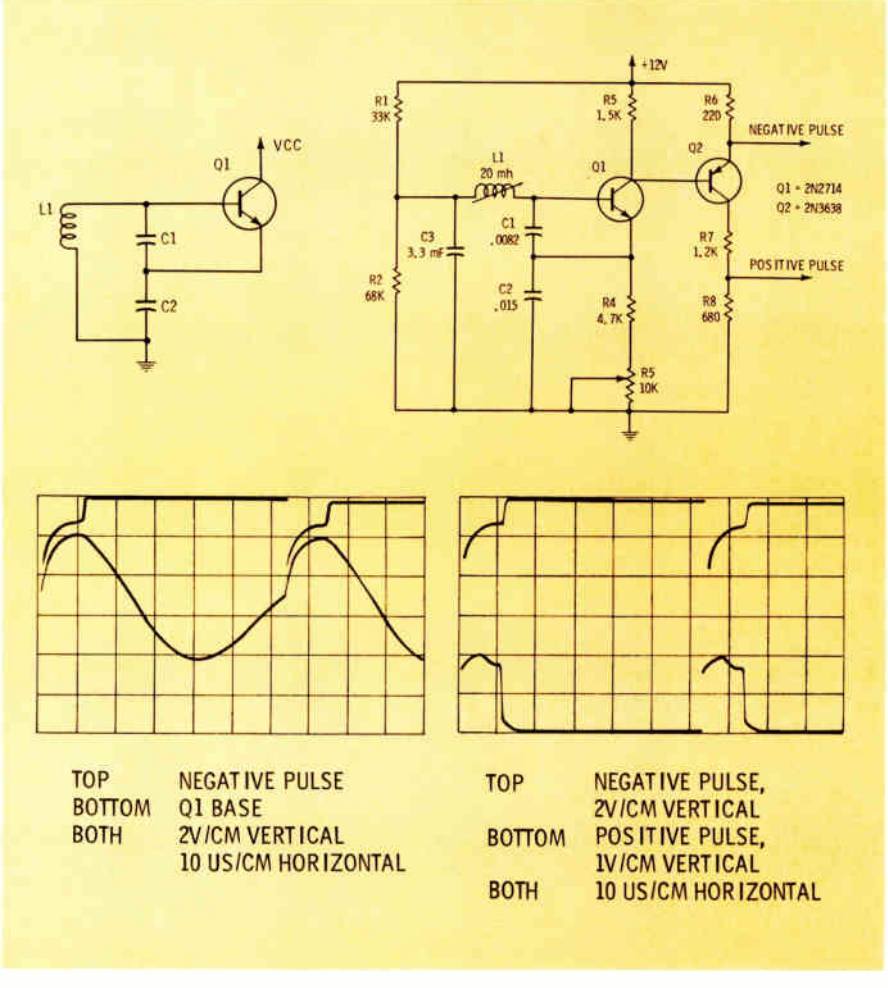
A transistorized colpitts oscillator makes an excellent source of stable timing pulses for a randomly interlaced TV camera. By controlling the conduction angle of the active element, the output pulse width can be used as the blanking interval timing as well as horizontal line rate drive.

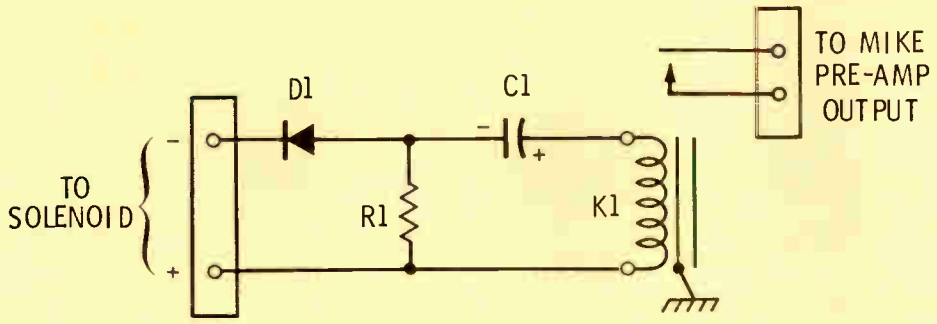
Referring to Fig. 1, C_1, C_2 and L_1 comprise the oscillatory tank in a colpitts configuration, with Q_1 providing the necessary amplification. If the LC tank is of insufficiently high Q and Q_1 is biased properly, the current will develop a large peak-to-peak voltage across the tank, and Q_1 will conduct on positive peaks of the sine wave.

