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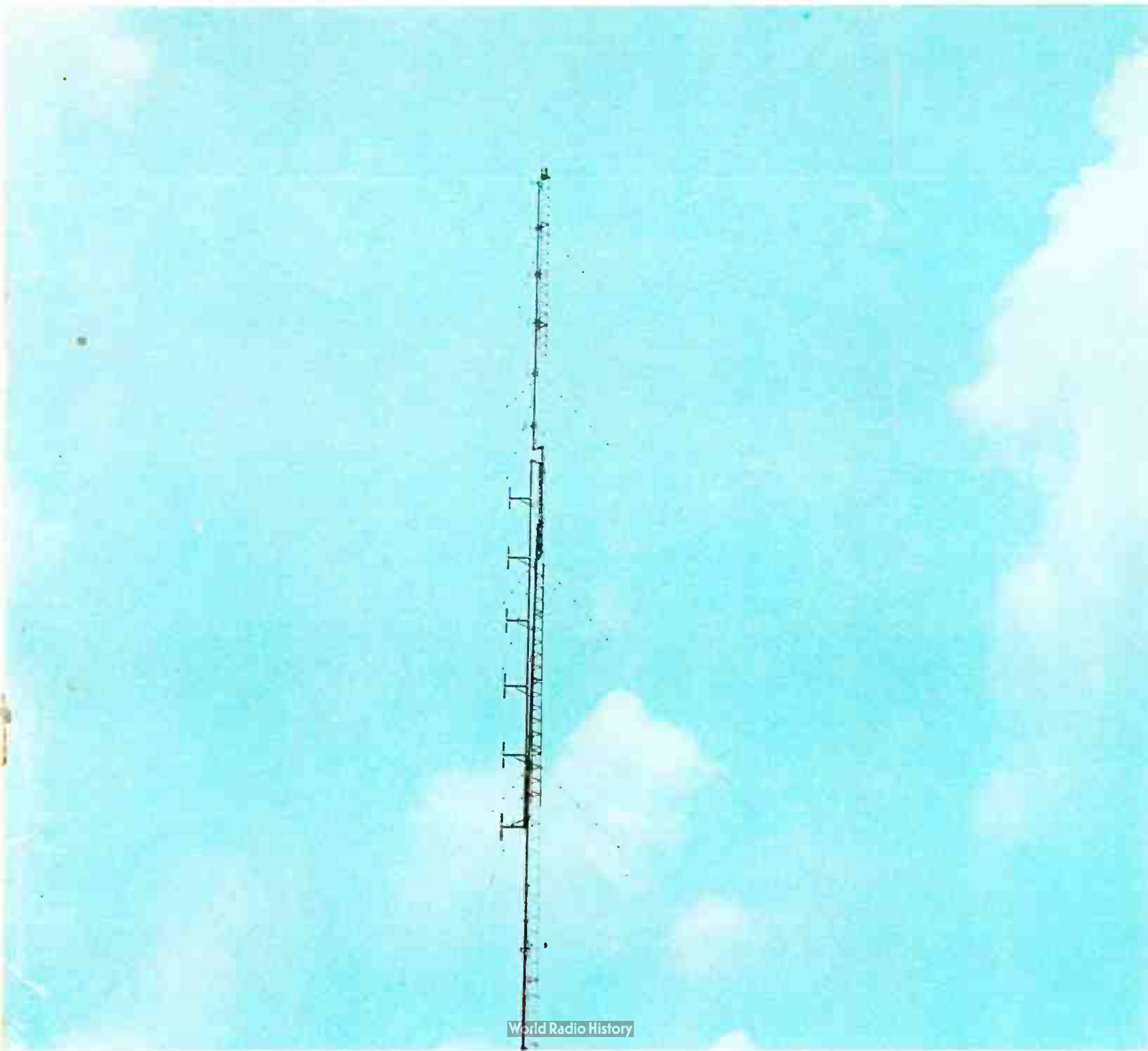

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the technical journal of the broadcast-communications industry

Broadcast Engineering

Volume 8, No. 8 — August, 1966

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Features

Departments

This month's emphasis on radio is illustrated on our cover by the dual-polarized antenna of stereo FM station WSMJ, Greenfield, Indiana. You'll find radio articles beginning on pages 11, 16, and 30.

This is the new FM Volumax.
It prevents FM overmodulation without distortion.
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It solves your pre-emphasis problem.

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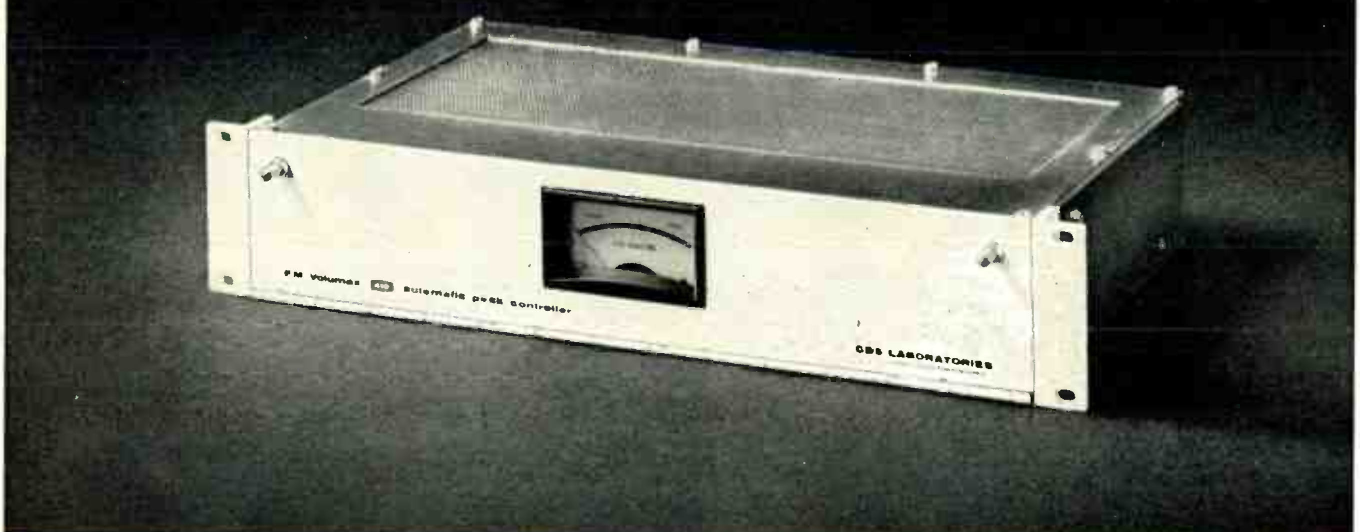

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LETTERS to the editor

DEAR EDITOR:

In your February 1966 issue was an Engineers' Exchange item, "Finding Momentary Shorts in Inductors" (page 6). The author has provided a well-thought-out method of trouble location but seems to have forgotten a basic principle, namely "safety first."

The problem he has had is one that has cropped up frequently and has become a bugaboo to many communications maintenance personnel, especially those who have worked on lower-power equipment. Out here, where it is hot and the humidity is high, the trouble occurs quite often. I have found the best troubleshooting method in these cases to be the use of an insulation tester, which should be familiar to maintenance personnel in all phases broadcast and communications.

As to the other part, I cannot agree with the use of insulating board of any type between the case and chassis, since safety should be of prime importance with station engineers. I can anticipate statements such as "All maintenance personnel have been notified," "It's been logged," etc., but it is peculiar that the ones that have been notified are the ones that get burned. My motto for over 20 years has been, "Safety first."

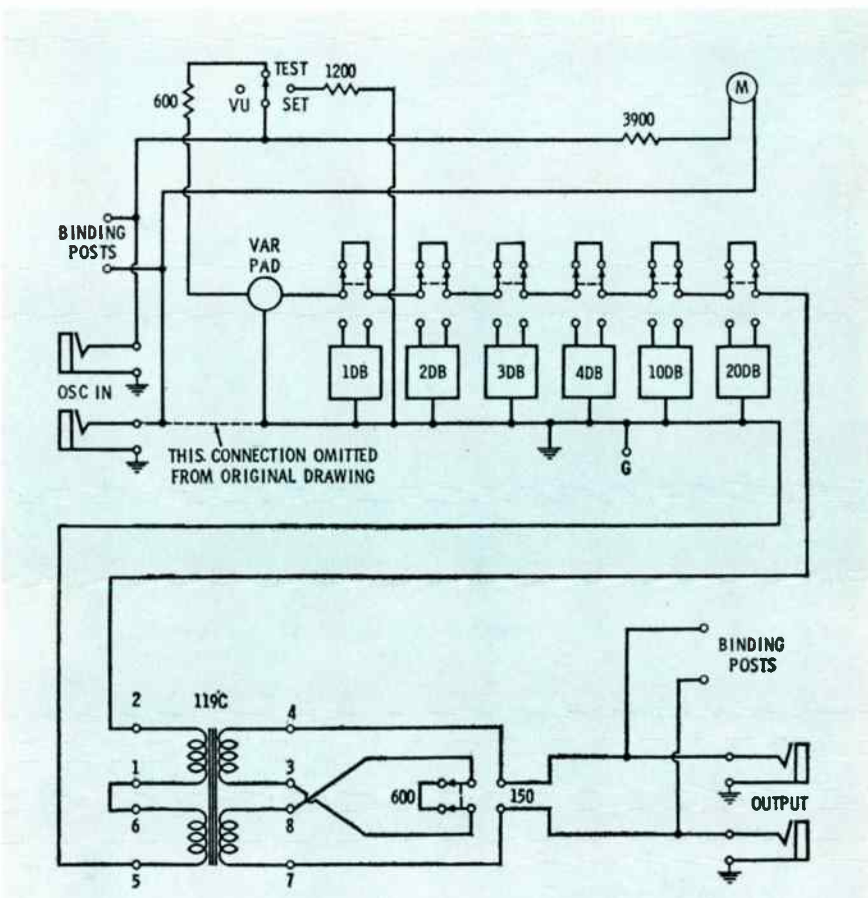
JAY P. GLADIEUX
Bangkok, Thailand

DEAR EDITOR:

A few days ago I went back to the September 1964 issue of BROADCAST ENGINEERING to build the fixed T-pad transmission set described on page 15. It seems to me that a connection has been omitted in the circuit. I don't seem to be able to trace a complete circuit from one input binding post, through the attenuation network and the primary of the output transformer, and back to the other input binding post. Have I overlooked something?

TED CHIDESTER
Santa Fe, N. M.

One connection was inadvertently omitted from the original drawing of the transmission set. The schematic of the unit is reproduced below with the missing ground connection indicated. Ed.



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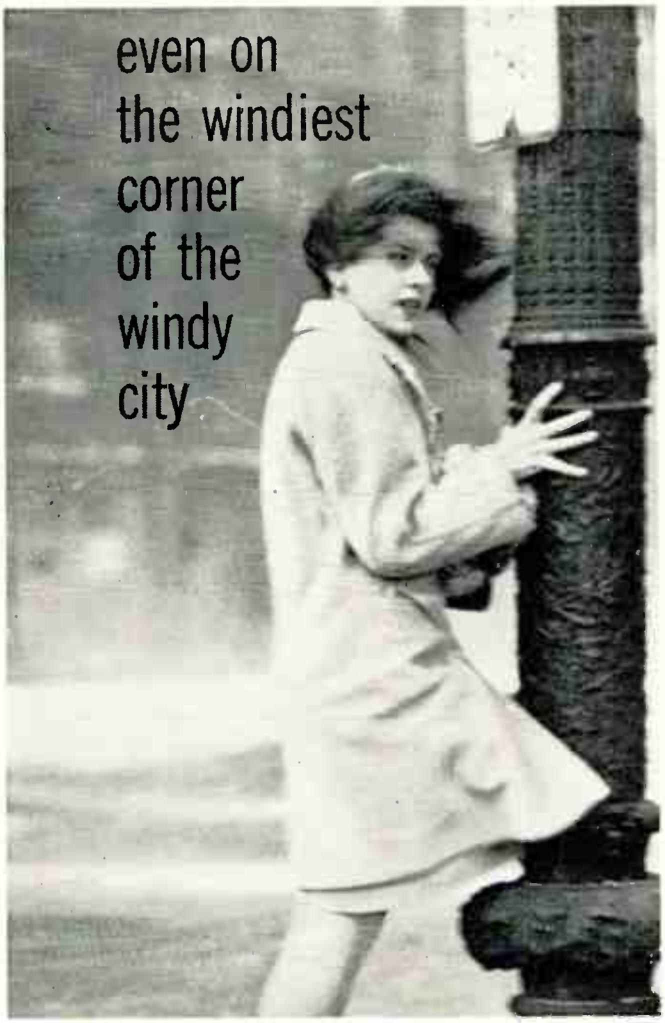

Shure's remarkable new SM50 omnidirectional dynamic microphone is SELF-WINDSCREENED! It is strikingly immune to wind noises and explosive breath sounds—making it ideal as a dependable "workhorse" microphone for remote interviews, news, sports pick-ups and a variety of field and studio applications. The five-element built-in windscreen makes it virtually pop-proof in close talking situations. And unlike other "built-in" windscreens, this one is "unitized" and self-contained with no bits or pieces to re-assemble after cleaning. In fact, you can actually rinse dirt, saliva, lipstick and other screen-clogging foreign matter out of the windscreen assembly under running water as often as needed—or replace the "unitized" assembly if necessary in a matter of seconds.

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For additional information, write directly to Mr. Robert Carr, Manager of Professional Products Division, Shure Brothers, Inc., 222 Hartrey Avenue, Evanston, Illinois.

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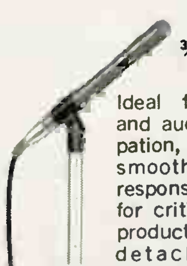

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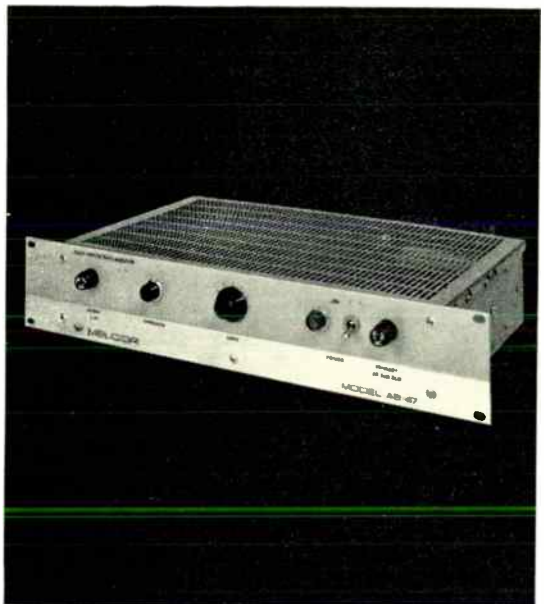
Circle Item 6 on Tech Data Card

Not so hot.



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- ☐ Total harmonic distortion: Less than 1.0% 20 cps to 15 Kc at 50 watts.
- ☐ Noise, unweighted: 75 db below rated output
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- ☐ Temperature range: 0 to 65° C.
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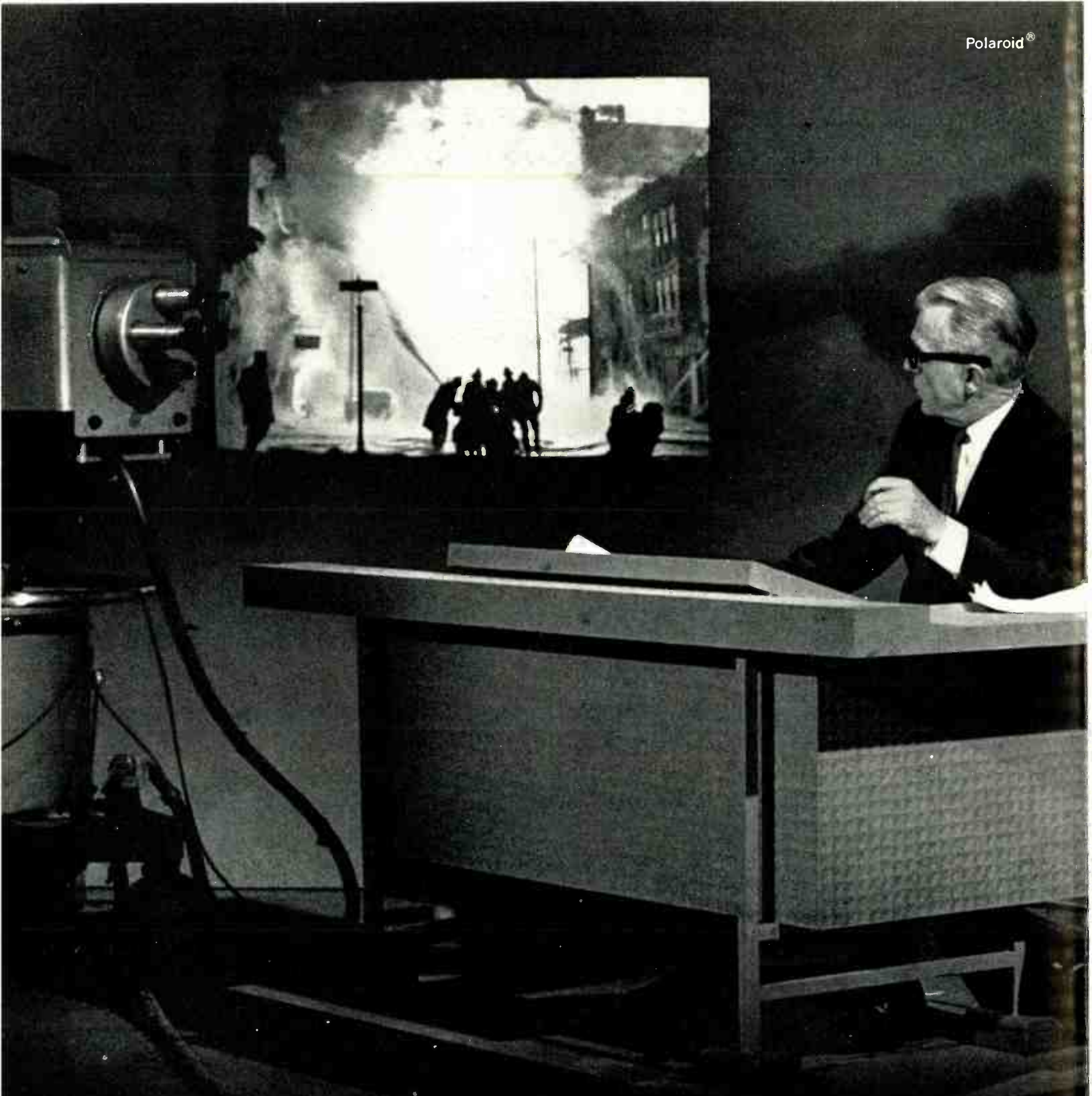

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Circle Item 15 on Tech Data Card

FINDING AN AM FREQUENCY

by Robert A. Jones, **Midwestern Regional Editor—New AM Frequencies are still being found. Here are the rules for conducting a search.**

The first step in starting a radio station is finding an operating frequency. Ordinarily a consulting engineer is retained for this purpose, but this procedure is not always necessary. If the methods described in this article are followed, it may be possible for a chief engineer or potential owner to discover an available frequency in or near a desired community. In large cities the task becomes more difficult, and in metropolitan centers extremely so. If an apparently available frequency is discovered, it is customary to have a consultant review the computations for possible error.

Recent examples of owner-found frequencies are WCGO, Chicago Heights, Illinois; WKKD, Aurora, Illinois; WIXN, Dixon, Illinois; and KGRB, West Covina, California (a suburb of Los Angeles). It is the intention of this article to show how a consultant makes a frequency search and to present some ideas on how the reader can do it himself.

Of primary importance is a thorough knowledge of current FCC Rules (Volumes I and III) and their interpretations. This will develop familiarity with the classes of channels and their effect, minimum and maximum powers permitted, protection to existing stations required, and minimum signal strength required to service a community.

Reference Lists

Several items are useful in making a frequency search. First is a complete list of existing AM radio stations. *Broadcasting Yearbook* is one source. While this is a very complete list, it does not give information on changes, applications, or grants between publishing dates. A satisfactory reference for current change information is the *NARBA Official Notification List*. This list is printed semi-annually, and a service provides frequent additions and corrections. It can be obtained for a nominal fee from Cooper-Trent, Inc., Washington, D.C. With complete and current lists it is easy to determine the distance to the nearest station on any given frequency. The NARBA list is also useful because, for each station, it shows geographical coordinates, radiation efficiency for one kilowatt, class of station, power, hours of operation, the height of each tower, and ground-system dimensions.

Another required list is one showing pending applications. If there is a choice of frequencies between one having a pending application in a nearby city and one unapplied for, assuming that other factors are equal, it is usually best to choose the "clean" frequency. In or near metropolitan areas, however, it is unusual to find even one channel, and it is well to be advised of any pending conflict over frequencies.

A third reference source is the *AM Frequency Allocations Map Book*. The most recent publication is several years old. This book, with supplements, was published by the Cleveland Institute of Electronics. This book contains one page for each standard broadcast frequency (Fig. 1). On each page the location (and call letters) of each station operating on that fre-

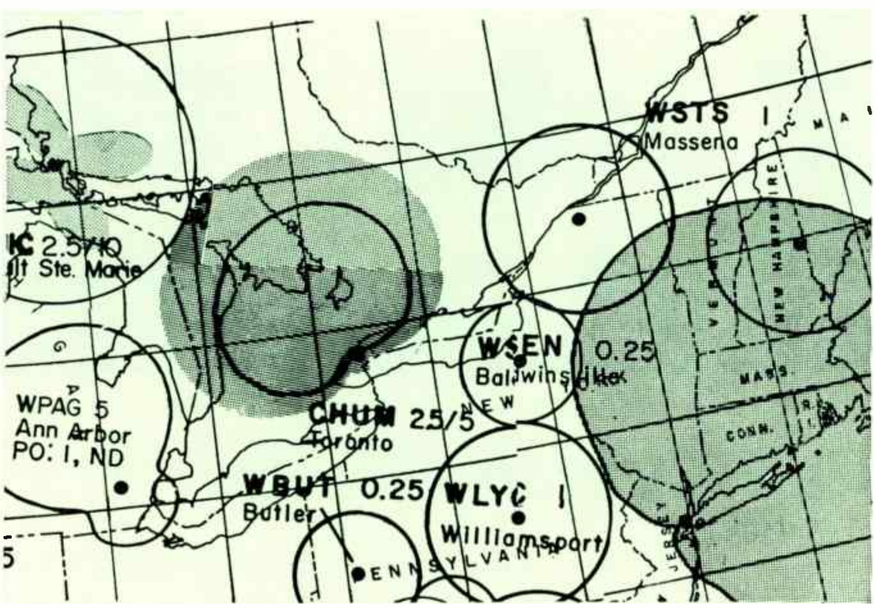

Fig. 1. Portion of a page for 1050 kHz from AM Frequency Allocation Mapbook.

quency is plotted, and the relative sizes of day and night patterns are indicated. Nondirectional stations have patterns shown as circles of the appropriate size. This book is seldom maintained up-to-date by owners and consequently is not as current or complete as the NARBA List. The advantage of this reference is that geographical relationships are more easily ascertained.