In Fig. 2 we see how this mode of operation has been effected. L_1 supplies base bias from the divider R_1, R_2 and C_3 provides an AC return path. The DC path for emitter current is made variable to allow adjustment of Q_1's operating point. Pertinent timing is seen in the waveforms. As base drive voltage reaches a positive maximum, Q_1 turns on rapidly and saturates. This sharp negative pulse, after being buffered by Q_2 is used as a trigger pulse. Q_2 also inverts the pulse at its collector; the resulting positive pulse is used to drive succeeding RTL logic stages.

With bias value shown, variation of R5 will adjust the output pulse width from 10 to 12 usec. Operating frequency and pulse width remain stable with temperature and supply variations.

Walter Jung
MTI, Maryland





R1 = 20K, 1 WATT
C1 = 10 mfd, 150 VOLT D.C.
D1 = LAMP, 1KV SILICON DIODE (I'M CONSERVATIVE!)
K1 = POTTER & BRAMFIELD KHP-17D11 (COIL RESISTANCE OK)

Dear Sir:

The solenoid in our tape cartridge playbacks made a loud "clank" on the air when the machines were started with the mike open. Mechanical attempts to reduce this noise only impaired the starting reliability of the machines.

Here is a device I built that solves the problem by muting the announcer mike for ½ second after the START button is pushed, eliminating the noise.

When the 120 volt DC solenoid is energized, C1 charges through K1, pulling it in for ½ second. This shorts the mike preamp output via K1's contacts. Within two seconds C1 has discharged through R1, readying the circuit for further use. D1 keeps the circuit from operation by the reverse current generated when the solenoid field collapses at re-cue.

The circuit is noiseless, so the announcer must be careful not to talk over the cart starts, as a syllable would be lost during the muting action.

Dave Moore
Chief Engineer, KXRO
Aberdeen, Wash.

TECHNICAL DATA

For further information, circle the product identification number on the reader reply card.

175. **AIRCO SPEER** — A new four-page catalog has been published which features the new Jeffers JPN series of precision metal film packaged networks for A-D and D-A conversion applications. The catalog includes an up-to-date listing of specifications for the standard series plus details on construction, stability, accuracy, and response time. In addition, there are diagrams of the three package configurations.

176. **AMERICAN ELECTRONIC LABORATORIES, INC.** — New literature has been introduced on hybrid micro-electronics. The two-color illustrated folder provides information on AEL's total service, ranging from design and prototype development through production, as well as on thick and thin film components for audio through UHF applications and integrated circuits for microwave applications. Typical packaging configurations, assemblies and substrates are fully illustrated. AEL also has available literature on their newly developed all solid-state FCC type accepted FM exciter and stereo exciter (Model 2202), and stereo generator (Model 2202). Features and specifications of AEL's new FM-lkB and FM-20KB broadcast transmitters are detailed in new brochures. The transmitters are solid-state and allow for the optional addition of the Model 2203 stereo generator and the Model 2204 SCA generator. Literature has also been released on the AEL FM-5HB FM broadcast transmitter.

177. **CONCORD ELECTRONICS CORP.**—A new six-page brochure covering a complete range of accessories for video tape recording and closed-circuit television systems is now available from Concord Communications Systems, a division of Concord Electronics Corp. Included in the brochure is a photograph and description of a complete range of accessories—remote control devices, special effect control panels, lenses, switchers and many others.