Other reference material that would be helpful includes the NARBA Treaty and the U.S.-Mexico and U.S.-Canada Agreements.[1] These are necessary for the evaluation of certain clear channels and for operations adjacent to the U.S. border.

Work Sheet

A system used by many consultants consists of a work sheet listing each AM frequency (540 to 1600 kHz). Fig. 2 shows a portion of a typical work sheet with data from a recent frequency search. Columns list each frequency, its class of channel, and comments. Since different Rules apply to each class of service, time can be saved by noting this fact on the work sheet. A complete list of frequency classifications assignments is shown in Table 1. The "comments" column in Fig. 2 is for noting facts concerning specific allocations for each frequency, and indicates reasons why the frequency cannot be used at a desired location. Usually nearby stations are indicated and their proximity to the desired location is noted. Class I-A channels are shown as "not available," since new applications on these frequencies are not being accepted by the FCC (except for a few Class II-A allocations in certain western states).

Normally, if a reason has been found that eliminates a given channel in the desired community, further study of that frequency is stopped, since the FCC's "go no go" Rules make it extremely difficult to squeeze in new stations.

When the entire AM broadcast spectrum has been evaluated, a review of the work sheet is made to determine which channels appear to be available. Assuming that one or more available frequencies have been found, the next step is to determine which is the most desirable. First, however, it is necessary to assure that each frequency will work.

How to Check a Channel

In the study of the availability of any given frequency, it is essential to evaluate both cochannel stations and adjacent-channel stations. For cochannel stations, daytime protection extends to the 0.5-mv/m contour, except for Class I stations for which it extends to the 0.1-mv/m

[1] The U.S. Mexico Agreement was published in the July 1966 issue of BROADCAST ENGINEERING. The U.S.-Canada Agreement will appear in a future issue.

WORK SHEET FOR WAUPUN, WIS.

Frequency	Class of Channel	Comments
540	Canadian Clear	WYLO too close
550	Regional	WYLO 0.5 mv/m prohibited overlap
560	Regional	WIND 0.05 mv/m overlap
570	Regional	WMAM 0.05 mv/m overlap
580	Regional	WILL 0.05 mv/m overlap
590	Regional	WKZO 0.05 mv/m overlap
600	Regional	2 and 25 mv/m overlap from WTMJ
610	Regional	same as 600 kHz
620	Regional	WTMJ too close
630	Regional	same as 600 kHz
640	U.S. Clear 1-A	not available
650	U.S. Clear 1-A	not available
660	U.S. Clear 1-A	not available
670	U.S. Clear 1-A	not available
680	U.S. Clear 1-B	0.5 mv/m overlap from WMAQ on 670 kc
690	Canadian Clear	2 and 25 mv/m overlap from WMAQ
700	U.S. Clear 1-A	not available

Fig. 2. A typical AM frequency search work sheet accounts for all frequencies.

Table 1. North-American Broadcast Frequencies

Channel	Use	Channel	Use
540	M & C	1080	I & II
550	III	1090	I & II
560	III	1100	I & IIA
570	III	1110	I & II
580	III	1120	I & IIA
590	III	1130	I & II
600	III	1140	I & II
610	III	1150	III
620	III	1160	I — clear
630	III	1170	I & II
640	I — clear	1180	I & IIA
650	I — clear	1190	I & II
660	I — clear	1200	I — clear
670	I & IIA	1210	I & IIA
680	I & II	1220	M
690	I — C	1230	IV
700	I — clear	1240	IV
710	I & II	1250	III
720	I & IIA	1260	III
730	M	1270	III
740	C	1280	III
750	I — clear	1290	III
760	I — clear	1300	III
770	I x 2	1310	III
780	I & IIA	1320	III
790	III	1330	III
800	M	1340	IV
810	I & II	1350	III
820	I — clear	1360	III
830	I — clear	1370	III
840	I — clear	1380	III
850	I & II	1390	III
860	C	1400	IV
870	I — clear	1410	III
880	I & IIA	1420	III
890	I & IIA	1430	III
900	M	1440	III
910	III	1450	IV
920	III	1460	III
930	III	1470	III
940	I & II	1480	III
950	III	1490	IV
960	III	1500	I & II
970	III	1510	I & II
980	III	1520	I & II
990	C	1530	I & II
1000	I & II	1540	I & II
1010	C	1550	I & II
1020	I & IIA	1560	I & II
1030	I & IIA	1570	M
1040	I — clear	1580	C
1050	M	1590	III
1060	I & II	1600	III
1070	I & II		

I — Class-I stations may be assigned to channel.
IIA — One unlimited-time Class-II station may be assigned (see Rules).
II — Class-II stations may be assigned. (outside the 48 adjacent states, Class-II stations may be assigned to the clear channels not indicated in this table. See FCC Rules for details.)
III — Class-III stations may be assigned.
IV — Class-IV stations may be assigned.
C — Canadian clear channel; Class-II stations may be assigned under specified conditions.
M — Mexican clear channel; Class-II stations may be assigned under specified conditions.

contour.* The ratio of desired to undesired signal at the protected contour must be at least 20:1. Therefore, the 0.025 mv/m (commonly referred to as the 25-μv/m) contour, of a new station cannot overlap the 0.5 mv/m contour of an existing or proposed cochannel station. (On Class I channels the 50-μv/m and .1 mv/m contours apply).

In the case of Canadian and Mexican clear channels, and other Treaty frequencies, the entire U.S. border must be protected, even though foreign stations do not actually have service along the entire border.

With adjacent-channel stations, protection required depends upon the frequency separation. With first-channel adjacency ($\pm$10kHz) a new station's 0.5 mv/m contour cannot overlap the 0.5 mv/m contour of any existing station. This same rule applies to Class I stations. For second-channel adjacency ($\pm$20 kHz) the protection extends to the 2.0- and 25-mv/m contours. This appears to be a double standard, but the FCC Rule clearly states that a new station's 2.0-mv/m contour may not overlap an existing station's 25-mv/m contour, and conversely. In effect, this means that if the power of a proposed station is higher than that of an existing station, the 2-mv/m contour of the proposed station would reach the 25-mv/m of the existing station before that station's 2-mv/m contour reached the 25-mv/m contour of the proposed station. If, however, the power of the proposed station is less than that of the existing station, the opposite would be true.

In determining the availability of a channel, it is customary to compute the 25-μv/m signal from the closest cochannel station first. If this contour does not overlap the desired community, than the signal from the next closest station is computed, etc.

Assuming that no cochannel problems exist, the adjacent channels are then evaluated. As noted, ascertain the proximity of the 0.5mv/m, 2-mv/m, and 25-mv/m contours of adjacent-channel stations.

* During the "critical" hours after sunrise and before sunset, the radiation from a new Class-II station toward an existing Class-I cochannel station is restricted to prevent skywave interference. See section 73.187 of the FCC rules and regulations.

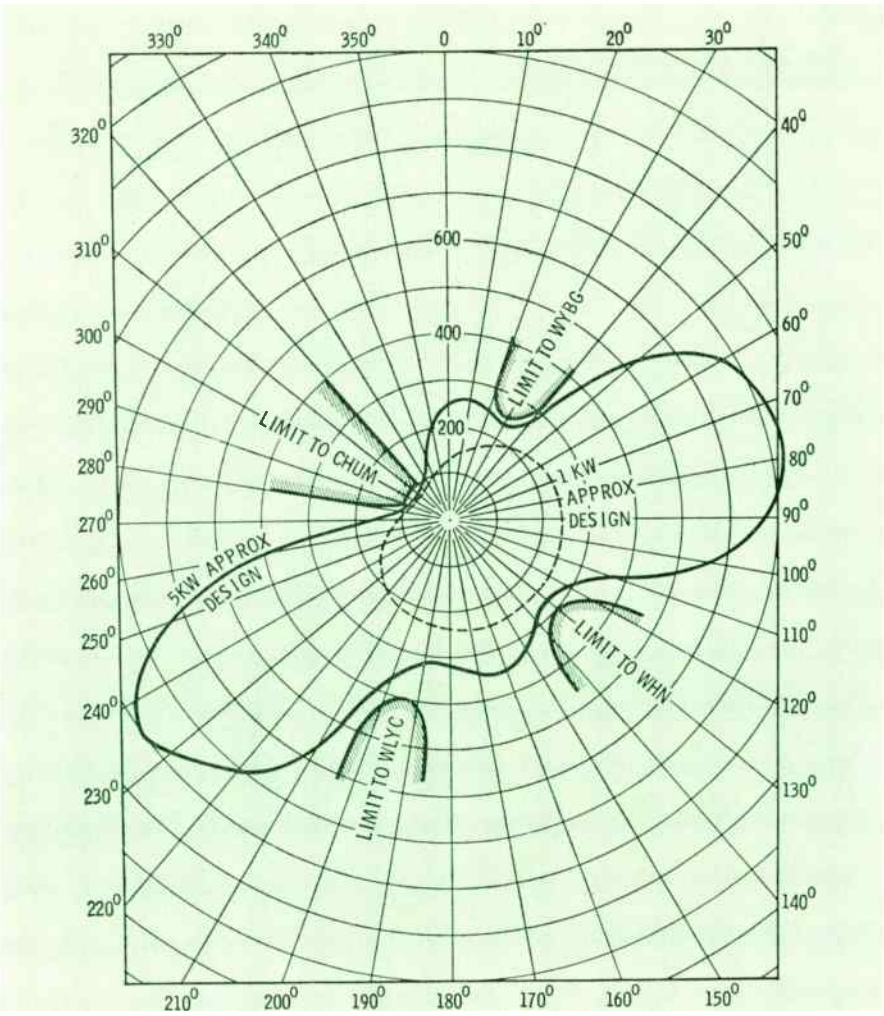

Fig. 3. Calculations show maximum possible radiation in protected directions.

Protection Graph

The "protection graph," or "maximum-allowable" graph, is a useful tool. It is used when it appears that a channel has possibilities (i.e., it has no prohibited overlaps). Fig. 3 shows a typical use of this graph. It is developed by calculating the protected contours of all existing stations. From an assumed transmitter site, the distance and bearing to all pertinent points along the protection contours are calculated next. If the path from the assumed site to any of the protected points crosses more than one soil conductivity factor, allowance must be made for this fact.

In Fig. 3, it can be seen that the smallest allowable radiation is about 100 mv/m (at approximately 300° azimuth). Therefore, a 250-watt nondirectional station is possible. If, however, more power is desired, a directional pattern would have to be used. For this purpose, the dashed line indicates a typical two-tower, one-kw design; and the solid line represents a possible four-tower, 5-kw design. By making intelligent guesses, the probable antenna requirements for several levels of authorized power can be estimated. It is not always easy to guess the number of towers required for a given power, since factors such as major-lobe direction, transmitter-site availability, nearby cities to be served, etc., affect this decision.

Use of Field Measurements

Field-intensity measurements are also helpful in the search for a new AM frequency. With current FCC policies, they are necessary in most applications. Previously, if calculations revealed a one- or two-mile overlap to the pattern of an existing station, it was a common practice to ignore it and file anyway, because the resulting interference was negligible. This concept is not looked upon with favor by the FCC today. In cases of doubt, field-intensity measurements may be necessary to predict whether prohibited overlap would or would not result from an assignment. In this study it is helpful to examine previous measurements on existing stations with which overlaps might exist. This information can usually be obtained at the offices of the FCC in Washington, D. C. For existing nondirectional stations, however, the information may not be on file.

Occasionally a "site test" can be made to predict accurately the coverage of a new station. These tests and other field-intensity measurements can be used to simplify the design of a directional antenna or to reduce the number of required towers. In the example in Fig. 3, field-intensity measurements from the proposed site might indicate that the radiation limit could be raised enough to allow for a 500-watt nondirectional allocation. Alternately, it might be possible to raise the limits enough to simplify directional antenna design. In some cases, one or two towers might be eliminated from the design. If so, the saving in additional tower cost would more than offset measurement expenses.

While discussing the use of field-intensity measurements, it is appropriate to mention a special technique used by one consultant. It is crude, but has worked on more than one occasion. In the city where a frequency is desired, a good automobile receiver is tuned across the broadcast band at full volume, and quiet spots are observed, Then, readings are made with a field-intensity meter on the quiet channels and the channels adjacent to them. More than one test location must be used, because any given location may yield low readings on a specific frequency. The average signal strength of several locations should verify the frequency.

How to Select the Best Frequency

Three general rules govern the selection of a frequency if a search reveals the availability of more than one at a specific location. These are: (1) all other things being equal, choose the lowest possible frequency, because greater coverage per radiated watt can be achieved at successively lower frequencies: (2) regardless of frequency, use a nondirectional pattern in preference to a directional system because of the cost factor; and (3) other factors being equal, select the frequency which permits the highest power.

The cost of building the station must always be given consideration. This involves the purchase or lease of ground for the antenna site. An elaborate directional system can require an extensive site. Also there is the cost of erecting and maintaining the towers, grounds, and phasors. Operating costs for a station using a directional antenna are greater because of the requirement for First Class operators. Other factors include predicted population coverage (which is a positive requirement of the Rules).

The Application Exhibit

Many readers are familiar with FCC Form 301. This form is used by applicants seeking new facilities or modification to existing facilities. Section V of the form is the engineering portion and, in addition to the frequency of application, requires that the coverage and interference studies used in the frequency search be submitted. There are prescribed contours and forms for these maps, but they are beyond the scope of this article. The point is that the information and maps used in the frequency search can also be used in the final application. Because of this, the names and sources of suitable maps are included here. These are the maps used to show the contours of existing and proposed stations and to compute maximum possible radiations.

The most frequently used map is the FCC Figure M-3. A portion of a simplified version of this map, Figure R-3, is shown as Fig. 4. This chart shows ground conductivity factors in the United States. An M-3 interference study is one of the exhibits required in the application. This map can be obtained from the Superintendent of Documents, Washington, D.C. Another map source is the United States Coast and Geodetic Survey, also in Washington. In addition to navigational charts, this office issues two base maps especially suited for the frequency search and application exhibit. One is the World Airways Chart (WAC) and the other is called the Sectional Chart. The difference between these charts is in the scale and total area covered. The WAC map has a scale of approximately 16 miles per inch. This is about double that of the Sectionals, which are used by pilots. When ordering them be certain to

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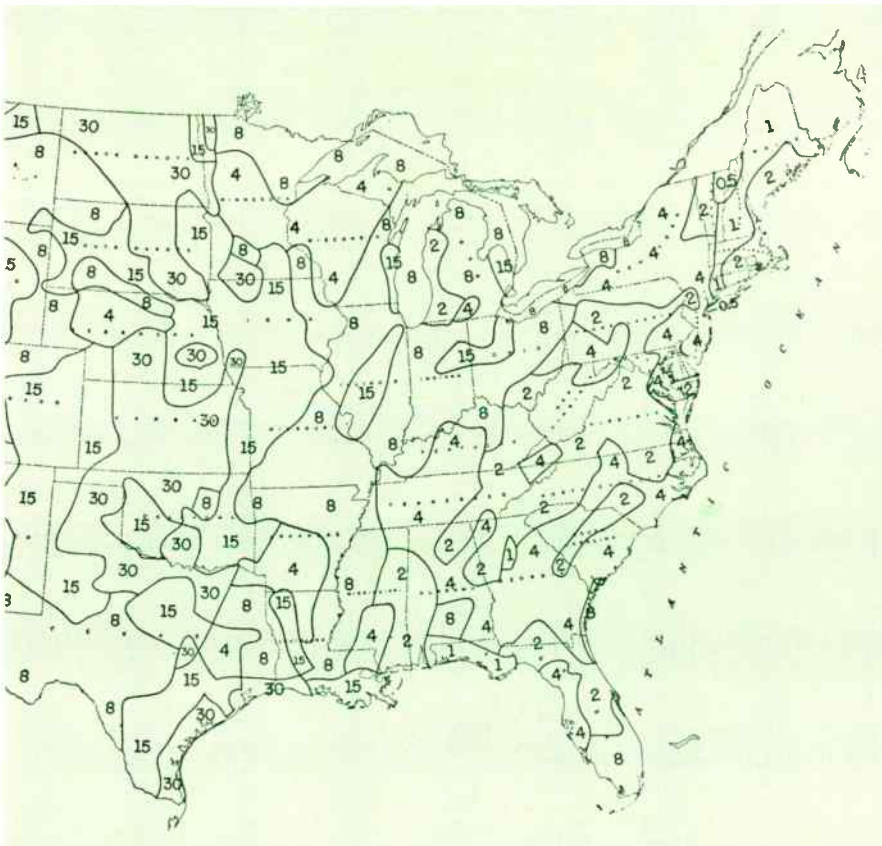

Fig. 4. FCC's Figure M-3 is simplified form of Figure R-3 for soil conductivity.

SIGNAL VARIATIONS OVER A FIVE-YEAR PERIOD

by Len Spencer, BE Consulting Author, and Chief Engineer, CKAC, Montreal, Quebec.—Daily recording of signal strength for five years has revealed large variations, apparently due to temperature changes.

In March, 1958, operation of CKAC's 730-kHz, 50-kw directional installation began. In keeping with approved practice, we took daily field-strength readings and recorded them, along with the temperature, at our downtown Montreal studio. This studio is within the 50 mv/m contour and is 18.5 miles from the antenna site. The purpose of the readings was, of course, to detect pattern shift. For the readings we used an RCA WX-2c field-strength meter permanently mounted inside the building.

As the first winter approached, a significant increase in field strength occurred until, on a day of bitter coldness (−14°F), the reading was 38 mv/m, compared to our proof reading of 24 mv/m.

By this time we were alarmed. Both transmitter and receiving-point meters were checked and found reasonably accurate. A trial proof was run, and all check points were found to be high in the same ratio as the daily check point at the studio. A thorough search of engineering texts, handbooks, and journals revealed no specific answer to our frustrating problem.

With the return of spring and higher temperatures, our readings returned to normal. By the third year of operation, a clear pattern of annual variation was evident; in winter our field strength in mv/m was more than half again that of summer. Effective propagation was clearly a matter of temperature.

In order to establish that temperature alone was the governing factor, we researched weather records and found no correlation of recorded field strength with such factors as rain, snow, sleet, cloudiness, or freedom from ambient moisture. Other variables given consideration were antenna common-point currents, leg currents, and phasing. The only variations found were directly related to line-voltage fluctuations. The maximum common-point current was 15.1 amps and the lowest, 14.8 amps. Temperature alone, therefore, appeared to be the controlling factor in our field-strength variation.

Our record keeping continued over a five-year period. Graphic representation of field strength vs time of year is shown in Fig. 1. Average extremes in field strength are shown for each month during the five year period, and the curve shows the mean average of monthly variations.

It can be seen from Fig. 1 that CKAC's effective radiated power was much higher in January than in June. Assuming that the June minimum of 21 mv/m represents nominal radiation of 50 kw, effective radiation of 164 kw in January can be developed in this manner:

Since field strength is proportional to the square root of the power[1],

$$F \propto \sqrt{P} \qquad \text{(eq 1)}$$

Therefore,

$$P \propto F^2 \qquad \text{(eq 2)}$$

where F = Field-strength in mv/m
P = Power in kw

Our next step is to establish a ratio between the maximum winter reading and the minimum summer reading; therefore,

$$\frac{P_w}{P_s} = \frac{F_w^2}{F_s^2} \qquad \text{(eq 3)}$$

where P_w = winter power in kw
P_s = summer power in kw
F_s = field strength in summer
F_w = field strength in winter

Developing for effective winter power, we arrive at the formula

$$P_w = P_s \left(\frac{F_w}{F_s}\right)^2 \qquad \text{(eq. 4)}$$

Substituting known values from Fig. 1.:

$$P_w = 50\left(\frac{38}{21}\right)^2 = 164 \text{ kw}$$

The effects of temperature upon field strength can be seen in Fig. 2. Fig 3 is the result of 1,325 readings at the studio and over 32,000 at the transmitter. From it one can easily observe a definite cyclic pattern in field strength. During the investigation, required readings were taken at specified points on designated radials; in addition, readings were also taken at the null point at three-month intervals. These readings substantiated our studio monitor findings, but the variations were not so pronounced.

It is our intention to continue this investigation by taking measurements on at least two radials during the winter and summer months. These will be made at distances much closer to the antenna in order to determine whether the effect is as great at shorter distances.

During the period of this investigation, parallel discoveries were made by Mr. Donald W. Howe, Jr., at WORC[2] and by Mr. Robert A. Jones at WIMS and WFRL[3]. From the data supplied by Mr. Howe, the curves in Fig. 4 have been developed for this article. Again the tempera-

[1] Terman, F. E., *Radio Engineering* (McGraw-Hill Book Company, Inc. New York 3rd ed. 1947), p. 611.

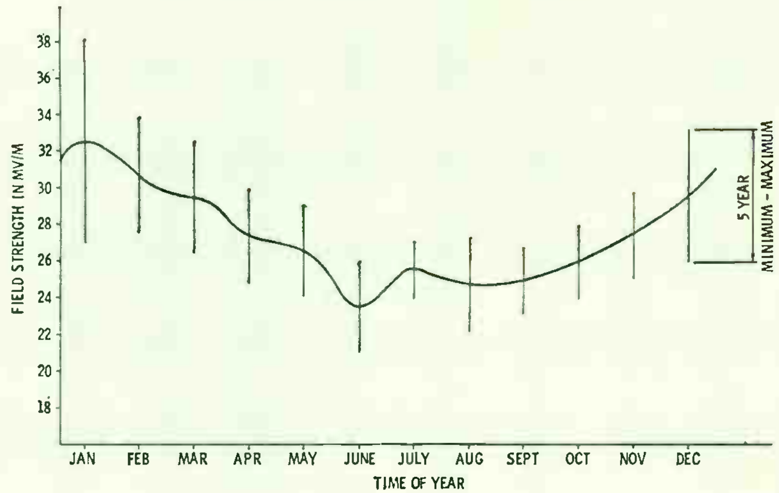

Fig. 1. Measured field strength at various times of year shows extremes of variation.

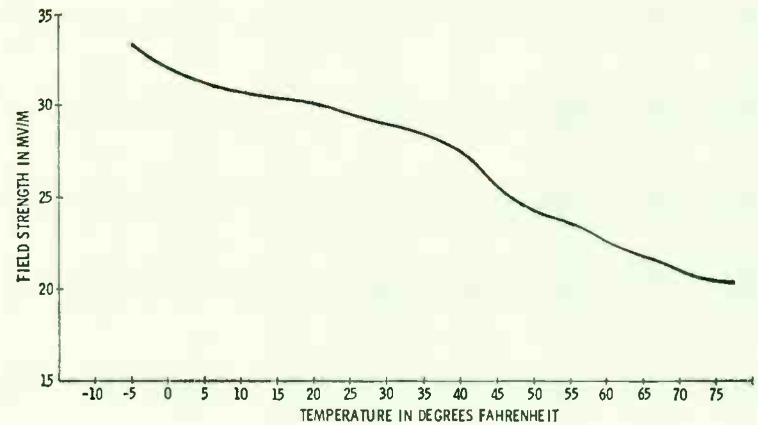

Fig. 2. Calculations indicate a relationship between signal strength and temperature.

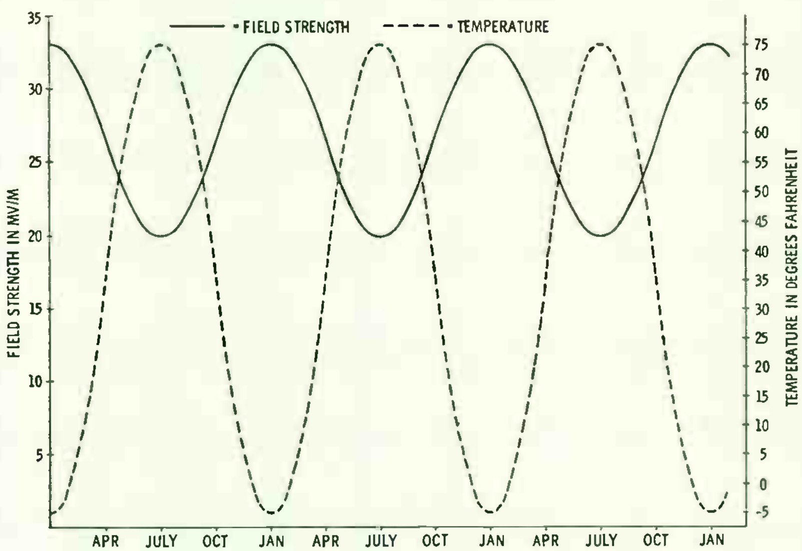

Fig. 3. Cyclic nature of variations reveals correlation with annual temperature changes.

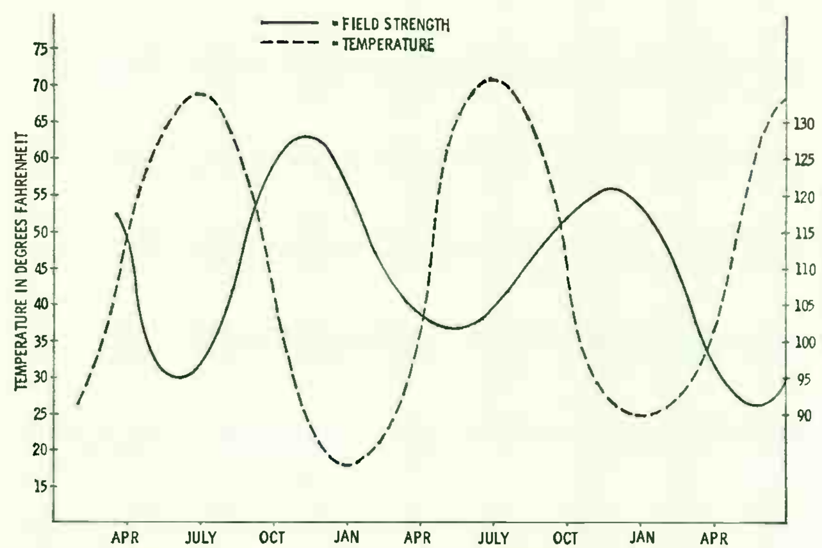

FIG. 4

Fig. 4. Curves of field strength and temperature developed from information for WORC.

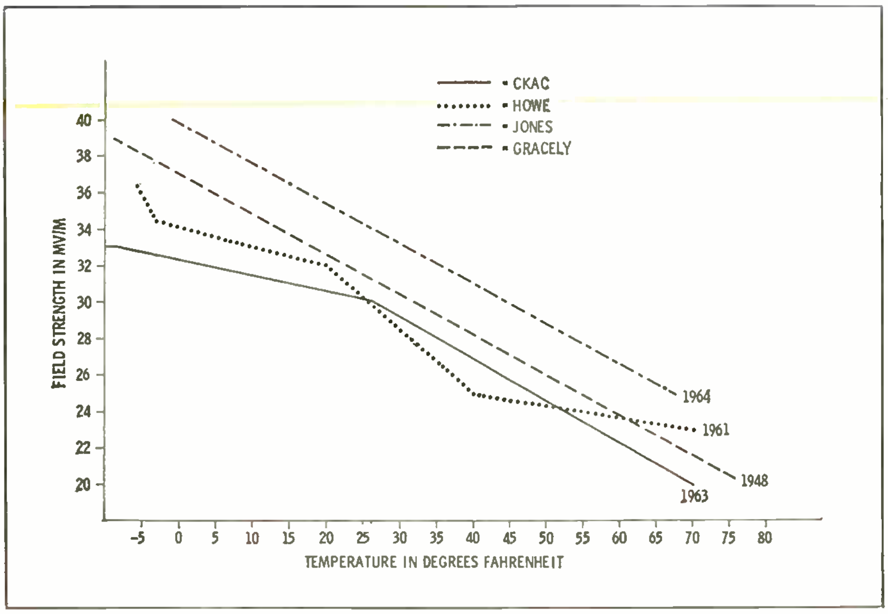

Fig. 5. Variation measurements from four sources over a seventeen year period.

ture/seasonal variation in field strength is evident. Observations of signal variation were published as early as 1949 by F. R. Gracely.[4] In each instance the temperature/seasonal variation in field strength is evident.

Fig. 5 is a comparative evaluation of each recorded report of seasonal variations. The phenomenon is consistent over a number of years, but variations in the degree of the effect would indicate that geographical location may be significant in assigning the cause.

From the data on CKAC, WFRL, WIMS, WORC, and Gracely, Table 1 has been prepared to show the variations in effective radiated power experienced at different locations over a period of time. Effective power has been computed from appropriate field-strength readings and the formula of Equation 4. Since information with respect to recorded temperatures was not available, a direct correlation between temperature and field strength could not be established.

Assigning the specific cause of this apparent phenomenon is difficult because very little research has been made, or at least, is available. Among serious hypotheses are temperature-coefficient factors in ground and air conductivity, and radiowave absorption by heavy runs of tree sap in heavily forested areas.

One study of this apparent phenomenon was undertaken by Frederick R. Gracely. In his summary he notes that variations of ground-wave signal intensity at standard-broadcast frequencies appear to be more closely related to changes in temperature than to any other single commonly observed meteorological measurement. Mr. Gracely's conclusions were based on an analysis of signal intensties and weather conditions over six paths between 30° and 45° north latitude, and at distances from 76 to 558 miles from respective radiation centers.

The distances involved in this study tend to indicate that ionospheric transmission is involved, but the CKAC observations were made at 18.5 miles and consistently between 9 and 10 a.m. These facts and the similarity of observations would seem to indicate that the ground wave is the more influential in producing the variations in signal strength.

At CKAC the question of the effect of changes in the character of vegetation was raised, because the difference of absorption or attenuation by tree foliage is quite marked in the 30 to 300 mHz range. It was suggested that low signal strength during the summer months could be attributed to this effect. This suggestion was discarded with the discovery that during January and February thaws and causal high temperatures, signal strength decreased to values obtained in early fall and spring.

This effect was also noted by Gracely, ". . . when an attempt was made to obtain correlations seasonally with vegetations, signal intensities at the same or similar temperature in various seasons were compared, but no appreciable trend or tendency toward grouping was apparent. Furthermore, there were short periods of high atmospheric temperature on a few winter days when signal intensities corresponding to the same temperatures in summer were closely duplicated, although presumably the vegetation would have been in a condition much different from that of summer. Two points should be further emphasized in this connection: The survey reported below consists of a large number of observations distributed over a range of frequencies, path locations, and path lengths; and the main bodies of the data in the two reports were in substantial agreement concerning the intensity versus temperature relationship."

"Probably the most promising data, next to temperatures, are those on precipitation," Gracely continues. "On most of the paths there were frequent instances of marked increases in signal intensity during, and for a few days following, periods, some of them with equally heavy rainfall, when no such increase occurred."

This was also observed at CKAC, but in nearly all of the observations the rainfall was also accompanied by a drop in temperature. This tends to support the first hypothesis, that temperature alone is the predominant factor in signal variations. No apparent correlation with barometric pressure appears in either study.

The 1949 paper corroborates the temperature theory: "Comparisons of intensities with atmospheric pressure, dew point, and vapor pressure were, in general, inconclusive. A few highly localized coincidences with humidity were observed: but

[2] Howe, Donald W. Jr. "Letters to the Editor" *Broadcast Engineering*, Sept 1964, p. 6.

[3] Jones, Robert A. "Winter-to-Summer Conductivity Effects," *Broadcast Engineering*, Sept 1964, p. 12.

[4] Gracely, F. R., "Temperature Variations of Ground-Wave Signal Intensity at Standard Broadcast Frequency," *Proc IRE*, April 1949, Vol. 37, No. 4, p. 360.

not enough to form a basis for generalized results."

It is assumed that ground conductivity and inductivity play a significant part in seasonal field-strength variations. Both are related to the material involved. Conductivity can vary considerably; sea water has conductivity of 4.64×10^{-11} emu, and a typical Pennsylvania countryside has conductivity of 6×10^{-14} emu, according to available tables. Translating this to terms of resistivity, we apply the formula

$$R = \frac{1}{G} \qquad \text{(eq 5)}$$

where R = resistivity in ohms/cm³ and G = conductivity in mhos/cm³
But first emu must be converted to mhos/cm³. This is accomplished by multiplying by the factor 10^9.

$$G = (\text{emu})\ 10^9 \qquad \text{(Eq 6)}$$

Therefore

$$R = \frac{1}{(\text{emu})10^9}$$

For sea water

$$R = \frac{1}{(4.64 \times 10^{-11})10^9}$$

$= 22$ ohms/cm³, approximately

For the ground of Pennsylvania, the answer is approximately 17,000 ohms/cm³. The resistivity of pure water would be approximately one-seventh that of the earth. It can be seen that the introduction of moisture into the ground can affect its resistivity considerably.

Table 1

Station	Frequency	Licensed Power	Season	Field Strength in mv/m	Maximum Effective Power
CKAC	730 kHz	50 kw	Winter	38.0	164.0 kw
			Summer	21.0	
WFRL	1570 kHz	5 kw	Winter	8.8	14.9 kw
			Summer	5.1	
WIMS	1420 kHz	5 kw	Winter	12.5	16.0 kw
			Summer	7.0	
WORC	1310 kHz	5 kw	Winter	130.0	10.0 kw
			Summer	92.0	
Gracely	—	50 kw	Winter	47.0	364.5 kw
			Summer	17.5	

The preceding can also be applied to inductivity, which is measured in terms of dielectric. The dielectric values of sea water, fresh water, and the described countryside are: 81, 80, and 13, respectively, in esu units. The entrance of moisture in excess of normal can also affect the dielectric of the ground through which a signal must pass. The effect which conductivity and resistivity have on signal strength can be ana-

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SIGNAL VARIATIONS RESEARCH PROJECT

During the past few years a number of observations have been made at broadcast stations throughout the country which corroborate the experience of CKAC, Montreal, Quebec, presented in this issue of BROADCAST ENGINEERING. Other items and articles of the same nature have appeared in previous issues.

In substance, it appears that there are seasonal variations in radiated signal strength which may or may not be the result of long-range, seasonal, temperature variations. In some cases the variations have resulted in extremes of radiation in excess of three times the licensed strength (in the case of CKAC, from 50 kw to 164 kw, effective). The consequences of these variations could theoretically result in any one of the following violations of engineering requirements: interference, pattern distortion (depending on how extensive the proof-of performance has been), failure to meet minimum contour strength, and retrogressive signal strength in normally fringe service areas.

In order to provide science with sufficient data to fully explore and act upon the problem, BROADCAST ENGINEERING is prepared to serve as the control agent in a major world-wide research project.

This will require the cooperation of a large number of our subscribers over a reasonably long period of time. As envisioned, the project should encompass all of the communications spectrum from the low to super-high frequencies, and at various points within each of the bands. Consideration should also be given to geographic distribution, normal weather patterns, radiated power, and the natural conductivity of soils at different radials in each pattern radiated.

At the conclusion of the project (which should take at least two years in order to establish cyclic patterns) BROADCAST ENGINEERING will accumulate, assess, and report at length upon the findings obtained from the project.

If your or your station is interested in becoming a part of this project, please write to

The Editor
BROADCAST ENGINEERING
4300 West 62nd Street
Indianapolis, Indiana 46206

In your correspondence, please include the call letters of the station participating, day and night power, exact geographic coordinates of the antenna site, appropriate contours (for AM stations 25, 5, and 1 mv/m), and if appropriate, for both day and night patterns; for FM and TV, city grade, and A and B; for microwave, normal receiving-point strength and degree of directivity, and an indication of whether appropriate instruments for reading field strentgh are available.

VERTICAL INTERVAL TEST SIGNALS

by *Patrick S. Finnegan,* BE Consulting Author, Chief Engineer WLBC AM-FM, WMUN FM, Muncie, Iniana—A description of these signals and the purposes for which they are used.

Vertical interval test signals (VITS) provide a method of dynamic evaluation of television systems during regular programming. The method evolved from the recommendations made by a committee composed of network, local telephone company, AT&T, and independent station engineers a few years ago. The system described here has not been adopted universally by either the networks or independent stations, but is in use in several places. In lieu of a universal system, a variety of test signals is now being tranmitted, but it is possible that a standardized VITS will be adopted by the FCC this year, and it is likely that this system will be employed.

The necessity for VITS is the consequence of several factors. Among these are: systems reliability itself, reduced shut-down caused by increased programming (normal testing being performed during shutdown), and increased use of color (which demands stricter system tolerances). The object of the method presented is to provide a continuous and simultaneous check of the entire system at one time. Its weakness lies in the ability of individual oscilloscopes to present a well defined display.

Many test generators provide all the signals used in the VITS, but on a continuous, individual basis. These generators cannot be used for VITS unless they are modified or redesigned with a VITS capability. A generator used for VITS must supply the individual test signals in proper sequence and at the proper place in vertical blanking, be locked to program sync, provide either internal or external unblanking of the correct position, and key in the correct signals in vertical blanking.

All of the networks transmit some form of VITS during normal programming. Those stations not network interconnected, or wishing to use VITS for local systems when network programs are not being carried, can modify test generators to VITS capability along with standard test signals.

FCC Rules and Regulations permit test signals to be transmitted on lines 17 through 20 in each field (during the vertical blanking interval). (See Fig. 1.) For this VITS system, lines 18 and 19 in each field have been selected, leaving other space for signals to be developed in the future.

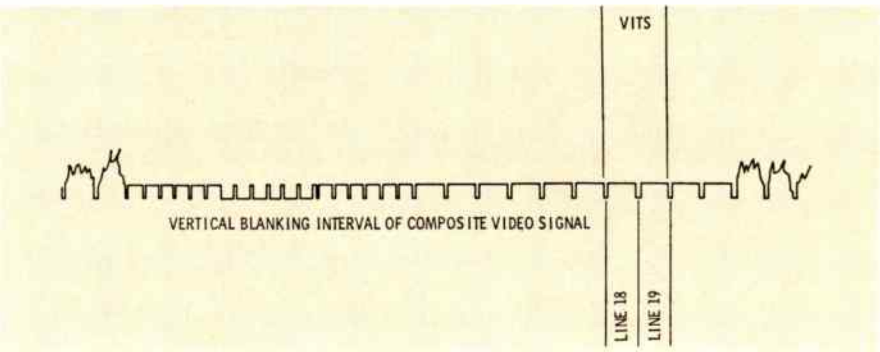


Fig. 1. Vertical blanking interval shows position of VITS on lines 18 and 19.

Standardized VITS

It is expected that a standard signal will be composed of signals (shown in Fig. 2) in this sequence and positions: line 18, field 1, multiburst; line 19, field 1, $\sin^2$ bar; line 18, field 2, some type of color test signal (undetermined to date — temporarily a multiburst); line 19, field 2, stairstep with 3.58-mHz color subcarrier on each step.

Each of the four lines will contain a program reference white pulse and a program reference black pulse, and a 3.58-mHz color sync burst will be in its normal back-porch position during color program broadcasts.

Monitoring

Displaying VITS requires a waveform monitor with good stability, a bright trace, and selection of fields. Most of the older waveform monitors and oscilloscopes are not VITS capable in one or more of these requirements. Newer waveform monitors are designed to handle VITS as well as normal program information. The monitors include the required stability, brightness of trace, and field selection; and they have preset selector positions, built-in filters, calibrated expanders, and calibrated graticules.

Test Signals

Most engineers are familiar with the individual test signals, but a brief review may prove helpful to those who are not.

Multiburst

This test signal consists of two elements: a square-wave pulse and 6 bursts of sine waves at different frequencies. The square-wave pulse is referred to as the "white flag," and its purpose is to establish white level against which the frequency bursts are measured. Some early generators do not provide this pulse. The bursts consist of a few cycles each at 0.5, 1.5, 2.0, 3.0, 3.6, and 4.2 mHz at all times.

Sin² Bar

This signal is composed of two individual test signals. The sin² pulse is actually one cycle of sine wave, displaced in time and axis so that negative peaks rest on the axis. The pulse width is measured in μsec. at the 50% (half amplitude, abbreviated HA) point. Between points where the waveform is tangent to the base line, the width is twice that of the HA point and, in μsec., is a measurement of one full period corresponding to the basic frequency of the signal.

The sin² bar is developed in this way: Consider the normal display of a single cycle of sine-wave voltage (Fig. 3A). The cycle starts from the zero-voltage axis, decreases from that point until it reaches the zero axis, changes polarity and increases in negative voltage until it reaches the negative peak, and decreases in voltage until it returns to the zero axis. The time elapsed between the starting point and the finish point on the zero axis determines the repetition frequency. In this example a 4-mHz sine wave is employed, so the time from start to finish is 0.25 μsec. This is represented mathematically by

$$f = \frac{1}{t}$$

where

f = frequency in mHz,

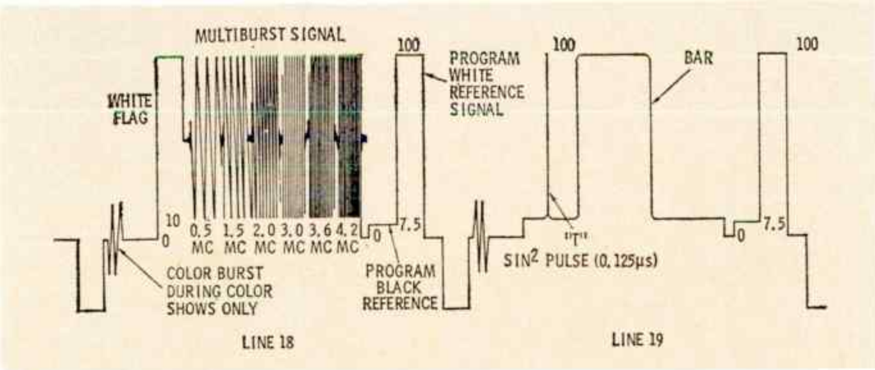
t = time in μsec.

In our case

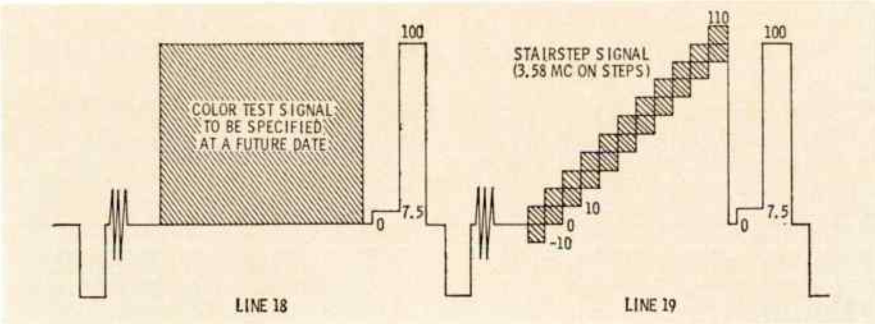
$$f = \frac{1}{0.25}$$

$$= 4\text{mHz}$$

Now consider the peak-to-peak voltage amplitude (Fig. 3B). The zero axis is at the 50% or half-amplitude (HA) level of the peak-to-peak amplitude. This is the point where the sin² pulse width is measured. This measurement is one-half the width of the full cycle. In our case, the basic 4-mHz period is 0.25 μsec., while the 50% measurement along the zero axis is 0.125 μsec (corresponding to 8 mHz).