178. **ENDECO**—The full line of desoldering/resoldering irons, tips and kits is shown in new Bulletin 69 just published. Included are the original Model 100A iron with temperature control for continuous heavy-duty service and industrial use, and the new pencil style Model 300 iron for removing and replacing miniature components. Thirteen replaceable tips are listed, with their inside and outside diameters.

179. **GBC CLOSED CIRCUIT TV CORP.**—The GBC Encyclopedia of Closed Circuit TV equipment, a compendium of available closed circuit TV cameras and accessories, is now in its 17th printing. This catalog, nearly 100 pages, includes all of the products of the GBC Corp., plus helpful technical information and prices.

180. **GENERAL RADIO**—The General Radio Experimenter, Volume 43, Numbers 1 and 2 for January/February, 1969, is available. The 16-page catalog offers information on a digital frequency divider and delay generator, the 1191 Counter which now features 35-MHz bandwidth, and an article on Wideband Amplifier Design by M. Khazam. Also described are the sweep-frequency reflectometer, type 1641, and the digital voltmeter calibrator, type 1822.

181. **GENISCO TECHNOLOGY CORP.** — Details of a new series of miniature arc suppressors—each smaller than an ordinary thimble—are provided in a data sheet by the Components Division of the company.

182. **MONSANTO**—A new brochure provides full performance specifications for the Model 110A 50 MHz programmable counter/timer.

183. **NARDA MICROWAVE**—Rf-to-DC power transducers suitable for a wide variety of uses are described in an application note. The 12-page note gives complete operating and application data for the Models 474 and 476 thermocouple coaxial power transducers. Applications described in Application Note No. 3 include remote monitoring of antenna power and commercial broadcast transmission power, protection of power-surge sensitive devices and more.

184. **NBS STANDARD FREQUENCY AND TIME SERVICES**—A 12-page brochure gives detailed descriptions of eight technical services provided by the NBS radio stations WWV, DDVH, WWVB, and WWVL: Standard radio frequencies; standard audio frequencies, standard musical pitch, standard time intervals; time signals, UT2 corrections; radio propagation forecasts; and geophysical alerts. The publication shows the schedules in effect on January 1, 1966.

185. **SOLITRON**—Solitron Devices, Inc., transistor division recently announced the publication of their 1969 condensed catalog. The 52-page book, printed in three colors on inside pages features Solitron's line of silicon and germanium small signal and power transistors used for military, industrial and commercial applications. It also contains new devices introduced by the company the past year, including RF power and PNP power transistors; and special products (hybrids, die and wafers, and multiples). Brief suggested application uses are included throughout the catalog.

186. **SONY**—Two four-color data sheets on new video equipment are now available from the company's VTR division. A four-page brochure details the latest addition to Sony's field-proven series EV, the EV-310 Videocorder® video tape recorder, and includes complete specifications, call-outs of all controls, and brief descriptions of optional accessories. The other sheet describes in detail one of these options—the CLP-1B Video Color Pack.

187. **SWITCHCRAFT** —A new catalog, number C-502b, describes their complete line of audio connectors, standard microphone connectors, adapters, RF connectors, Y connectors, AC receptacles, and phone jacks.

NEW PRODUCTS

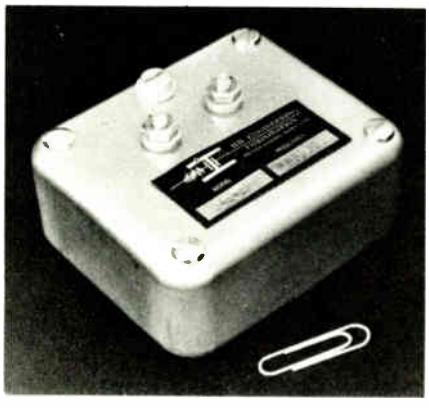
For further information, circle the product identification number (in parenthesis) on the reader reply card.

It is now possible to locate and identify CATV system faults from the head end to the most remote subscriber location when using the new LP-3 electronic monitoring system, according to the **HB Engineering Corporation.** Tiny encoders which require no local electric power, may be installed at the head end, cable amplifiers, power supplies and terminators, They are bridged across a leased telephone circuit or wire pair paralleling the CATV cable. In the event of an off-normal condition, a signal is sent to a central monitoring point. Up to 100 independent monitoring channels can be multiplexed on a single voice grade circuit.

The encoders can be installed at various locations, bridged across the wire line. They are powered from the monitoring location through the line, and operate with DC voltage at any level from 10 to 110 volts at the encoder terminals.

Tone frequencies can be spaced so as to provide up to 100 independent channels. This is made possible through the use of Twintron resonators in the encoders and decoders.

The system can also be used for determining what TV programs are being watched by selected subscribers and for remote control of CCTV cameras and other devices.



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A new solid-state 5-inch video monitor, model MV-5 has been announced by the **GBC Closed Circuit TV Corporation.**

(51)

Its compact size and performance make it a handy unit for technicians to take along on service-installation calls. It can be carried in the same case as a camera. It is also ideal for rack mounting in CCTV applications.

The model MV-5 features high horizontal resolution (550 lines) and is designed for optimum performance with all CCTV cameras. Weighing only 9 pounds, it is extremely compact and can be installed easily where space is a problem. Three MV-5's can be mounted on a standard 19″ monitor mount like the GBC MV-5RM.

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The company also announces a new 9mm lens designed to improve closed circuit TV techniques. The lens, GBC model 914, provides wide angle coverage of more than 82 degrees, about three times as much as the conventional 25mm vidicon lens. Not only is the coverage wide enough to extend the angle of coverage for CCTV cameras, but the depth of field is excellent. GBC says every object within the field of view from foreground to the most distant, is always in focus. The lens fits standard C mounts and will fit almost all CCTV cameras available today.

The Essex 3625 Directional Tap, featuring seized center conductor connectors and the plug-in modular concept, is now available from

Essex International, Inc., Controls Division.

This CATV tap utilizes an AC bypass circuit and provisions for seizing the cable center conductors inside its aluminum housing. The module-cover which plugs into the housing contains the directional coupler and splitter. The two units when plugged in are sealed to provide weatherproofing and RFI shielding.

The 3625 Directional Tap provides for strand mounting or is available in a pedestal version for underground systems.

Measuring 3″ x 5″ x 4″, the 3625 has a wide frequency response of 50 to 270 MHz and a wide range of values (8 to 30 db with 1, 2 or 4 outputs). It is available with connectors for any conventional cable for the through line and "F" fittings for the tap terminals. This tap has a minimum 20 db return loss at all terminals, insuring ghost-free operation; low insertion loss (1.2 db maximum); and high isolation.

Gotham Audio Corporation announces availability of the latest generation of audio flutter meters manufactured by Welke of W. Germany.

Three solid-state units are offered: two are flutter meters and the third is a precision wave analyzer designed to determine the frequency of the offending flutter.

Both flutter meters feature separate instruments for the indication of drift, which is the deviation from correct speed, and flutter content in ± percent. Both instruments have self-contained 3150 Hz oscillators which permit recording of the test signal as well as calibration of the metering section. Both weighted and unweighted measurements can be made and both meters feature a unique input circuit which allows use of any input level above 30 mV without necessity for level adjustment.

A relay in the ME-102b unit prevents erroneous readings from insufficient input signal level. The ME-102b also provides switching between 3000 Hz and 3150 Hz to accomodate both international and U.S. frequency standards. Flutter between 1 Hz and 315 Hz is metered.

The companion ME-301 wave analyzer provides continuous tuning between 1 Hz and 330 Hz, making possible exact diagnosis of the source of flutter.