(A) Field one



(B) Field two

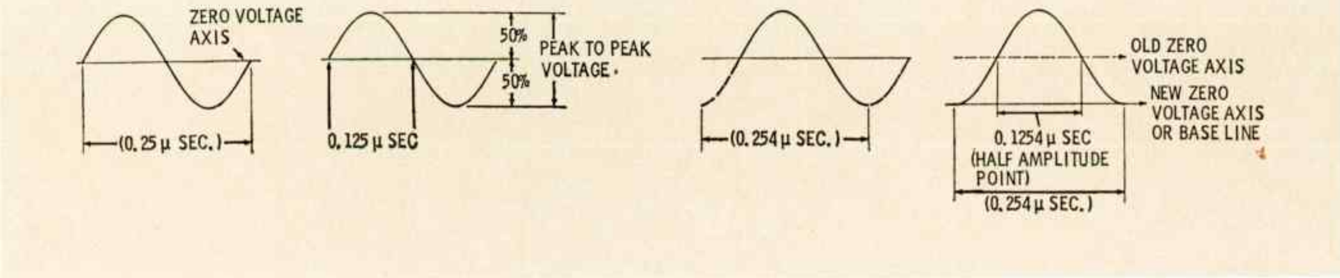
Fig. 2. Complete VITS signal shows location of various test patterns in fields.

In Fig. 3C the negative half cycle is split, and the right portion is moved to the left of the original sine wave so that the cycle starts at the first negative peak and ends on the second negative peak. The distance between the two negative peaks is one full cycle, and to complete the sin² pulse (Fig. 3D) it is only necessary to move these two peaks to rest on the zero-axis line, which now becomes the base or zero-voltage line.

This is a very simplified explanation. Actual pulse generation is much more complicated and requires special filters to insure correct slopes, widths, and freedom from harmonics in the waveform.

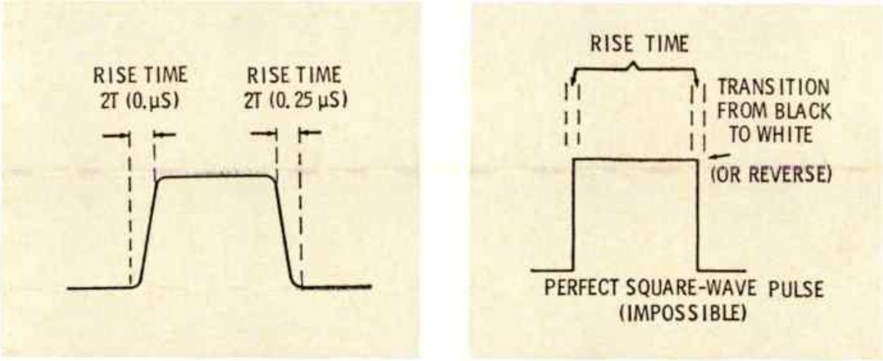
Most test instruments provide three pulse widths for television system testing: T/2 (HA width 0.0625 μsec), T (HA width 0.125 μsec), and 2T (HA width 0.25 μsec). The standard sin² pulse in VITS is the T pulse (HA width 0.125 μsec). This pulse provides transient-response indications for the television passband of 8 mHz, which is of the most interest to network and telco system transmissions.

Note in the preceding development of the sin² pulse that the HA width measurement is actually one half of the full-cycle width at the old zero-axis line. It is also the equivalent (in time) of the second harmonic of the basic frequency (4-mHz basic frequency second harmonic = 8 mHz). The special filtering insures that little or no spectrum energy beyond the second har-



(A) Basic sine wave (B) Proportions of wave (C) Displacement source (D) Completed pulse

Fig. 3. Simplified explanation of how sin² pulse is formed. In practice the pulse is relatively much higher.



(A) Bar pulse (B) Square wave pulse

Fig. 4. Comparative evaluation of bar pulse and theoretical square wave pulse.

monic content is found. Thus, the "T" designation corresponds to the upper limit of the passband to be tested, while the basic frequency is the center of the passband. Therefore, the standard T pulse is a basic 4-mHz cycle, but is designated by its HA width of 0.125 µsec, which corresponds to 8 mHz.

The Bar Signal

The bar is not a normal square-wave pulse. While it is similar in low-frequency energy level to the square-wave pulse, the high-frequency energy, as represented by the slope of its leading edge, is considerably different.

Expanding this pulse on a waveform monitor will disclose that the rising portion of the waveform is sin² shaped. Compare the square wave and the bar pulse shown in Fig. 4A and 4B. (A real square-wave pulse does not have zero rise time, of course, but more nearly approximates Fig. 4B than 4A.) A square-wave pulse has a large number of high-frequency harmonic components. In the bar pulse, the leading and trailing edges are the equivalent of a 2T sin² pulse, whose frequency-component voltage drops to zero at 4 mHz. The bar pulse is excellent for analysis of low-frequency distortion, indicated by trailing blacks or whites in a picture. The 2T pulse edges aid in the test of mid-frequency ranges of the passband signals.

Stairstep

This is the familiar stairstep test signal, with a 3.58-mHz sine-wave burst on each step.

Using VITS

VITS are designed to indicate system performance during programming; that is, they provide a dynamic and continuous test of the system with measurable test signals, rather than depending on evaluation of constantly moving program material on the kinescope or waveform monitor.

Readers should be cautioned that these signals do not constitute a complete system test, but many indications of how well the system is performing in a number of important areas are given. They are important indicators in that they show a balanced system performance in various critical areas at the same time. Where the indications are of poor performance, the usual standard test methods and procedures are used during regular maintenance periods.

The multiburst is excellent for a spot frequency check of the system amplitude frequency response. That is, it will check response through 4.2 mHz. For equipment having greater band-width, obviously the multiburst signal gives no information about the higher frequencies. For example, the system may have a serious overpeaking condition at 6-mMz, but the multiburst would not show this condition. (See Fig. 5.) Similarly, this signal will not show over-peaking conditions occurring at frequencies between the burst frequencies. The passband of transmitters is 4.5 mHz, so the multiburst provides an excellent spot check of amplitude response in the transmitter. Here again, it will not indicate lower sideband suppression, or serious overpeaking between the burst frequencies. In all cases where the multiburst indicates amplitude distortions, an adjustment depending entirely on the multiburst should not be made. A sweep signal during the maintenance period is the preferred method. Internal peaking coils in individual units can then be adjusted properly, or malfunctioning components can be changed. Some adjustment to level and peaking controls during operation can be accomplished if misadjustment seems to be indicated.

The sin² pulse indicates system transient response. A decrease in sin² pulse amplitude indicates a reduction in high-frequency response. Ringing problems caused by overpeaking, equalizers, and ghosts or echos on transmission lines (including those received in off-the-air systems) will also be revealed by this pulse. Fig. 6 shows how ringing is indicated by leading or trailing ripples and overshoots at the base line. More severe overshoots indicate greater deterioration of the transmitted picture. Overshoots toward the negative, or black, region will show up on the picture as black lines or negative images, while those going toward white, or positive, will show up as white outlines or positive ghost images. The distance from the pulse to the ripples or reflections is the same in the reproduced picture. Ringing caused by equalizers or overpeaking will be close to the main pulse, while ghost images will be farther away. Ringing caused by the passband filters and suppression in the transmitter of part of the lower sideband appears at the right side of the pulse. "Preringing" can be caused by cable problems or may be a predistorted signal caused by color phase equalizers.

The bar pulse is useful for checking low-frequency distortion, as with any window or square-wave pulse. Tilting of the pulse, overshoots, and undershoots at the edges will indicate low-frequency problems. These will appear in the picture as trailing black or white smears following large objects.

Some of the newer waveform monitors have special graticules de-

• *Please turn to page 40*

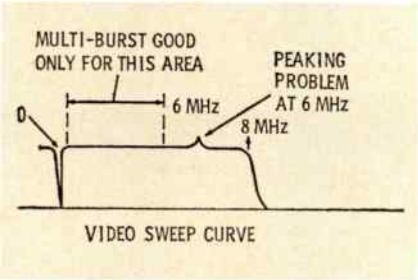


Fig. 5. Analysis of video sweep curve shows limits of multifrequency burst.

THE 13TH ANNUAL AUDIO ENGINEERING SOCIETY SPRING CONVENTION

Highlights of the Society's West Coast Convention.

William L. (Bill) Robinson given award for contributions to Society.

Bill Robinson Presented Award

William L. (Bill) Robinson, director of recording at Capitol Records, Inc., was named recipient of the Audio Engineering Society Award as a major contributor in the field of audio engineering, and as the person who has helped most to advance the society.

Among his many contributions has been the translation of professional audio standards and techniques into the Spanish language. This document has been a "bible" in Mexico and South America for more than a decade.

Mr. Robinson's career has included being the chief engineer of a Los Angeles radio station at the age of 14, a member of the engineering staff of WDAF in Kansas City at the age of 15, and of WABC in New York at age 16.

Attendance at the California Institute of Technology was interrupted by service with the U. S. Army Air Corps during World War II. During this service he was a senior music mixer for the Army Hour and made the first radio broadcast from a combat B-29 over Japan. Later he did many Southern California remotes for the Mutual Broadcasting System until he joined Capitol Records.

The 13th annual Audio Engineering Society Spring Convention was considered the most successful in the history of the society in terms of number of attendees, exhibitors, and papers presented. Delegates from four continents witnessed the presentation of 50 technical papers in nine sessions, and saw the latest products of 28 exhibitors specializing in professional audio equipment.

Guest speaker at the convention banquet was Joseph Sonny Burke, vice-president and head of the Artists' and Repertoire Department of Warner Brothers' Reprise Records. He discussed the critical interface between the artists and the audio engineer and described a unique educational approach to training future professionals in the audio field.

In a special ceremony, William L. (Bill) Robinson, director of recording for Capitol Records, Inc., was given the Society's highest award for his many contributions to the audio and recording industries.

Exhibitors overflowed convention headquarters in the Hollywood Roosevelt Hotel, Hollywood, California. One exhibitor was forced to rent space in the hotel's mezzanine. Products on display covered the entire professional audio recording spectrum.

Papers in the technical sessions were related to loudspeakers, solid-state amplifiers (stressing field-effect transistors), magnetic tape recording, recording and broadcast applications, microphones, audio measurements, and audio application. A paper of special interest to attending engineers was "Field Effect Transistors in Audio Preamplifiers," presented by Donald L. Wollesen of Motorola Semiconductor, Inc.

In order to provide more space for exhibitors and delegates, it is expected that the Society will move to larger quarters in future conventions. ▲

Joseph (Sonny) Burke speaks to AES on engineer/artist relationships.

AES 1966 Spring Convention
List of Exhibitors

Aerovox Corp., HI-Q Div.
Altec-Lansing
Ampex Corp.
Audio Industries Corp.
Bauer Electronics Corp.
The R. T. Bozak Mfg. Co.
Electro-Voice, Inc.
Fairchild Recording Equipment Co.
Gauss Electrophysics
Gotham Audio Corp.
HAECO
Lipps, Inc.
Magnetic Recorders Co.
3M Company
North American Philips Co., Inc.
Scope Electronics Corp.
Scully Recording Instrument
Sennheiser Electronic Corp.
Shure Brothers, Inc.
Spectra Sonics
Taber Manufacturing and Engineering Co.
Teletronix Engineering Co.
Telex and Magnecord
Universal Audio-Studio Electronics Corp.
Vega Electronics Corp.
Waveforms, Inc.
Westrex Division of Litton Industries

AN INEXPENSIVE WAVEFORM CAMERA

by the staff of the ETV Technical Department, South Carolina Educational Television Center—Instructions for adapting an inexpensive camera and plans for constructing a hood and holder are presented.

Photographs of oscilloscope waveforms, for reference in equipment adjustment and evaluation of performance, are a useful adjunct to good maintenance. This is particularly true when a large amount of equipment is involved. South Carolina Educational Television is comprised of two stations in operation, one under construction, and a large studio complex. The need for waveform photographs was acute. With the need and value of the photographs apparent, we set about developing a system.

These criteria for a system were established:

1. Must take pictures which could be developed easily and quickly.
2. Must be inexpensive.
3. Must fit the Tektronix 524, 527, and 543 oscilloscopes.
4. Must be easy to put on and take off.
5. Must be able to take recognizable waveform photos.
6. Must be easy to make.

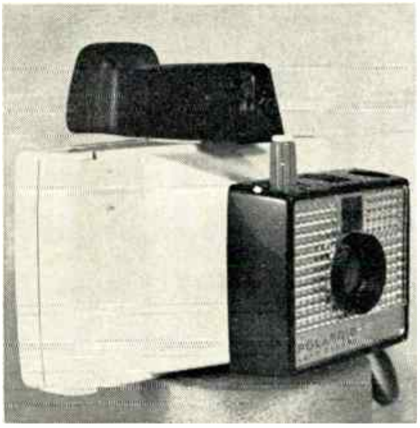


Fig. 1. Polaroid "Swinger" camera as manufactured and sold over counter.

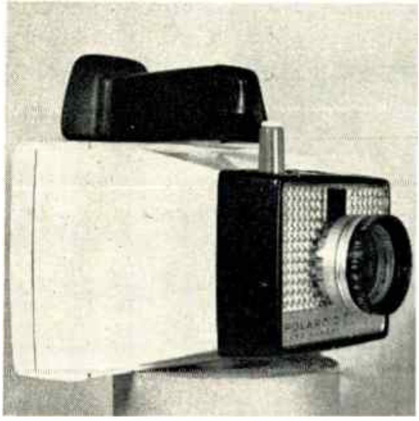


Fig. 2. Modified camera with close-up lens holder and one of "Portra" lenses.

It appeared that a Polaroid type camera would best fit specification 1, and the recent advent of the "Swinger" camera (Fig. 1) for less than $20 satisfied requirement 2.

As shipped from the factory, the "Swinger" has a shutter speed of 1/200th of a second, with a fixed-focus plastic lens and an ingenious light-control device. The only film available for the camera has a speed of 3000.

To take satisfactory pictures of an oscilloscope screen with this camera, it is necessary to remove the fast shutter and add two close-up lenses. It is also wise to remove the light-control mechanism in order to reduce operator error. With plus 2 and plus 3 close-up lenses, the distance for best focus is approximately 7 inches from the face of the scope graticule to the front of the camera lens. The camera with close-up lens holder and lenses is shown in Fig 2.

A hood was designed to hold the camera steady on the scope and to provide a shield against extraneous light. The hood had to be adapted to several types of scope, and has to contain some means to adjust focal distance. It was decided to construct it of sheet aluminum. The finished hood is shown in Fig. 3. The completed camera and housing are shown in Fig. 4.

For those who wish to build this unit, the following construction details are suggested:

1. Construct the hood.
   a. Cut out parts as indicated by Fig. 5. It is advisable to cut extra shims at this time. Additional shims may be necessary to adjust focal length on different scopes.
   b. Carefully fold flaps on top, bottom, and side pieces as indicated by dotted lines. Note that flaps on end of each piece will fold outward when these pieces are assembled. (Study Fig. 3.)
   c. Assemble top, bottom, and sides. Use screws, rivets, or (if flaps are in good shape) epoxy glue.
   d. Attach scope mounting plate to hood.
   e. Fold flaps on camera-front retaining clamps and camera mounting plate.
   f. Attach camera-front retaining clamps and camera mounting plate shim.

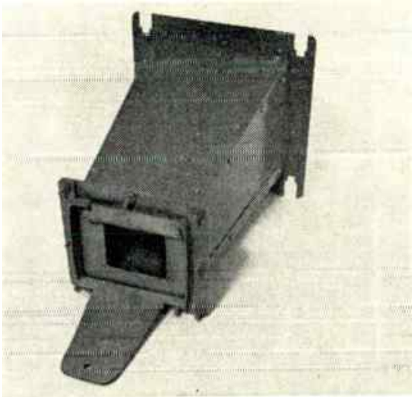


Fig. 3. Complete hood assembly before installation of reconstructed camera.

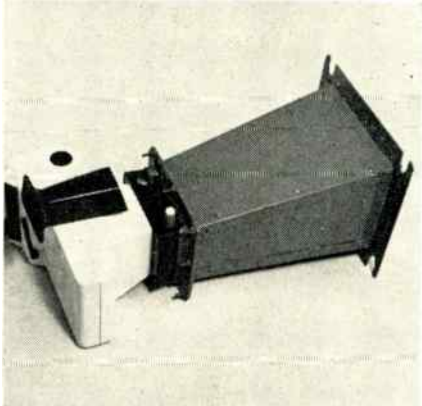


Fig. 4. Waveform camera assembly ready for mounting on oscilloscope.

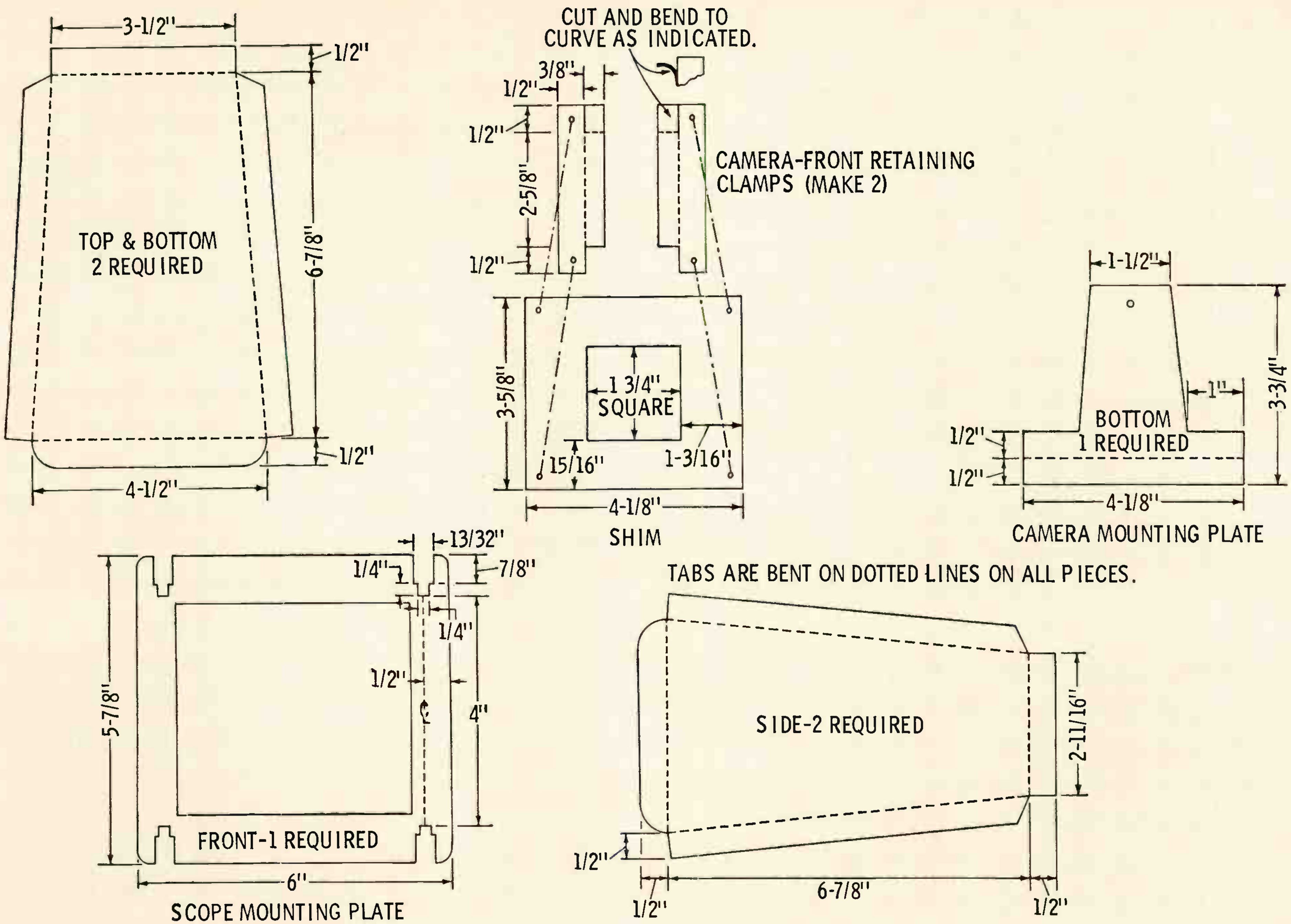


Fig. 5. Layout of parts for waveform camera hood. Enlarge plans to full size before cutting and assembling members.

Fig. 7. Front of camera removed arrow shows screw holding back plate.

   g. Attach shim to hood with nuts and bolts.
2. Camera Modifications.
   a. Open rear cover and remove battery compartment.
   b. Remove three small Phillips-head screws which hold the front of the camera to the body (Fig. 6).
   c. Separate the front.
   d. Remove the single Phillips-head screw which holds the back plate (Fig. 7).
   e. Remove the back plate. This exposes the shutter plate.
   f. Remove the plastic flash-bulb ejector, and remove the two small Phillips-head screws which hold the shutter plate (Fig. 8).
   g. Remove the shutter plate (Fig. 9).
   h. Using long-nose pliers, remove the tension spring (a in Fig. 9) on the light aperture sheaves; then carefully pull out the rivet (b in Fig. 9) at the axis of the sheaves.
   i. On the front of the shutter plate (the side facing the lens) remove the tension spring (c in Fig. 9) from the snap shut-

Fig. 8. Back plate removed with arrows indicating screws requiring removal.

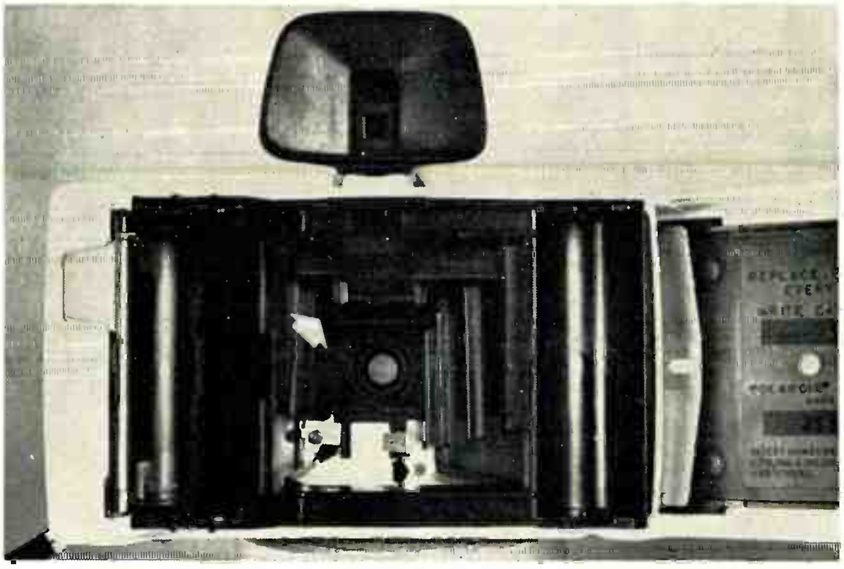


Fig. 6. Inside of camera. Arrows indicate which screws are to be removed.