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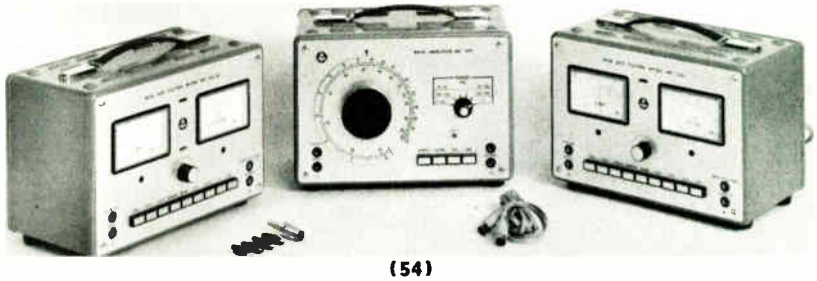

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NEW PRODUCTS

The **Heath Company,** who has always had the builder in mind, is offering a soldering iron kit that should save time and help the builder avoid burns.

Protected when not in use by an element rest and cage, the Model GH-17 features three heat ranges and a line-isolating transformer power supply. The low range is ideal for light jobs on circuit boards and around solid-state components;

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the medium range works for normal wiring; and the high setting is best for heavy soldering on the chassis.

Once locked into the cage, the iron tip protrudes from the back, making it easy to do those soldering jobs that require "three hands." Replacement tips are available in three sizes, but the tip supplied is a non-corroding type that doesn't require frequent tinning.

Spectra Sonics has announced the development of a professional quality audio equalizer for recording and broadcasst applications. The model 501 microphone/program equalizer provides continuously variable reciprocal equalization for both low and high frequencies, and has a separate switch to allow instant insertion or withdrawal of equalization for individual portions of the program.

A full range of ± 10 dB boost/cut at 100 Hz and ± 8 dB boost/cut at 7000 Hz is possible. The 501 also provides zero insertion loss equalization. As an element in the fedback loop of the Spectra Sonics 101 audio amplifier, total harmonic distortion is less than 1/100th of 1 per cent, according to the manufacturer.

In a joint statement, James B. Tharpe, president of Visual Electronics Corporation, and Glen R. Southworth, president of Colorado Video Inc., have announced an exclusive marketing agreement whereby Visual will direct all the sales, installation and service of the CVI line of video converters, to be marketed under the Visual Electronics name.

The present converters known as the VC201B Transmitter, and the VC220B Receiver, convert by means of sampling techniques, standard 525 line television signals to audio banadwidths for transmission over ordinary telephone or communication lines. The VC220B Receiver stores these samples on a magnetic disc reconstituting a standard 525 line picture which can be viewed on an ordinary TV monitor. The time of transmission of a single TV frame varies from 4 seconds to 2 minutes depending upon resolution and bandwidth used.

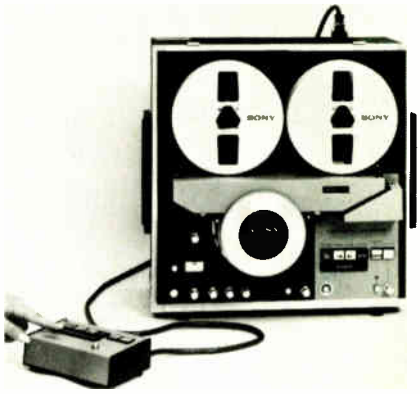
Tharpe, in announcing this agreement, stated that this new system of television transmission will find many applications in closed circuit television for education, industry, and business where diagrams, charts and other information picked up by a TV camera can be viewed at a distance by others on ordinary TV monitors using economical communication lines. This TV sampling system is also useful for data reduction in conjunction with computers.

(56)

A new compact, portable one-inch format video tape recorder that is particularly suited to applications in education, training and CATV distribution is now available from the **Sony Corporation of America.**

The model EV-310 Videocorder(tm) video tape recorder uses one-inch video tape and records any composite TV signal with a 60-field frequency, including random-interlace signals. Video recording is accomplished through a rotary, two-head scan system. Recording time is 60 minutes on a 2,460-foot reel of tape. Tapes are interchangeable between all Sony EV-310, EV-210 and EV-200 series Videocorders.

Standard features of the EV-310 are two-channel audio, editing and slow motion and stop action in the playback mode. The playback picture is continuously variable from



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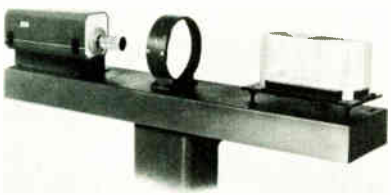
still frame to one-fifth of normal speed. Audio may be dubbed on channel 2 after video has been recorded. Automatic shutoff occurs when the tape reaches the end of the reel. A manual tracking feature permits any necessary adjustment to assure the optimum picture in the playback mode. The EV-310 has been engineered to permit threading and operating in either the horizontal or vertical position.

A new, moderately priced educational viewfinder TV camera, and a new high-quality film chain TV camera have been introduced by **GPL.** GPL TV cameras and systems are products of the LINK Education Systems Division, an element of The SINGER Company's Education & Training Products Group.



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The new Viewfinder, called the GPL Precision 990V, is completely solid-state and self-contained and offers either 800 or 900 lines of horizontal resolution. Fully automatic, simple to operate, and weighing only 19½ lbs., the Precision 990V is suited for most basic educational TV installations.

Measurements of Boonton, N. J., has announced a new standard FM signal generator which provides mobile communications with a precise, rugged instrument that is designed for use in the laboratory, production line or service shop.

The Model 800's solid-state circuitry covers all mobile frequencies and may be precisely set by vernier

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electronic tuning while modulation is applied. Output voltage is maintained automatically at a constant reference level. A range switch automatically selects proper deviation compensation.

The instrument has a direct reading individually calibrated dial, incremental electronic tuning, internal 1 kHz sine wave modulation and 20 Hz internal sawtooth sweep modulation. The unit may be modulated externally from DC to 20 kHz.

Gray Research of Hartford, Conn., has two new transcription equalizers ready for the market. Called the 808-A and the 810-A, these units are designed to provide passive equalization for high impedance stereo cartridges.

The model 808-A features a dual channel input with single channel output, while the 810-A is a complete two-channel stereo unit. These units provide four equalization

(60)

curves similar to those of the 602C low impedance units.

The equalizers have 47,000 ohm input with 50, 150 or 250 ohm balanced or unbalanced output with output level of −61 dBm with 5 V input at 1 kHz.

The **Chapman Manufacturing Company** has produced a handy new midget ratchet kit which they will call Kit No. 1320. This pocket-sized kit houses its tools in an oil resistant molded foam, protected by a steel case.

The set includes removable snap-out socket screw adapters, phillips screw adapters, and screwdriver adapters in the most common sizes. The adapters are made of chrome nickel molybdenum alloy steel.

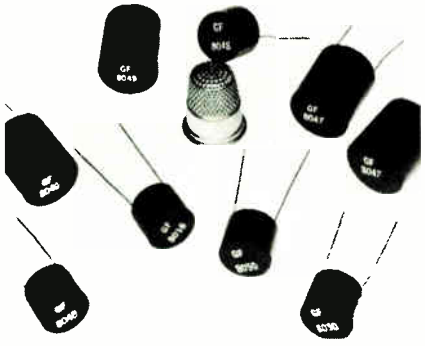
NEW PRODUCTS

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

A new series of miniature arc suppressors—each smaller than an ordinary thimble—has been introduced by the Components Division of **Genisco Technology Corporation.**

Units in the series, utilizing an RC network concept as an RFI filter, range in values from .01 uf to .001 uf. Voltage ratings are 28 VAC or 100 VDC, and 125 VAC or 400 VDC. All units are available with axial or plug-in leads, in series or parallel.

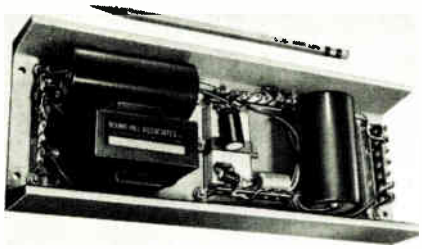
The miniature arc suppressors are available in two high-temp epoxy sizes: .50″ x .40″ and .62″ x .70″. The units are epoxy filled for added strength and moisture-proofing.