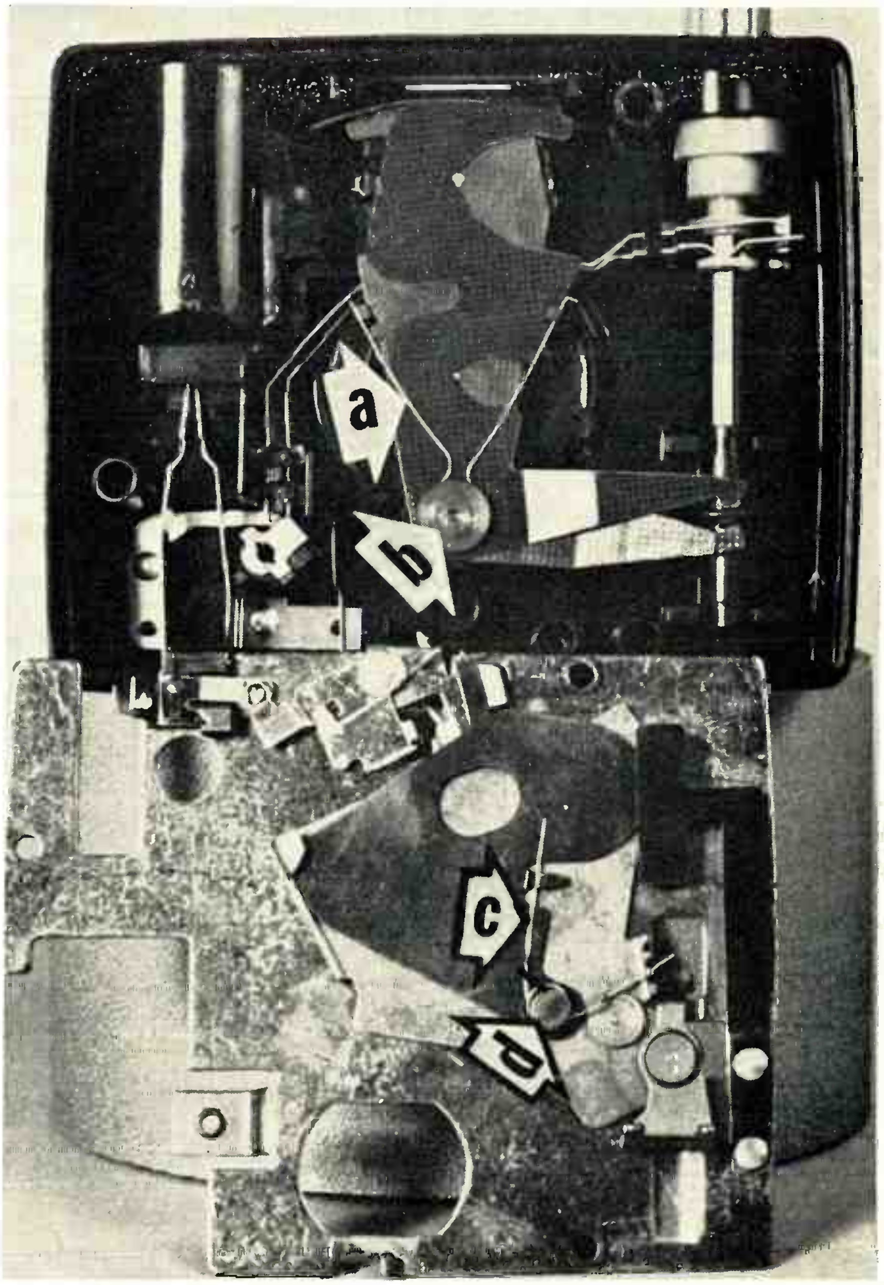
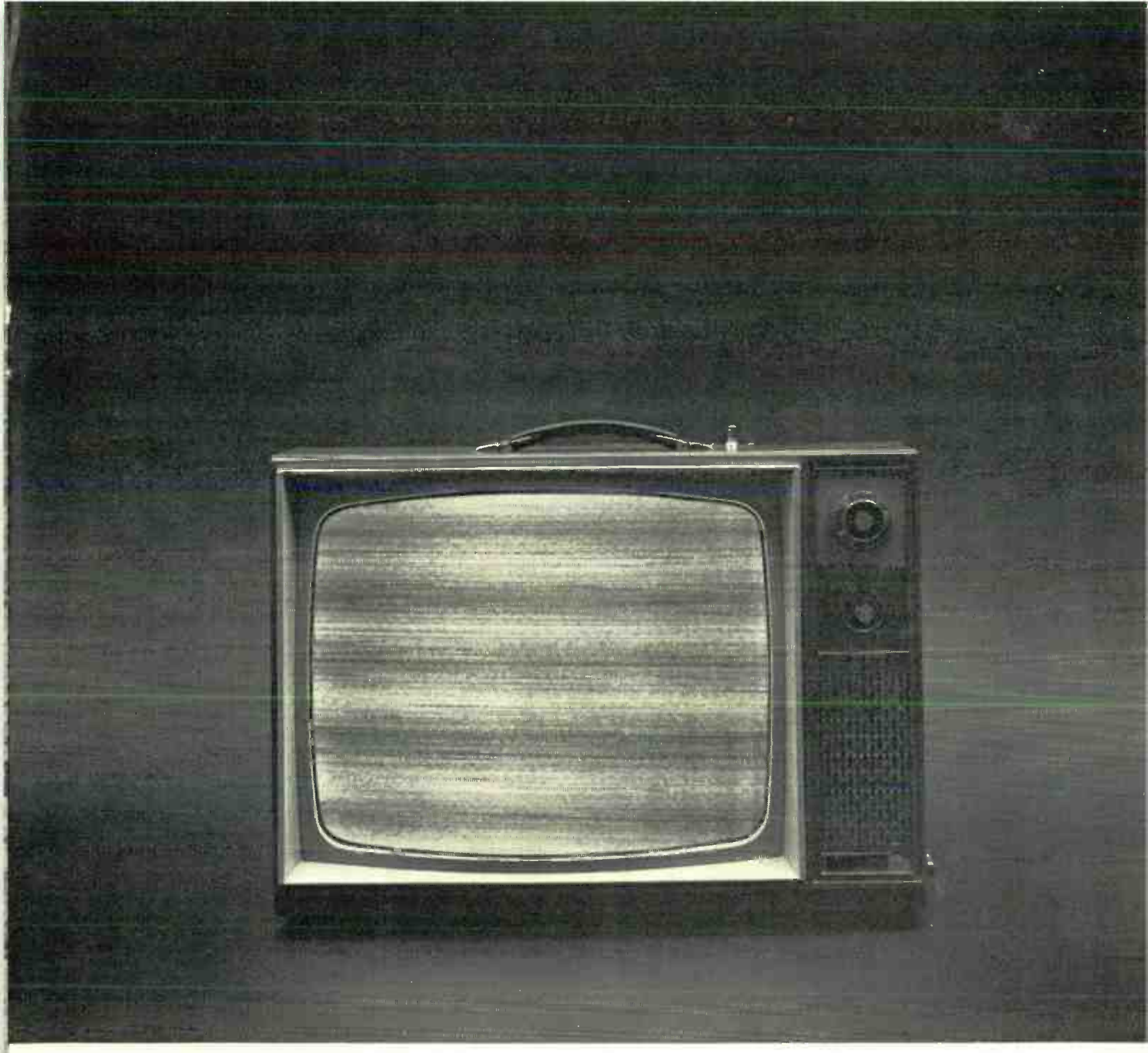


Fig. 9. Shutter plate and front of camera. Arrows point to: (a) sheave tension spring; (b) sheave rivet; (c) shutter tension spring; and (d) shutter rivet.



This kind of programming costs you money

You're in business for one reason: to make a profit.

Anything that takes away from your profit-making is your enemy. That's why you're way ahead when you choose Lenkurt microwave transmission equipment for your CATV or ETV system.

For instance, there's our 76 TV microwave relay system that has become the standard of the industry, due to its outstanding performance, ease-of-maintenance, and economical operation. 76 TV is designed to handle monochrome or color transmission and lets you insert and drop programs with ease at intermediate locations.

There is also Lenkurt's 75A, the ideal backbone microwave relay system. Because of its non-demodulating heterodyne repeaters, 75A delivers clear, sharp monochrome and color TV pictures regardless of distance, terrain, or weather.

Lenkurt microwave systems have proved themselves in virtually every situation. From high on Freel Peak in Nevada where 76 TV brings in a sharp high-resolution picture (even when snow levels reach 20 feet), to an ETV closed-circuit system at the University of Kansas Medical Center. And our 75A has been transmitting high quality pictures for a number of CATV networks in New York and Pennsylvania.

And remember, when you buy Lenkurt equipment, you are buying more than hardware; you are purchasing Lenkurt's heritage and reputation for quality and continuity.

It all comes down to this: when you're thinking about microwave transmission equipment, for any application, think of Lenkurt. We'll show you how to improve your picture – both TV and profit. Write or call Lenkurt Electric Co., Inc., San Carlos, California. Other offices in Atlanta, Chicago, Dallas, and New York City.

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Circle Item 9 on Tech Data Card

ter; then carefully remove the rivet (d in Fig. 9) holding the **snap shutter only** (Fig. 10). This rivet must be broken off. Fig. 10 shows the shutter plate and front of camera with modifications completed.

j. Replace the shutter plate and secure two screws.

k. Replace the back plate and secure the single screw.

l. Replace the front portion on the camera body and secure the three screws.

m. If the same type camera mounting plate as shown in Figs. 3, 5, and 11 is used, place the camera in the holder, and mark on the underside where the bushing should be. Using caution, drill a hole large enough to accept the bushing with a rather tight fit, and force it in place (Fig. 11).

n. Remove the batteries and replace the battery holder.

o. Push on the close-up lens holder, with the plus 3 lens closest to the camera (Fig. 2).

3. If the illustrated scope mount is used, note the shape of the slots in the front plate. These will accept the bezel mounting studs on most Tektronix oscilloscopes.

The system is now ready to operate. The camera shutter remains open as long as the plunger is depressed. By removing the mounting and close-up lenses, the camera can be used to take pictures of objects other than waveforms.

We have found it necessary to experiment with individual scopes for proper adjustment of intensity and graticule illumination. The length of exposure is also established by experimentation. Pressing the plunger and immediately releasing it seems to provide the best results. A timed shutter could be devised.

In use, the camera has taken some excellent pictures of equipment and transmitter characteristics, as can be seen in Fig. 12. There is a slight "pincushion" effect at the edges of the pictures which was caused by the original plastic lens. For us this was not a draw-back serious enough to warrant the extra labor and expense of an additional lens.

These cameras have been in use at SCETV for several months, and we have found them to be excellent for their purpose. Total cost is under $30, and an eight-exposure roll of film sells for less than $2. It has been a good investment.

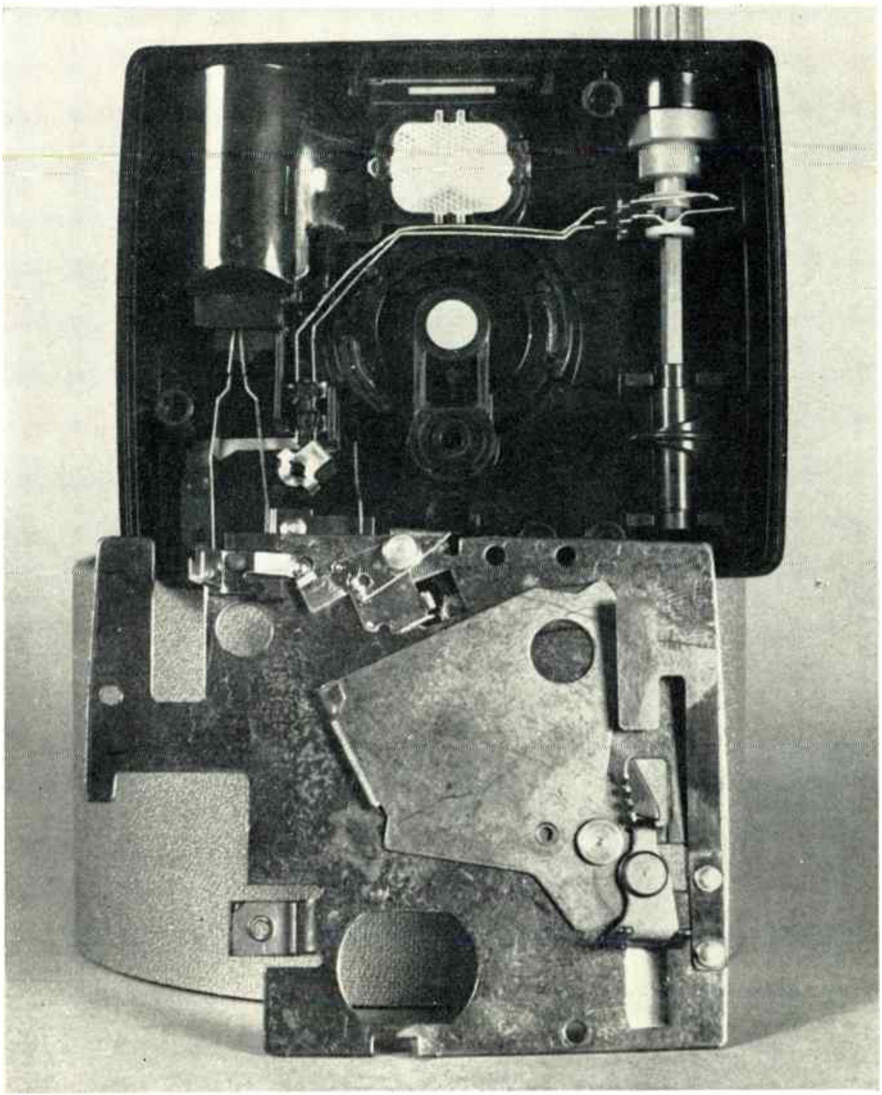


Fig. 10. Camera before reassembly shows that modifications have been completed.

Parts List

Polaroid "Swinger" camera.
1—sheet thin aluminum.
1—Series 5 Portra lens, plus 2.
1—Series 5 Portra lens, plus 3.
1—Series 5 adapter ring, 1⅛-in diameter.
1—Series 5 retaining ring.
Rivets or machine screws, threaded bushing.

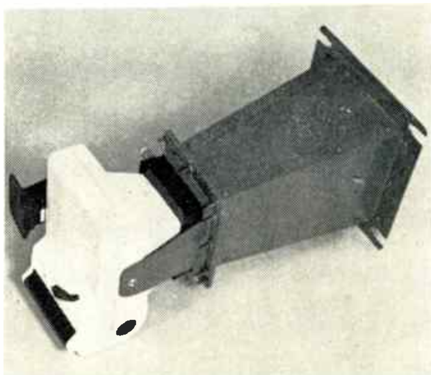
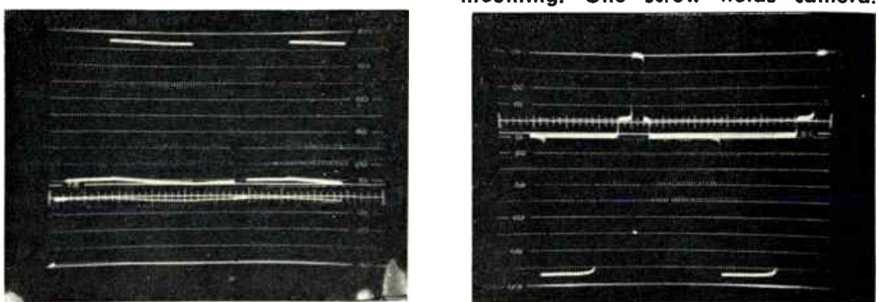


Fig. 11. Closeup of camera bottom mounting. One screw holds camera.



(A) Field rate

(B) Line rate

Fig. 12. Photographs of waveforms taken with the inexpensive waveform camera.

EIMAC offers new 1 kW PEP tetrode for SSB with highest linearity—at least -40 db in typical operation

EIMAC's new 4CX1500B power tetrode is the most linear tube on the market; intermodulation distortion characteristics under typical operating conditions are at least −40db at all drive power levels from zero to maximum. The new tube is ideal for advanced single sideband transmitters demanding high linearity to avoid channel-to-channel interference. The 4CX1500B is the product of a four-year development study which included optimization of internal tube geometry by computer techniques. Rated maximum plate dissipation of this radial beam tetrode is 1500 watts, and control grid dissipation rating is 1 watt maximum. Because the 4CX1500B has very low grid interception (typically less than 1.5 mA grid current), it is possible to drive the grid positive without adverse effects upon the distortion level; the tube is therefore recommended for Class AB_2 linear amplifier service. For further information, write Product Manager, Power Grid Tubes, or contact your nearest EIMAC distributor.

TYPICAL OPERATION (Frequencies Below 30 MHz)

DC Plate Voltage	2500	2750	2900 volts
DC Screen Voltage	225	225	225 volts
DC Grid Voltage	−34	−34	−34 volts
Zero-Signal DC Plate Current	300	300	300 mA
Single-Tone DC Plate Current	720	755	710 mA
Two-Tone DC Plate Current	530	555	542 mA
Driving Power	1.5	1.5	1.5 watts
Useful Output Power	900	1100	1100 watts
Intermodulation Distortion Products			
3rd Order	−38	−40	−40 db
5th Order	−47	−48	−48 db

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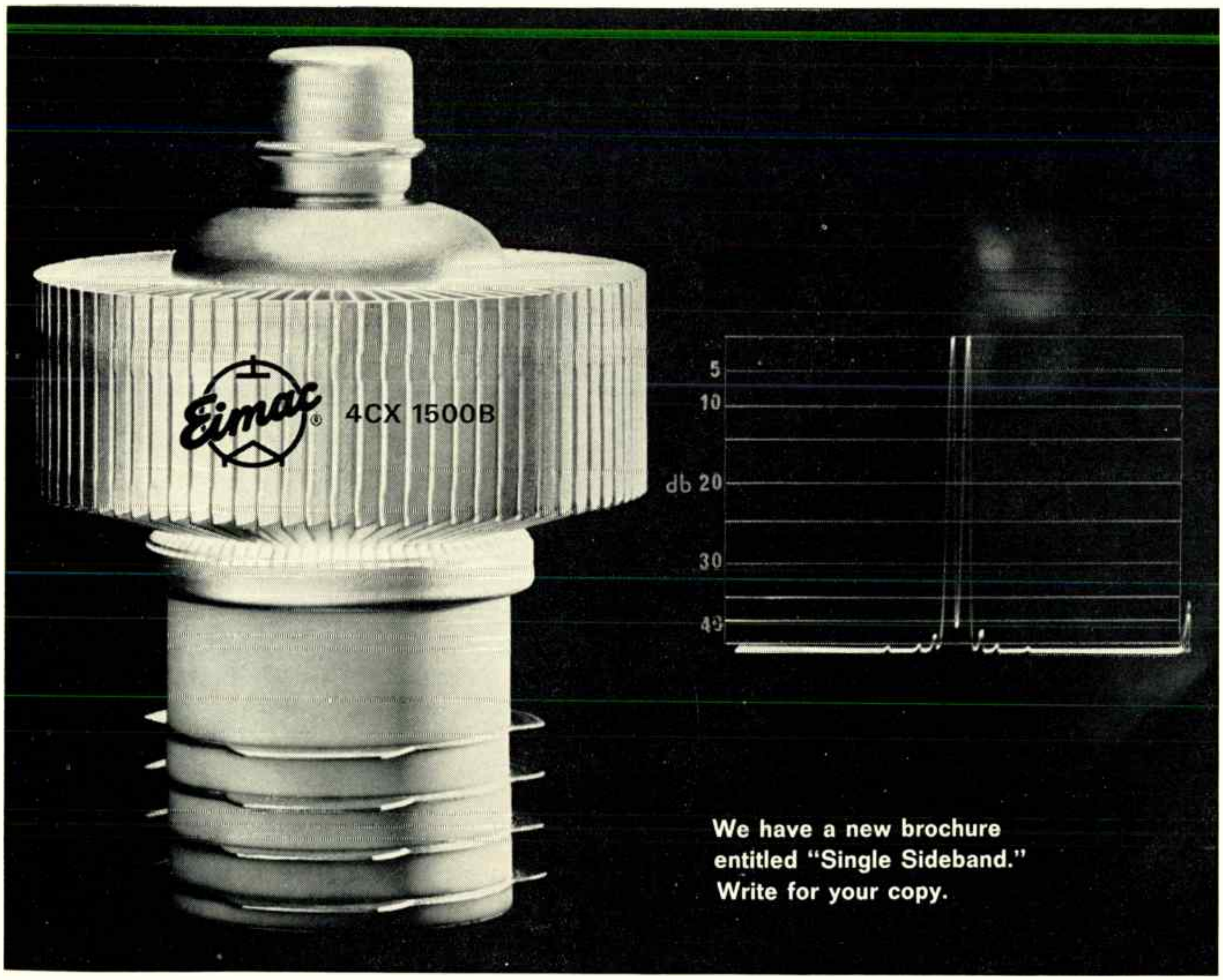


Circle Item 10 on Tech Data Card

PREDICTING FM FIELD STRENGTH

by C. G. Cunningham, Professional Engineer, Taos, New Mexico—
A transmitting antenna below average terrain requires an unusual application of conventional procedures.

It has been a common practice to locate FM antennas on available structures, usually AM towers. This practice can present a problem in the prediction of FM coverage because the radiation center of the antenna may fall below the average terrain on one or more radials. In the valleys of the West the problem arises often because of the topographic structure of the landscape. The consequence is that prescribed FCC methods for predicting coverage are not feasible, since no allowance has been made in the curves for this condition.