(61)

International Nuclear Corporation is now offering a model TCS2 color subcarrier standard which will be available shortly to replace subcarrier oscillators where a tendency to jitter has produced serious problems in multiple generator color tape recording and editing. They claim that the unit has frequency stability of one part per million and jitter less than 5 nanoseconds under all conditions. The unit produces dual outputs for 3.58 MHz; dual burst flag outputs; and a 31.5 KHz output. Integrated counting circuits are used throughout.

The company also is announcing another new product, the model TBC2 background colorizer. This instrument allows any hue, saturation, or luminence of background to be available for matting, keying and other special effects. It allows the producer to fade or switch to any desired background color. Any black and white art work may be keyed in color. The unit is self-contained in a 1¾ inch rack mount.



(62)

Model AA-800 is a new complete 12-watt integrated circuit audio amplifier offered by **Round Hill Associates.** The entire amplifier is constructed using thick film solid-state devices. The power supply is included and ¼″ thick aluminum is used for the chassis to give heat sinking for the amplifier. Signals as small as 300 MV input will produce 12 watts audio output with low distortion.

The AA-800 is ideally suited for use in high fidelity amplifiers, public address systems, broadcast and television studio monitor amplifiers, and similar applications. Technical specifications are: Input Impedance, 18,000 ohms nominal; Input Voltage, 300 MV for 12 watts output; Output, 4-16 ohms; Frequency Response: ± 1 db, 20-20,000 Hz at 12 watts.

(63)

A newly-developed 8-ft. diameter microwave multi-element grid parabola antenna is now available from **Mark Products Company.**

The welded aluminum parabola is designed for point-to-point relay operation at any specified frequency between 400 MHz and 2.5 GHz. Multi-element grid design provides system performance equal to solid reflectors, with tower wind loading as low as 25 percent of that imposed by solid reflectors of comparable size.

Standard termination is a ⅞-inch EIA swivel flange, and type N termination is available.

A new automatic gain control available to broadcasters, the Solid Statesman AGC Amplifier (M-6629), has been introduced by **Gates Radio Company,** division of Harris-Intertype Corporation.

The Solid Statesman is engineered for a wide range of control and adjustable attack/recovery time in order to insure flexibility in station programming. Its high compression ratio and rapid attack time result in consistently high modulation levels. At the same time, its slow attack/recovery mode will maintain control over average program material and extend dynamic range.

The extremely close balance of the Solid Statesman's "differential amplifier" used as a gain-controlling device is the key to its wider control range, lower distortion and rapid attack time.

Another new feature is the selectable attack/recovery time that allows each station to adjust the control time best suited to its individual type of programming.

For stereo operation, two Solid Statesman amplifiers can be strapped together with a small jumper cable.

Front panel controls permit an engineer to disable both the expansion and compression functions separately for proof-of-performance tests. With these settings, the unit has the same gain as a 15 dB compression level, the ideal operating point. This provides a test position and also maintains system calibration.

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Immediate openings for First Class licensed technicians in TV master control room. Also Stereo FM under construction. Four season recreation. Write: Chief Engineer, WVNY-TV, Box 22, Burlington, Vermont, 05401. 6-69-2t

TV Engineer—Excellent opportunity for young man who wants to get into TV engineering and who has capability to learn quickly under Chief Engineer. The man we are seeking must have first-class license, fundamental knowledge and is perhaps presently employed in radio. Profit sharing and other long-range attractions. WSAV-TV, Savannah, Georgia. 6-69-1t

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Equipment for Sale

AM or FM Audio P.O.P. form kit $1.50 postpaid. Broadcast Service Co., Box 2605, Corpus Christi, Tex. 78403. 2-69-tf

CoAx TRANSFER SWITCHES—3⅛" Andrews 6720 50 ohm—Unused. $500.00 each. Sierra-Western Elect. Co., Oakland, Cal. 94607. Phone 415-832-3527. 3-69-tf

Surplus audio and video patch panels and patch cords 500 to 500 ohm repeat coils flat to 20 000 cycles. Send for list. Gulf Electro-Sales, Inc., 6325 Beverly Hill, Houston, Texas 77027. 4-69-12t

TV EQUIPMENT: 4 TV studio camera chains TK-10A consisting of viewfinders, control housings, power supplies, current regulators, lens turrets with lenses, four master monitors, sync generator; TK 21 film chain consisting of vidicon camera TK 21B and related equipment; 2 RCA Feerless pedestals; and orthicon and vidicon tubes. Contact Dr. Hefzallah, Fairfield University, Fairfield, Conn. 06430. 6-69-1t

EQUIPMENT FOR SALE: Stereo Automation System "Prolog" type by Continental Electronics. Model 913-20. Good working order at less than half price, three years old, contains 3 reel tapes, 2 carousels, control table with logger, typewriter & 2 25 cycle recorders, one reel tape 14 inch recorder. Crated & packed FOB Honolulu $15,000.00. Estimated freight SFO $300.

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Stereo Daven Attenuators 600/600 ohm 60db in 2db steps, good order packed and mailed for $150.00 the lot.

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One Collins ATC recorder unit for PB190 series cart machines Packed FOB Honolulu $80.00.

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Wanted to purchase for South American client, 5 used Marconi Mark IV Monochrome Camera Chains. Contact SYLVAN GINSBURY LIMITED, 72 West 45th Street, New York City, New York 10036. 6-69-1t

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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.

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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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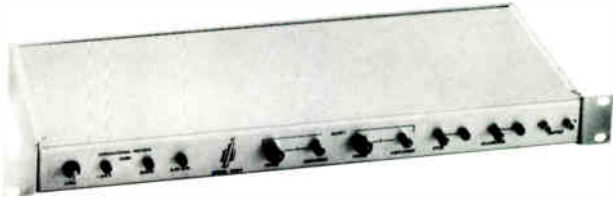
The brand new TBG2 Black Burst Generator allows you to go black and back with perfection. The TBG2 has two outputs available for added versatility, and each has burst phase and burst amplitude adjustments so the two feeds can be matched under any condition. The TBG2 has the industry's only continuously 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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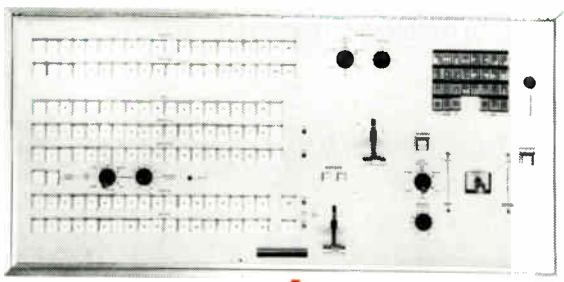

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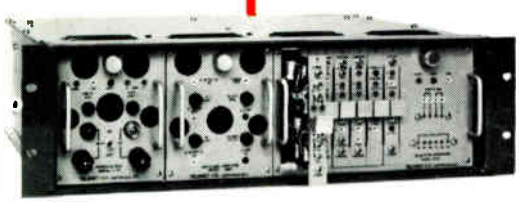

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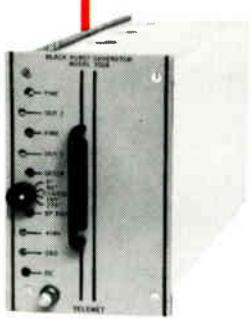

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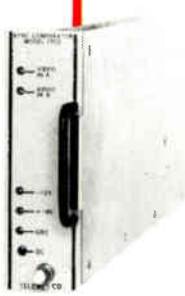
Model 3528



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Model 7502

Burst Comparator
Model 7503

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