Predicting FM Field Strength

Paragraph 73.313, FCC Rules and Regulations, describes a standard method for predicting FM field strength vs. distance. This method requires the use of curves and sliding scales published as Figure 1, Paragraph 73.333. Fig. 1A is a reproduction of the curves, and Fig. 1B is the necessary sliding scale.

Employment of the curves first requires that a profile of local terrain be made along each of eight radials extending ten miles from the antenna site. The radials begin at true north and occur at 45° intervals, with at least one radial through the principal center of population to be served by the station. If the prescribed radials do not satisfy this requirement, it is necessary to profile one or more additional radials. The Rules further require that an average altitude of the portion of each profile between two and ten miles from the antenna site be found by utilizing a planimeter or mathematical computation. This average is called "average terrain" for each radial predicted.

When the average terrain elevation is subtracted from the elevation of the FM radiation center above sea level, the effective antenna height is obtained. In order to use the curves in Fig. 1A, place the right edge of the sliding scale at the point on the x axis which corresponds to the effective antenna height. Move the sliding scale upward or downward so that the effective radiated power is set on the straight horizontal line in the middle of the chart. The intersection of the sliding scale with the appropriate distance curve determines the field intensity indicated on the right edge of the scale.

This method provides a simple and direct approach to a complicated problem. However, the charts do not provide facilities for those occasions in which the effective antenna height is less than 100 feet. In many cases the antenna is below average terrain.

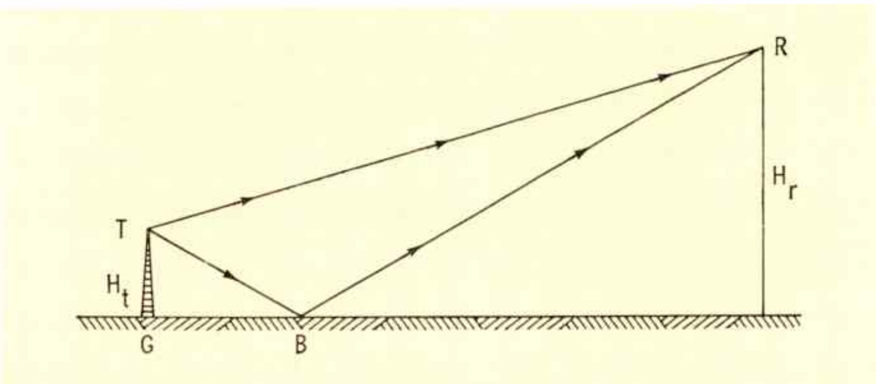


Fig. 2. Signal paths where transmitting antenna is below receiving antenna.

Antenna Height vs. Field Strength

Before approaching the problem of "underground" antennas, it seems appropriate to examine briefly the propagation mechanism with respect to the effect which antenna height has on the intensity of the received radio signal.

The influence of antenna height develops through the cancelling effect of the reflected wave on the direct wave. For the purpose of this discussion we will assume that the earth (at FM frequencies) is a perfect reflector. Experience has substantially validated this assumption.

In Fig. 2, H_t is the height of the transmitting antenna, and H_r is the height of the receiving antenna. The transmitting radiation center is located at point T, and the receiving antenna is located above it (typical-

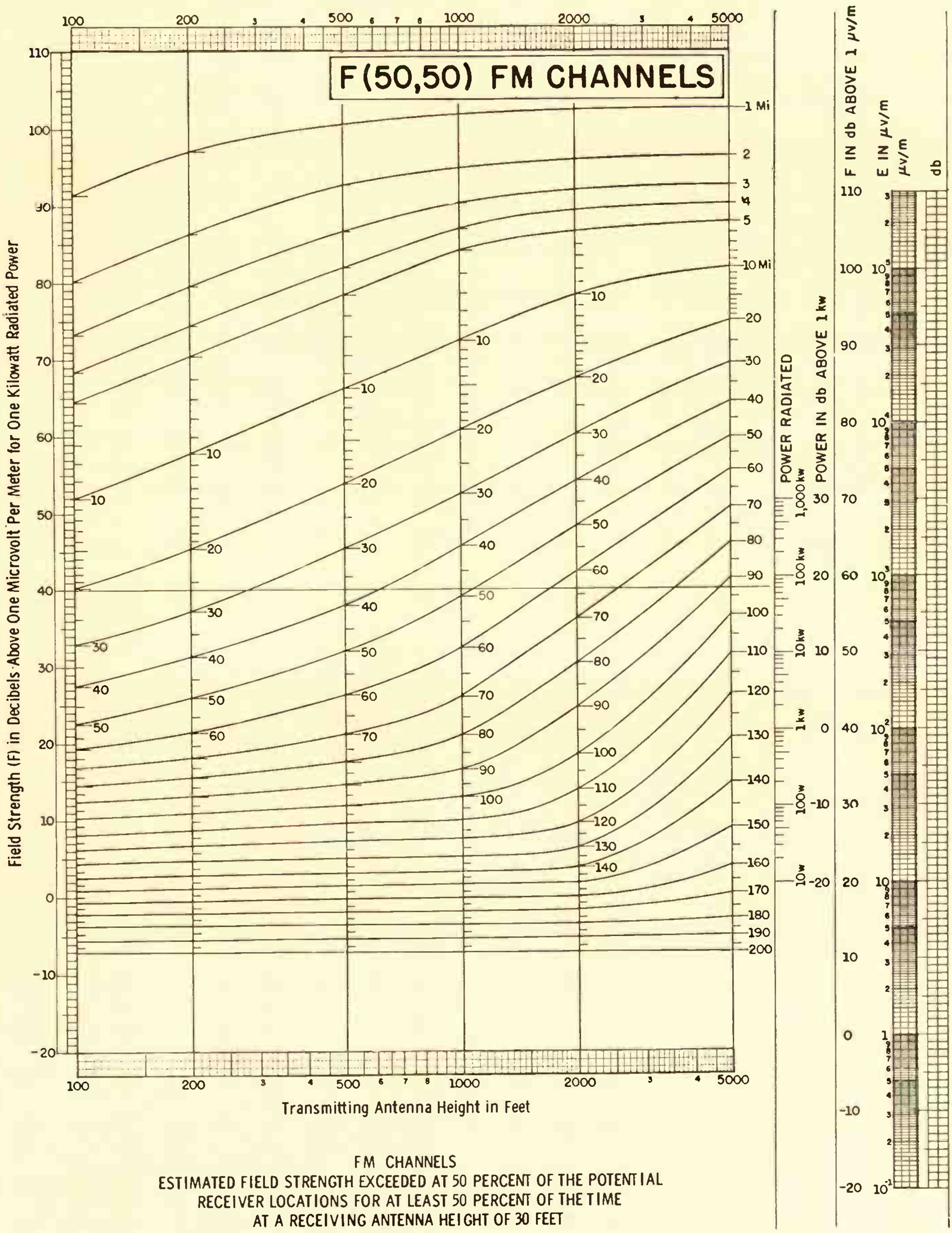


Fig. 1. Curves for predicting FM field strength. For below average terrain conditions use receiving antenna height.

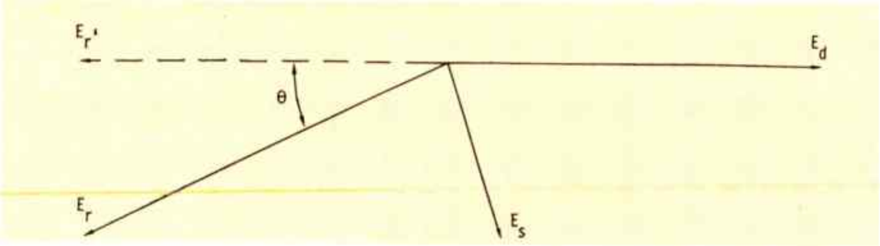


Fig. 3. Vector analysis of direct and reflected signals shows phase difference.

ly on a mountainside) at point R. The signal arriving at the receiving antenna is composed of two parts: the direct wave traveling from T to R and the reflected wave traveling from T to B, undergoing phase reversal at reflection, and continuing in this mode from B to R.

Fig. 3 is a vector diagram of the two waves arriving at point R. The direct wave (travelling by path TR) is represented by the symbol E_d, and the reflected wave (travelling by path TBR) by E_r. Angle θ represents the delay caused by the longer path and the phase reversal of point B in Fig. 2. E_s is the sum of the vectors. If it were not for the delay, there would be no signal at R because of phase cancellation. A vector corresponding to E_r without the delay is shown as vector E_r' in the figure.

It can be seen in Fig. 3 that the amplitude of the received signal depends upon the size of angle θ, which in turn depends upon the difference between the lengths of the direct and reflected paths. A general mathematical solution of this difference as a function of antenna height is rather involved, but by making some simplifying assumptions based on the conditions normally encountered, it can be shown that H_t and H_r have a similar effect on the received field strength. This conclusion makes possible a simplified method of determining expected field intensities for transmitting antennas below average terrain. This method yields results of practical accuracy.

Using the Chart for Antennas Below Average Terrain

Since the height of either the transmitting or receiving antenna can affect the strength of a received signal, it is possible to predict field strength from the curves in Fig. 1 by reversing the process normally employed. The height of the receiving antenna is substituted for that of the transmitting antenna on the x axis, and the resulting signal intensity is adjusted to compensate for the fact that the transmitting antenna which now replaces the receiving antenna is at some height other than 30 feet above the plane of reflection.

The effects of earth curvature may be disregarded for two reasons: an allowance for this factor has been calculated into the FCC curves, and distances usually involved cause the effect to be insignificant.

An example of reverse application of the curves is shown in Fig. 4. This is a hypothetical profile of one radial of a Class A station in the mountainous terrain of the West. The Rules and Regulations limit this station to 3 kw ERP.

The base of the transmitting antenna is at 4300 feet, and the radiation center is at 4400 feet above sea level. The ground rises gently for the first six miles, where, at 4390 feet, it begins rising to a shadowing ridge of 5400 feet at a distance of nine miles from the radiation center. The point of reflection will probably occur somewhere between two and six miles; i.e., in this hypothetical case, between 4330 and 4390 feet. The average of this profile is 4360 feet.

The ridge is 1040 feet above the average plane of reflection. Placing the sliding scale at 1040 feet and sliding it down to the 3-kw mark gives a value of nearly 10,000 μv/m at nine miles. However, the chart is drawn for a receiving-antenna height of 30 feet. Therefore, this result must be corrected to compensate for the height of the transmitting radiation center—in this case 40 feet. Multiplying the value obtained from the curve by 40/30 gives the expected field strength: 13,300 μv/m.

Usually, reverse application of the field-strength curves will produce a slightly optimistic figure when compared to straight mathematical computations. This is because of the statistical nature of the curves. Results, however, do compare well with measured values.

Precise prediction of field strength is a difficult science. The FCC field-strength prediction curves are a practical shortcut, but their application requires intelligent evaluation of the circumstances under which they are used. It is hoped this article will contribute to the utility of these curves in a situation where they cannot be used in the usual way because of built-in restrictions. ▲

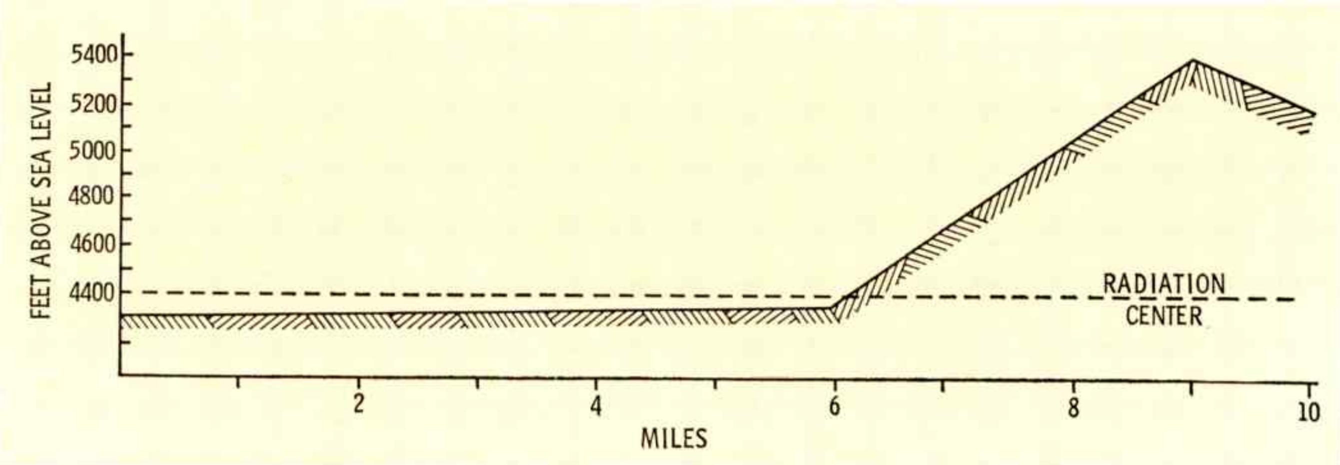


Fig. 4. Profile of a radial in mountainous country indicates typical elevations which are frequently encountered.

Book Review

Communications Electronics Circuits: J. J. DeFrance; Holt, Rinehart and Winston, New York, 1966; 548 pages, 6" x 9", cloth, $9.50.

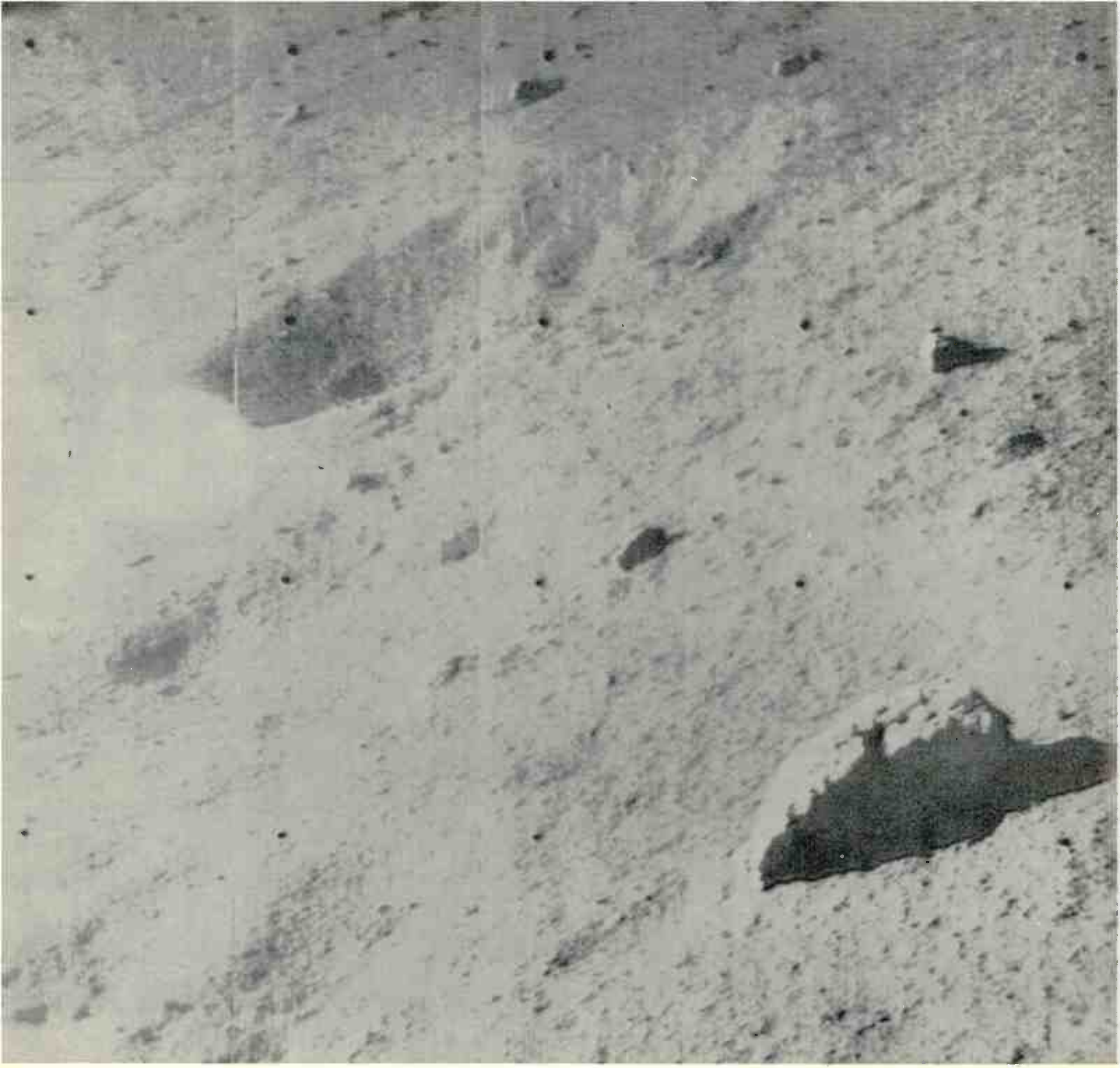
This book presents a detailed analysis of each of the principal circuits used in RF applications. Circuits are grouped according to purpose, such as RF voltage and power amplifiers, oscillators, modulators, and detectors. Complete chapters are devoted to combined circuits in transmitters and receivers. Frequency modulation is treated separately, as are transmission lines and antennas. Special chapters are given to resonant and coupled circuits, and to special transmitters.

Each circuit described is developed by mathematical analysis, and most circuits now in use are discussed. At the conclusion of each chapter are several pages of test questions and design problems. Their solutions require considerable review of each circuit and problem covered.

This is a text on the subject and can be used as a handbook of RF design. The use of mathematics, extending to integration, is extensive, but does not preclude use of the volume without knowledge of calculus.

Dictionary of Electronics: Harley A. Carter; Hart Publishing Company, Inc., New York, New York, 1966; 410 pages, 5⅜" × 8", paperback, $2.65.

This volume, first published in England, is a comprehensive dictionary of electronic terms. It has a distinct British accent, but cross-indexing permits its use to translate British texts and handbooks into U. S. terminology. Many entries, particularly circuits and devices, are illustrated with schematics and drawings. Illustrations include waveforms and vector diagrams. Six appendixes include graphic symbols, color codes, decibel conversion tables, the electromagnetic spectrum, tube bases, and a conversion table from cgs to rationalized mks units.



August 1966

We interrupt this magazine to bring you...

Late Bulletin from Washington

by Howard T. Head

"Want Ad" FM Operation To Be Tried

The Commission has authorized the sale of a Los Angeles FM station to a licensee proposing to change the station's programming format to a schedule consisting only of classified advertisements and public service announcements. In authorizing the transfer, the Commission acknowledged the unusual nature of the proposal, and granted the application to provide an opportunity for the licensee to demonstrate that this program format can render a useful public service.

The grant was made for a trial period of one year only. At the end of this period, the licensee must submit a detailed report to the Commission, including an analysis of public reaction, a statistical breakdown of the type of advertising material broadcast, and any financial information which the Commission may require in analyzing the operation.

It was emphasized that this authorization is to be considered as a trial only. Any extensions will depend on the Commission's findings with respect to the first year of operation.

Land Mobile-Television Channel Sharing to Be Tested

The Land Mobile Radio Services, which have long complained of having an inadequate share of the radio frequency spectrum, have advanced various proposals to the Commission for additional land mobile channels. One proposal repeatedly advanced is that the land mobile services -- a host of users including such diverse services as fire, police, industrial, public utility, and taxicab -- be permitted to share both the VHF and UHF television channels in areas where these channels are not locally assigned. Broadcasters have consistently opposed these proposals on grounds of potential cochannel and adjacent-channel interference to television reception.

The Commission, to a considerable extent acknowledging Congressional pressure for more land mobile spectrum space, has announced its intention of authorizing experimental testing of TV-channel sharing. Plans for tests were discussed at a recent meeting in the Commission Chief Engineer's office in Washington, attended by representatives of both the land mobile and television broadcasting industries. Although the Commission had visualized fairly simple "look-see" tests, such limited tests were opposed by both the broadcast and land mobile representatives on the grounds that hastily conducted tests might be not only inconclusive, but possibly misleading. At the meeting, plans were made to organize an engineering group, to include both broadcasting and land mobile interests, which will draw up plans for suitable tests.

Plans for New AM Treaty With Mexico

The United States Senate has ratified an extension of this country's treaty with Mexico governing the use of the standard broadcast band in the two countries. This action extends the life of the present treaty until the end of 1967. In the meantime, plans are under way for the negotiation of a new treaty, and delegates of the two countries are to meet in Washington on September 6, 1966. Informal discussions among U.S. representatives, in preparation for the formal September meeting, were held on July 11.

Many of the restrictions imposed on U.S. broadcasters by the present treaty are certain to be up for negotiation. These include the prohibition of nighttime operation in the United States on the Mexican Class I-A clear channels, the limitation of daytime power of U.S. stations on these channels to 5 kw, and the present 250-watt power limitation on U.S. Class IV local-channel stations near the Mexican border.

NCTA Reviews CATV Future

In the wake of the recent Court decision holding that CATV systems must obtain permission of copyright holders to transmit copyrighted material (July, 1966 Bulletin), the CATV industry has concluded that the requirements of the decision are tolerable, and the decision may even have a silver lining. At least two of the three major television networks have formulated policies for CATV carriage of network-copyrighted material, and it does not appear that other copyright requirements will be unbearable. In some instances, CATV systems feel that by paying copyright fees they will be free to use copyrighted programs as they please, including the deletion of commercial material and the insertion of their own commercials. NCTA has also urged a renewed interest in local program originations, with emphasis on public-service activity in small towns lacking local television broadcast facilities.

Short Circuits

At the request of the NAB, the Commission has extended the deadline for daily frequency checks of FM stereo and SCA subcarriers to October 31; previous deadline was July 5...A recent 3-3 tie vote came near to upsetting the Commission's policy which prohibits new nighttime AM grants where the proposed facility would not serve at least 25% "white area"... The life of the Emergency Broadcasting System National Industry Advisory Committee (NIAC) has been extended to June 30, 1968...A recent Commission CATV decision in Poway, California (a San Diego suburb) held that field-strength measurements on television stations would be considered in determining requirements for CATV carriage -- details on how to make the measurements were not spelled out, however...The Commission has authorized the use of frequencies in the 72-76 mHz band for the remote control of model aircraft, although two Commissioners dissented to the use of radio frequencies for such "trivial" purposes.

Howard T. Head...in Washington

The soundest sound in broadcasting is the new sound of GATES

ATTACHE "70"


DYNAMOTE "70"


COURIER "70"


UNIMOTE "70"

Four new portable transistorized remote amplifiers from GATES

Four handsome, fully transistorized models. All rugged, compact and lightweight. Studio console quality.

ATTACHE "70"— three microphone mixing channels. Two are switchable to accommodate tape recorders or turntables. Extremely light weight — 10 lbs. with batteries.

DYNAMOTE "70"— four channels. Broadcasting's newest and most deluxe. Accommodates nine signal sources, including two high-level inputs, two magnetic phonos and built-in tone oscillator. Weighs 12¼ lbs., including batteries. Ideal for major news coverage or complex remote originations.

COURIER "70"— two-channel amplifier provides two microphone mixing channels, master gain control, illuminated VU meter. Weighs only 8¾ lbs. with batteries.

UNIMOTE "70"— single-channel, fully transistorized remote or utility amplifier is no larger than a table radio. Ideal for mounting under a lectern or pulpit.

For full details, write for ADV-160, our new attractive 8-page illustrated brochure.

HARRIS INTERTYPE CORPORATION

GATES

GATES RADIO COMPANY • QUINCY, ILLINOIS 62302 U.S.A.

A subsidiary of Harris-Intertype Corporation

Circle Item 13 on Tech Data Card

Signal Variation

(Continued from Page 19)

lyzed by imagining an infinite number of capacitors in series, with an infinite number of resistors across the capacitors. If the dielectric constant increases and the resistance decreases, conductivity is considerably increased.

There are two additional factors which must also be given consideration in a study of the problem. The first is skin effect, wherein the depth of signal penetration into the earth is dependent on the frequency of the transmitted signal. In substance this means the lower the frequency, the greater distance into the earth the signal goes. Terman gives 20 feet at 10mHz.[5] This is developed from the maxim that the depth of penetration varies inversely as the square root of the frequency. The other factor is dependent upon the "skin-effect" and is called "tilt." As a wave front crosses the earth, the lower part of the wave strikes the earth and is absorbed into it. This absorption causes the upper portion of the wave to fall forward in an attempt to compensate for the signal loss. This results in a "tilt" in the forward direction. This tilt, however, never exceeds 15°, and like skin effect, is a product of the frequency.

There was a belief that the crystalline formation in frozen earth might be responsible for the signal variations, but a National Research Council of Canada Bulletin (June, 1965) reported the work of M. Khalifa and R. M. Morris on "Transmission Line Insulators Under Rime Ice." In this report it is stated that ice is a good insulator with a conductivity of 1×10^{-8} µmho per cm^3 at 10° F. The average conductivity between the transmitter and monitoring point at CKAC is 6×10^{-5} mho per cm^3. Thus it appears that reducing the temperature of water would tend to reduce signal during the winter months.

This was confirmed by some kitchen-variety experiments with a home-type freezer. A cubic inch of water changed in resistance from 9,000 ohms in the liquid state to 1.5 megohms as ice. Next, a one cubic-inch container of moist earth was frozen, and the results were as follows:

Time	Resistance
0 minutes	25 k
10 minutes	35 k
30 minutes	100 k
1 hour	2 meg
2 hours	2 meg

A strange occurrence was noted during the experiments; when breath was blown across the frozen earth, resistance decreased sharply and after a short time returned to its previous value. The experiment was repeated at short intervals, and after about five minutes the effect ceased, the resistance remaining constant. The same experiment with ice produced similar results, but it could be observed that the film of water between the electrodes froze immediately after the breath air ceased to flow across it.

With dry earth, resistance was 60,000 ohms at room temperature and 20 megohms when reduced to freezing temperatures. Again the breath experiment achieved reduction of resistance.

It appears that summertime low-signal complaints from listeners are justified, at least in relation to maximum signal strength in the winter. To this time only the Northeast, East, and Central regions have reported the phenomenon. It would be of interest to know whether other regions are also affected, and to what extent. In their presentations neither Mr. Howe nor Mr. Jones indicated whether ice was present during the periods of high conductivity. It has been assumed, because of their locations, that this was the case.

For the CKAC data supplied in this paper, the sincerest gratitude is extended to G. Champagne and P. Smith for their faithful reporting and recording over a long period of time. ▲

[5] Terman, F. E., *Radio Engineers Handbook* (McCraw-Hill Book Company, Inc. New York 1943) p. 697.

AM Frequency

(Continued from page 15)

specify that they be without "overprinting." This will insure that airways, airports, and other flight information do not appear on the map. They should also be ordered unfolded.

A third source of maps is the United States Geological Survey, also in Washington. This office publishes the so-called "topo" maps. These are issued in either 7.5 or 15 minutes of latitude and longitude on a single page. A portion of one of these maps is shown in Fig. 5. This type of map is very useful in the selection of transmitter sites and in accurately determining coverage to business and residential areas.

Usually less accurate are county, city and state, population, and oil-company highway maps. These are sometimes used, but their accuracy may not comply with the Commission's requirements.

The choice of map depends upon the area to be studied and the degree of accuracy required. On low frequencies, where stations are widely separated, a map having many miles per inch is better than one with few miles per inch. For this study, an M-3 or World Airways Chart would be best. For studying a high-frequency or low-power station, a Sectional is more appropriate. While Sectional maps are available everywhere in the United States, they are not always found in other countries. World Airways Charts can be procured anywhere in North America.

Final Proof

"The proof of the pudding is in the eating." This expression applies well to the frequency search on the day after the FCC grants a Construction Permit. Many engineers believe that there are no new frequencies available, but 20 possibilities have been uncovered in the midwestern states during the past year. It is true that a search is more difficult now and that an applicant will usually have to accept a directional antenna. If, however, an engineer or potential owner is determined—and exercises care in a search—it is possible that new frequencies can be found. ▲

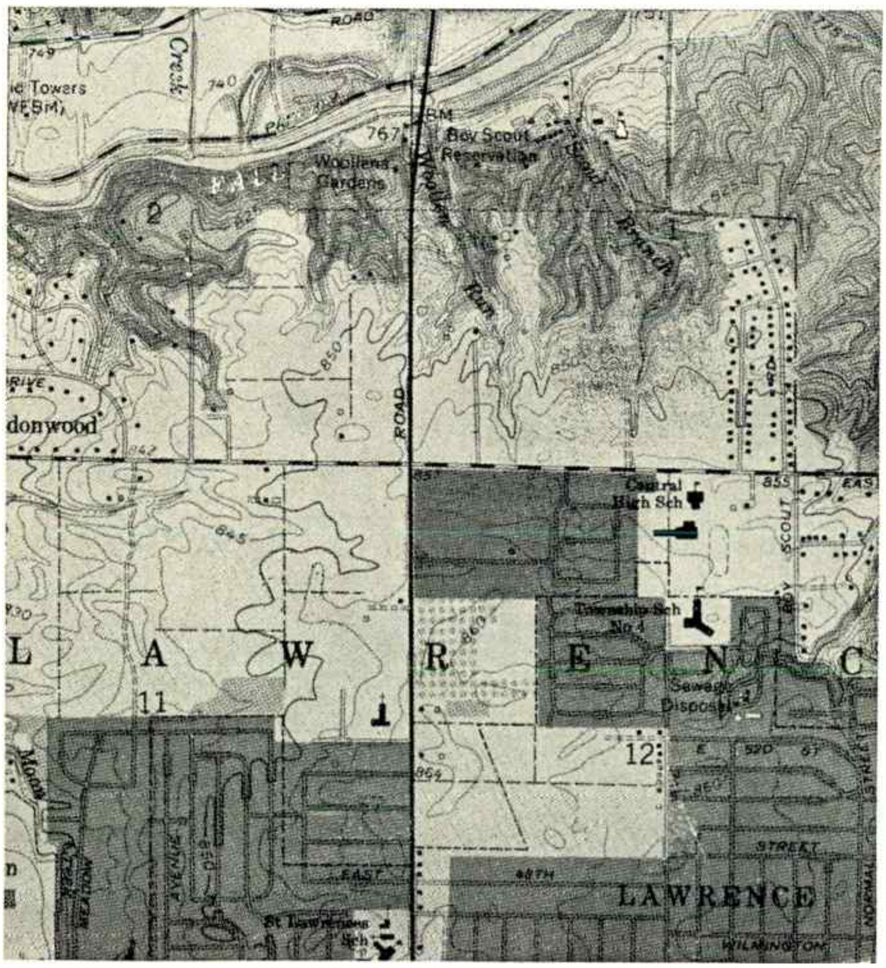


Fig. 5. Section of 7.5 minute U.S. Geological Survey map shows much detail.

Vertical Interval

(Continued from Page 22)

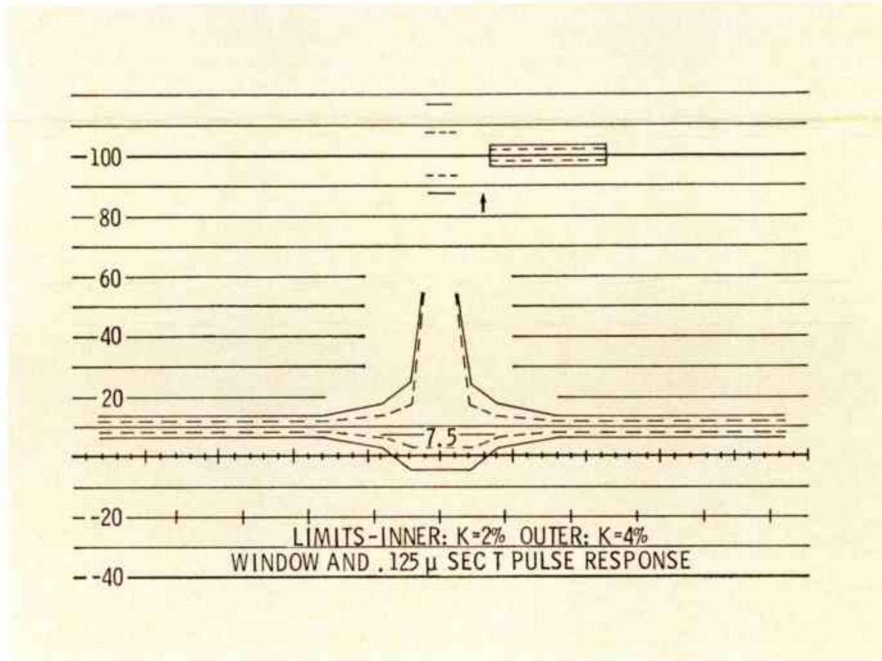


Fig. 6. Study of "T" sin² pulse will reveal overshoots and other problems.

signed to measure sin² and bar pulses. Present tolerances are also indicated. These graticules indicate quickly whether corrections are in order. The tolerances are referred to as the "K" factor of the sin² bar pulses. (See Fig. 7.)

The stairstep signal is a good test of system linearity (gamma) and is particularly useful in the testing of transmitters and microwave systems. Most studio systems (excluding cameras) usually do not have serious problems with linearity, unless clipping occurs because of improper levels or overpeaking, or misadjustment of clipping stages. Linearity problems usually occur in transmitter power or modulator tubes, and microwave transmitters.

The stairstep 3.58-mHz signal is a good test signal because it permits at least three measurements to be made: low-frequency nonlinearity, high-frequency nonlinearity, and differential phase.

A low-pass filter will eliminate the 3.58-mHz signal, leaving only the low-frequency stairstep on the display. This stairstep indicates low-frequency nonlinearity because the steps should progress from black to white level with equal amplitude. A high-pass filter eliminates the low-frequency stairstep from the display, leaving the 3.58-mHz burst from each step, but displayed on a common base line. Amplitude change in any of the bursts will be indicated, as perfect linearity leaves each burst with equal amplitude.

The 3.58-mHz signal can also be separated from the stairstep and fed to a phase analyzer or vectorscope to indicate differential phase changes and problems.

Conclusion

VITS are excellent dynamic system-performance indicators which operate continuously. They are a tool with which system performance can be measured with calibrated test methods and stationary indicators, thus eliminating the need to rely on constantly changing picture information. At best, however, VITS are indicators and not correction test signals. Some operation-control corrections can be made during programming, but maintenance adjustments should be made during shut-down. ▲

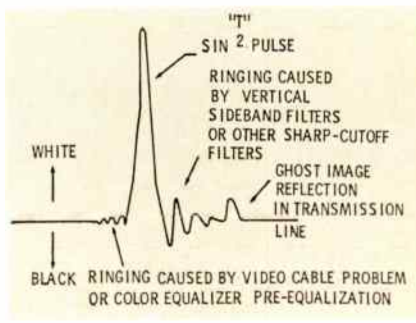


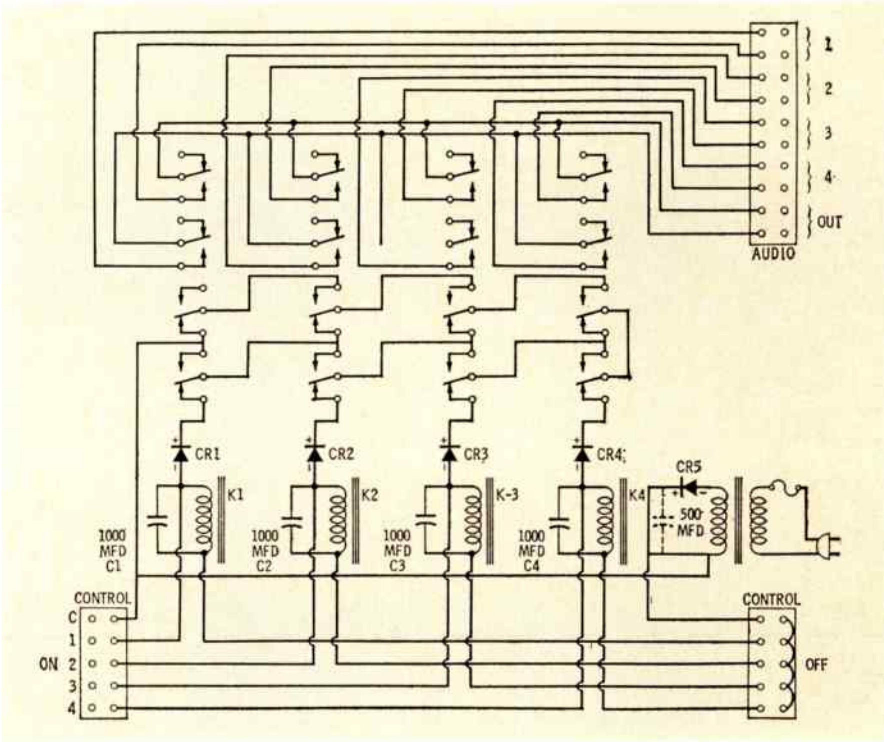
Fig. 7. Special graticule on waveform monitors measures sin² and bar pulses.

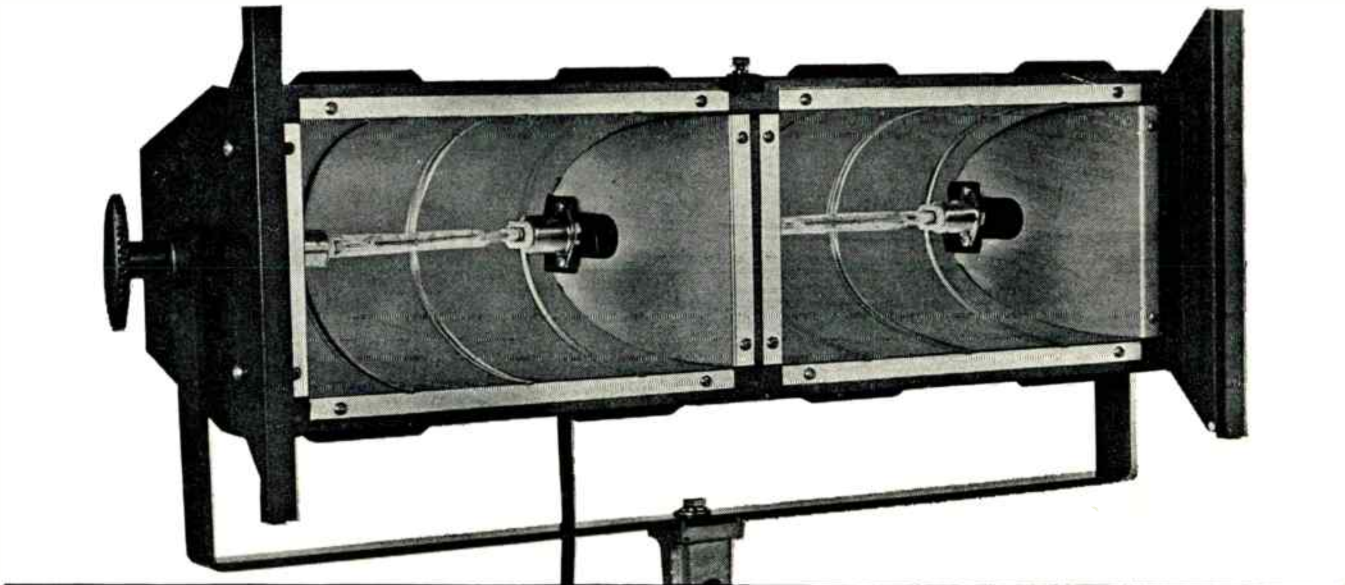
Audio Switcher Modification

by John E. Thayer
Chief Engineer, KDON
Salinas, California

Audio switchers are used in relatively few radio stations for a number of reasons, one of which is that they do not "mix" audio signals. This is especially true with "top-forty" formats where a constant high level signal is desired. We have modified our typical switcher so that signal release is slightly delayed, and, in conjunction with a compressor, a smooth transition from one signal source to another is achieved.

Delayed signal release is effected by adding capacitors across the relays, substituting larger diodes, and eliminating the power-supply filter capacitor. The capacitors are 1000 mfd and the substituted diodes are 1N2484's. The capacitors hold the





relays open for an extra second or two, and the diodes permit higher voltages and currents.

Mr. Thayer is this month's contest winner. Have yon entered?

Ribbon-Microphone Repair

by Ed Schloss
KAAR-TV
Spring Valley, Calif.

At 3:00 p.m. the over-eager son of the owner of a shoestring rock and roll recording studio decided to check out the mikes for a session scheduled at six o'clock. Since it was difficult for him to hear the control room speaker—you guessed it—he blew on the mikes.

Everything went well until he got to the only good mike in the system—an RCA 44 of some antiquity. He blew out the ribbon.

Normally, the repair of a microphone should be done at the factory, but this outfit had neither time nor budget for that luxury. There was no way to get another mike, and the other mikes in the system were not suitable. Therefore, I decided to make another ribbon.

The first attempt with aluminum foil was pretty bad, and pleated aluminum foil was not much better. Finally, we found a good substitute with the foil from a Nestles candy bar (about the right thickness and compliancy). It was smoothed on a sheet of glass, cut with a razor blade, and pleated by placing it on a pocket comb and applying pressure with the edge of the thumb in a continuous longitudinal motion. The best ribbon was obtained with a comb that had teeth spaced about ⅛ inch apart.

Replacing the ribbon in the magnet was relatively uncomplicated, but tedious. Steel tools could not be used close to the magnets, so toothpicks were used to position and apply slight tension to the ribbon. The small holder screws were tightened with an ordinary miniature screwdriver. Our first good ribbon had a slight lateral bow and scraped on the pole pieces.

It took about four hours to get the hang of it, but later replacements took about half an hour. The final result was amazingly good. It wasn't factory quality, but it was good enough for a demonstration.

This method of repair is recommended only for an emergency, or where the budget is extremely low and high quality is not necessary.

Turntable Cartridge Maintenance

by Walter L. Moring
WCSC-TV
Charleston, South Carolina

Cartridges which employ "push down and twist" type styluses often collect dust and other refuse in the stylus "seat" area. This keeps the stylus from seating properly and results in low output and a loss in high frequency response. It is common for maintenance technicians to be misled into the belief that a faulty cartridge is responsible and to replace the cartridge with a new one.

When this combination of faults occurs, try cleaning the stylus seat area before replacing the cartridge. Push the stylus down and twist one-quarter turn to the right or left. Using a soft brush and a gentle type of solvent cleaner, carefully remove dirt accumulations from the front and rear stylus seats. Restore the stylus to its normal operating position and check to see that it is properly seated. It should be exactly in the center. If it is not, severe distortion will result. This is caused by the stylus holder restricting movement of one or the other of the pole pieces. Check also to see that the stylus holder is not bent.

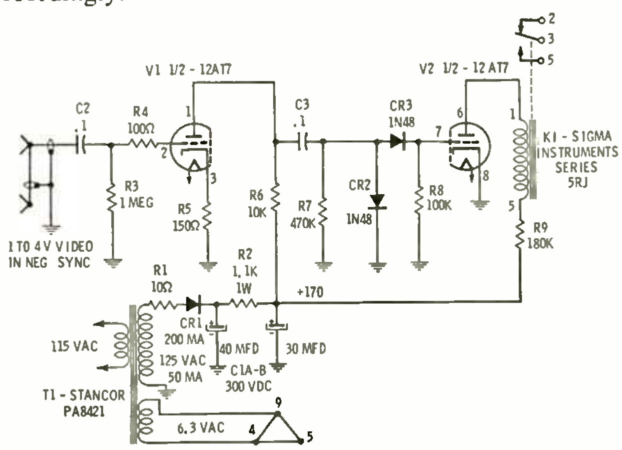
Signal Failure Alarm

by James C. Miller
KOKH-FM/TV
Oklahoma City, Oklahoma

Active video gain riding is virtually a thing of the past with automatic level control on the film chain, stable video-tape machines, and high quality network transmission. Still, interruptions occasionally occur, and when they do they demand instantaneous response.

Here is a simple, dependable device which, when bridged across a 75-ohm line carrying a standard 1.4 volt composite video signal, will ignore the standard fade to black but will react instantly to total loss of signal. It will automatically sound an audible alert, switch on a light at a remote location, switch sync generators, put up the trouble slide, or re-cycle the transmitter. Mounted near the video patch panel, it can be bridged across various outputs to help isolate intermittents.

The device consists of a twin triode isolation amplifier, a power supply, and a sensitive relay. The first section of the 12AT7 is a high-gain video amplifier. This is followed by a signal-rectifying network which provides approximately 3 volts negative bias (with 1.4 volts video input) to the second grid. Component values were chosen to close the relay when the signal level drops to .2 volts. The second half of the tube is a DC amplifier with the relay in the plate circuit. The relay used was purchased at a government surplus store. If a less sensitive relay is used, the value of R9 should be varied accordingly.



Emergency Filament Supply

by Harold Hardy
Chief Engineer KTTT
Columbus, Nebraska

Recently a high voltage rectifier filament transformer failed at noon on a saturday. The fault was in the primary winding, and very difficult to repair. The rectifier filament total load was 5 volts at 10 amps. Because of the high voltage insulation required, rewinding seemed impossible, so a six-volt car battery was used with the battery placed on a wooden block to insulate it from ground. It was necessary to shut down every three hours to change batteries for recharge. This carried us through until a new filament transformer arrived.

NEWS OF THE INDUSTRY

INTERNATIONAL

Global Network Urges Use of Satellite

Steps to hasten the growth of global television were taken by **Worldvision International Commercial Broadcasters** and **ABC International** during three days of worshops in Mexico City.

The Worldvision broadcasters, representing stations in 25 countries, voted unanimously to move with dispatch to secure for television its "inherent right" of access and priority to the global communication satellite system.

The group gave a mandate to Worldvision network manager Kevin Corrigan to work with ComSat and any other necessary organization, to see that global television is allowed to become the practical working medium that satellite technology is now making possible.

"Global television is not something that we are going to have to wait for a far-off future to implement," Donald W. Coyle, president of ABC International remarked. "It is upon us now. By the end of this year, satellites will be capable of communicating with two-thirds of the world. By 1968, when ABC-TV will telecast the Summer Olympics from Mexico City, television will be able to reach all of the world —LIVE!

"The broadcasters have moved to do all they can to insure that television will have access to the system commensurate with the great public service it can provide, and at a realistic price. With television around the world growing at such a fast pace; with satellites literally shrinking the world and bringing the peoples of the world closer together, television now has communications opportunity, responsibility, and challenge that it must be allowed to fullfill completely."

The group expressed the hope that along with an expanded number of ground stations, with a capability for both sending and receiving, which are already planned, a number of smaller stations with receiving ability be projected so that live via-satellite programs will reach isolated people.

The Worldvision stations upheld the advantages of a freer flow of information through participation by and operation of ground stations by commercial broadcasters.

"The development of a truly effective global television system calls for satellites with a much greater capability than those now planned," Mr. Coyle said. "Unless we launch birds with many more channel capabilities, our technological progress will not fully live up to the potential it has for serving all of the world. It is this potential for service that must be a major influence in the development of the international commercial satellite system."

Plans for closer communications and relations between the Worldvision stations to solidify their operational base were also adopted.

A Board of Governors for the network was created, with each member responsible for one facet of telecasting. The members are:

William Davies, Southern Television Corporation, Ltd. (Australia)—Sports.

Hubert Federspiel, Televisora de Costa Rica, S. A.—News.

Kan-ichiro Matsuoka, Nippon Educational Television—Programming.

Mrs. Consuelo de Montejo, Producciones Tecnicas (Colombia) — Public Relations, Promotion.

Dr. Pedro Simoncini, Dicon Difusion Contemporanea, S. A. (Argentina) Sales.

Robert Stewart, Republic Broadcasting System (Philippines)—Technology.

Color TV For Philippines

An agreement providing for the establishment of the first color television broadcasting station in the Philippine Islands was announced jointly by the **Bolinao Electronics Corp.** of Manila and the **Radio Corporation of America.**

The Philippines thus will become the second Far East nation to introduce United States-type color television, the other being Japan, which has been highly successful in its color TV operations for the past three years.

Eugenio Lopez, Jr., President of Bolinao Electronics Corp., said that his company plans to install RCA color equipment in its Manila Channel 3 station—DZAQ-TV—and have color on the air by November.

Although the initial color broadcasts will be limited to filmed programs, slides and commercials, live programs in color will be presented as soon as increased viewership is established.

Bolinao, which operates three broadcast divisions consisting of 19 radio stations and four television outlets, introduced black-and-white television in the Philippine Islands.

For several years before entering the broadcasting field, Bolinao has been a manufacturer of electronic equipment for radio stations, and an innovator in electronics.

NATIONAL

Manufacturer Wins Emmy Award

The **MVR Corporation** of Palo Alto, Calif. (also known as Machtronics) received the television industry's highest honor when corporation president Kurt R. Machein accepted an Emmy Award for "Individual Achievement in Engineering Development" from the Academy of Television Arts and Sciences. The Emmy Award was presented for the development of the MVR Videodisc Recorder.

The recorder is used for both instant replay and stop-action sports broadcasts. It is also employed in the NASA Apollo Space Program.

Firm Changes Name

Because of increased involvement in color videotape syndication and dubbing, and an unprecedented demand for tape-to-film transfer, **Acme Film Laboratories, Inc.** has changed its name to **Acme Film & Videotape Laboratories,** according to Mel Sawelson, general manager of the Hollywood-based firm.

A new trademark design accompanies the name change. It is similar to Acme's well-known film core, but is also symbolic of Acme's participation in videotape.

New Eastern Field Office

Cohu Electronics, Inc., San Diego, Calif., has established an eastern field office in Pleasantville, N. Y., to assist its representative organizations east of the Mississippi in broadcast and closed-circuit television applications.

Edward T. Clare, Cohu vice president-marketing, said Edward J. Manzo, formerly with CBS Laboratories and General Precision, Inc., will direct the Cohu-East operation.

New Export Representatives

Three new export representatives have been appointed by **McMartin Industries, Inc.** They are **Rocke International Corporation, New York City,** for broadcast; **ManRep Inc., North Miami Beach** for audio (Central and South America only); and **Gates Radio of Canada** for both broadcast and audio.

Theatre, Television, and Film-Lighting Symposium

The second annual theatre, television, and film lighting symposium was held in Chicago on May 9 and 10, 1966, sponsored by the **Illuminating Engineering Society.** Technical presentations and discussions among the three hundred lighting personnel provided valuable information, especially through the interchange of ideas. Reports on methods, standards, and new equipment developments emphasized significant changes now being made.

The program of this symposium was balanced to provide data on all aspects of the theatre, television, and film industries. The opening state-of-the-art report set the stage for the discussions, forums, and technical papers which followed. The demonstration of the lighting methods used in the various fields revealed many close similarities among them, and illustrated the countless changes taking place.

The progress show of new equipment developments provided a fitting climax to the symposium. More than sixty recent developments from approximately ten manufacturers were demonstrated, again emphasizing the change in these fields.

ATC Purchased

Harris-Intertype Corporation and **Automatic Tape Control, Inc.** of Bloomington, Ill., have completed an agreement for the purchase of ATC on June 1 by the **Gates Radio Company** of Quincy, Ill., a subsidiary of **Harris-Intertype.**

Automatic Tape Control is a large manufacturer of automation equipment for radio broadcasting stations. The electronic products it manufactures include automatic systems that permit AM and FM stations to program their music, announcements, and features in advance of broadcast through magnetic tape memories.

Owners of Automatic Tape Control, founded in 1959, include Adlai E. Stevenson III, the estate of the late Adlai E. Stevenson II, and Loring C. Merwin, publisher of the *Daily Pantagraph*, who is also president of ATC. Other large stockholders are Vernon A. Nolte, president of WROK Inc., Rockford, Ill., and Robert S. Johnson, general manager of ATC.

The company will continue to manufacture ATC products in Bloomington, under Gates Radio management.

PERSONALITIES

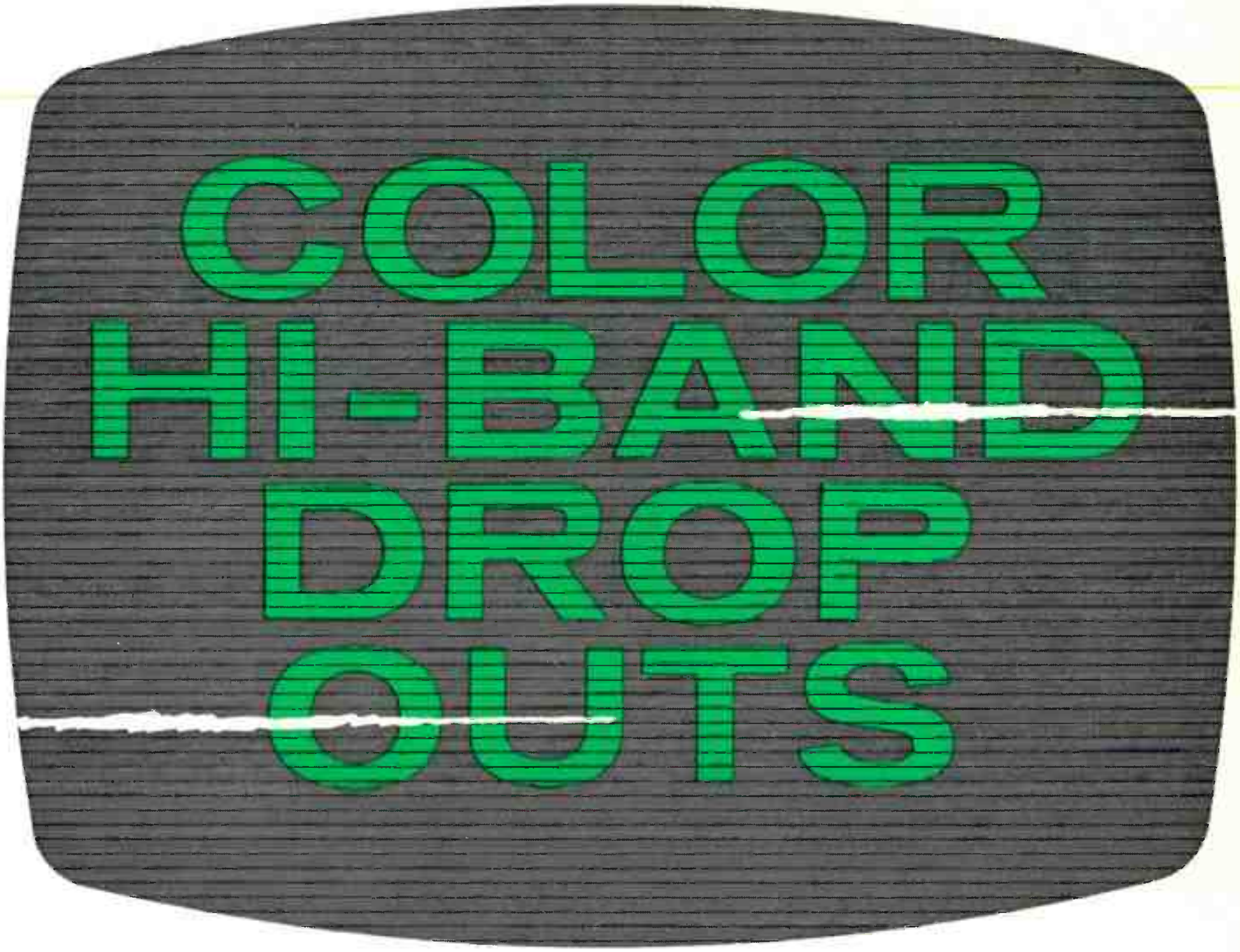
Alexander J. Autote has been appointed marketing manager for **Professional Products at CBS Laboratories** according to Barton Conant, general manager of the **Professional Products Department.** CBS Laboratories is the technological division of the Columbia Broadcasting System, Inc.

In his new capacity, Mr. Autote will be responsible for all phases of marketing and customer service of the expanding commercial product line. These products include professional equipment for the broadcast industry, stereo and monaural test records, digital display equipment, video amplifiers, and a new line of professional test instruments.

Mr. Autote joined CBS Laboratories in 1961 and, prior to his new position, had been editorial coordinator, publications manager, advertising and sales promotion manager, and Broadcast Products manager. He served four years with the U.S. Air Force both in the U.S. and Saudi Arabia.

Matthew M. Dorenbosch, vice president, **North American Philips Company, Inc.,** has announced the appointment of **Television Utilities Corporation,** Long Island City, New York, as national representatives for the standard line of **Norelco** closed-circuit television and allied video and sound equipment.

Mr. Dorenbosch emphasized that product inventory and service stock will continue to be supplied from the Norelco warehouse and service center also in Long Island City.



Eliminated by Revere-Mincom Dropout Compensator...

NOW TAKING ORDERS

Due to the shorter wave length and lower tip projection employed in Hi-band VTR, dropout problems are 5 or 6 times more prevalent than those encountered in low-band recording. These distracting white flashes destroy otherwise prime program content and good, clean video signals.

The Revere-Mincom Dropout Compensator restores the clarity and sparkle of Hi-band/Color VTR by detecting the dropouts as they occur and replacing the "lost" signal with stored information from the previous scan line of the same field.

Moderately priced, the Dropout Compensator features maintenance-free, solid-state circuitry, standard rack mounting and compatibility with all VTR equipment.

Rescue old tapes. Insure optimum playback quality in new COLOR/HI-BAND recordings. Save money by eliminating unproductive engineering evaluation time and unnecessary wear on expensive recorder heads and VTR equipment.

Call or write today for a demonstration of the remarkable Dropout Compensator.

Revere-Mincom Division 3M COMPANY

300 S. Lewis Rd., Camarillo, California
(805) 482-1911

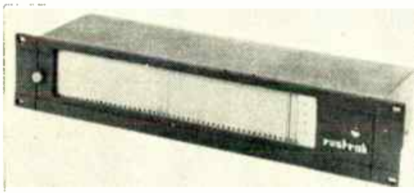
Riker Industries
Huntington Station, L. I., N. Y.
(516) HA 1-3444

See the Dropout Compensator in action at the NAB show; booths 248 and 103.

Circle Item 39 on Tech Data Card

NEW PRODUCTS

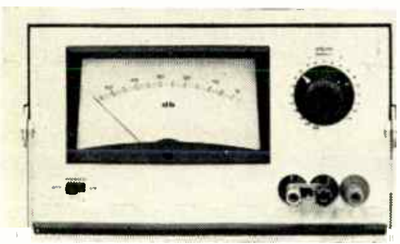
For further information about any item, circle the associated number on the Tech Data Card.



Extended-View Recorder

(85)

The Model 156 strip-chart recorders permit a 12-inch span of recorded information to be viewed, and by opening the front door, twelve inches more can be examined. Two sliding plastic windows provide access to the visible part of the chart, so that notations can be made even when the recorder is operating. This **Rustrak Instrument Co.** recorder uses inkless, dry-writing process and chart paper. Various chart speeds from 1/16 inch per hour to 1800 inches per hour are possible; and at 1 inch per hour, a full 24-hour record is visible at a glance. The 3½-inch extruded aluminum panel is suitable for EIA rack mounting. Case dimensions behind the panel are 3½-in. high, 17 in. wide, and up to 8 in. deep. Price is $80 plus the cost of the selected instrument.



Dual-Purpose Studio Monitor

(86)

The Model 600 wide-range program monitor, developed by **CBS Laboratories** division of **Columbia Broadcasting System, Inc.,** allows the measurement of program audio, noise, and crosstalk on a single 60-db-wide scale. Unlike the standard volume indicator which measures only the top 23 db of signal level, this program monitor displays information from +3 to −57 db on a single linear decibel scale. Reference settings for 0 db are adjustable from +18 to −22 dbm. The instrument allows the accurate reading of low-level audio material as well as line-noise measurements during program pauses. In addition, it is equipped with a DC output for graphic logging or remote metering.

Although the monitor is not intended as a replacement for the standard volume indicator, the meter ballistics are such that in the top 23 db of the range, the readings are compatible with VU indications. This feature permits use of the instrument as a studio monitor as well as a measuring tool. The Model 600 is priced at $345.

16MM Automatic Camera

(87)

Canon Scoopic 16, by **Canon USA, Inc.,** is a professional 16-mm motion picture camera combining automatic CdS exposure control, a built-in 13-76 mm zoom lens with through-the-lens reflex viewing, electric drive, and automatic loading.

A cross-coupled CdS cell, located above the lens mount, can be programmed for ASA film speeds from 10 to 320 and automatically sets proper exposure from f1.6 to f22 for each with all of the camera's running speeds, 16, 24, 32, and 48 frames per second. An illuminated scale, located inside the reflex viewfinder, shows the aperture selected by the exposure system. Apertures can also be selected manually, and are indicated in the finder scale in either the automatic or manual mode of operation.

The lens is a Canon f1.6 13-76mm zoom in a focusing mount; The lens focuses down to 5 ft (an accessory screw-in close-up lens is available). Optical design of the lens consists of 18 elements in 12 components. A manual zoom lever is employed to change focal lengths.

The electric motor, which runs at 16, 24, 32 and 48 fps (and shoots single frame with accessory cable release), is powered by a single 12.5-volt rechargeable and interchangeable nickel-cadmium battery. Batteries are capable of providing power for about 800 ft of filming per charge.

The camera utilizes standard 100-ft rolls of 16-mm film, which are loaded by means of an automatic threading system. The unit weighs 7 lb., 5 oz. and measures 8¾ in x 11⅛ in x 5⅛ in.

Suggested list price is $1,250.

Studio Recorder

(88)

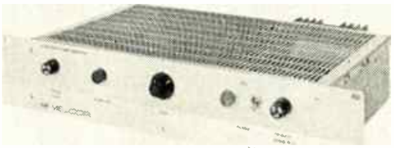
Utilizing two capstan drives instead of the conventional single capstan to carry the tape, the **Tape-Athon Corp.** Maestro has a measured starting time of less than .01 second, and a stopping time equal to ½″ of tape at 7½ ips running speed. This quick reaction permits precise programming and editing. Over a 30-minute span of tape, the initial and second runs coincide within ±2.0 seconds.

The standard Maestro is available with 7½ and 3¾ ips tape speeds and accommodates 10½″ tape reels for ¼″ tape. It has a capacity of 2400′ of 1.5-mil tape and 7200′ of "triple-play" tape. Rewind time for a 2400′ reel is 60 seconds. The recorder may be ordered with 15–7½ ips, 3¾–1⅞ ips, or 1⅞–15/16 ips tape speeds.

Controls for the tape transport consist of pushbuttons for PLAY, STOP, FAST FORWARD, and FAST REWIND, and shade-type toggle switches for TAPE SPEED and TORQUE (used to compensate for 10½″ or 7″ reels). Tape is threaded by dropping it into a slot.

A number of options are available besides the tape speeds. An "edit" switch stops the take-up reel and bypasses the tape-break switch, permitting one-reel operation with slack tape for editing. An automatic reversing switch may be ordered that provides tape reversal at end of reel. A remote-control box is also available for operating the transport and the record switch.

Prices start at $1200.



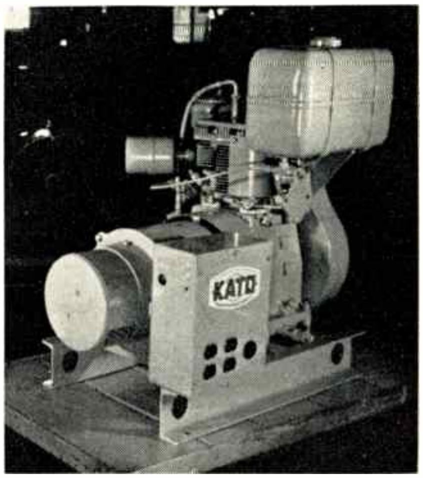
50-Watt Monitor Amplifier

(89)

A 50-watt monitor amplifier featuring all silicon semiconductors, is available from **Melcor Electronics** Corp. Known as Model AB-47, this unit can be used as a driver for disc-cutting heads, and the optional integral output autotransformer provides a 70-volt line for sound distribution and reinforcement systems.

The Class-B output circuitry of the amplifier is supplied from a self-contained power supply. If the output of the amplifier is short-circuited during operation, the dissipation-limiting circuit is activated immediately; this feature is intended to protect the amplifier from damage even if deliberately shorted.

Other features include bandwidth of 20 Hz to 15 kHz, sensitivity of 70 mv to produce rated output, full power out for 4-, 8-, and 16-ohm outputs, and high-impedance input.



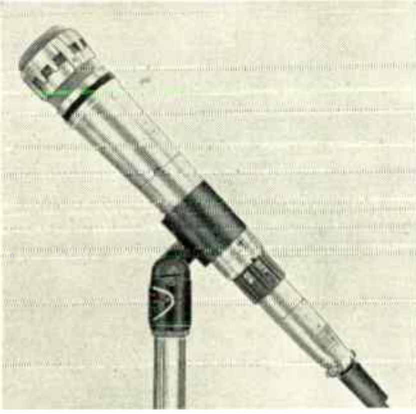
AC Power Plant

(90)

A 4000-watt AC light plant has been developed for general-purpose standby emergency use or as a continuous-duty sole-source power supply by **Kato Engineering Co.** It features a revolving-field AC generator with separate rotating exciter directly connected to a Wisconsin engine. The plant is available in either single or three phase.

Features include grease-sealed-for-life generator main bearing, solid-state voltage regulation and inherent overload protection. Standard equipment includes engine muffler, governor, rope start, heavy-duty base, four 115-volt receptacles, and one 230-volt receptacle.

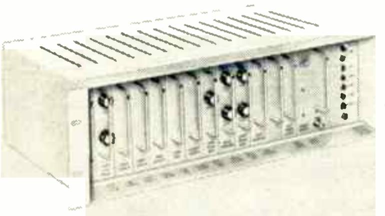
Accessories available include push-button plant starting, remote stop and start, load-demand idler, 3-wheel dolly, fuel pump for larger gas tank, and radio shielding. Factory direct price for basic unit is $365.



Cardioid Microphone

(92)

The Model 777 "Jet Star" microphone by the **Turner Microphone Co.** features a cardioid pattern and easy changeover from hand-held to stand-mounted operation. The on-off switch is a rotary type marked for good readability even in dim lighting. Rolled-off bass response is provided to permit close-to-mouth use without popping and breath noises. The microphone has an impedance of 150 ohms, balanced line. Its list price is $110.



Video Amplifier

(93)

The MARK VIII AGC amplifier has been designed by **Ball Brothers Research** to provide capability to compensate automatically for a variety of video signal deficiencies. Two models are available, the standard A unit where local drives are supplied, and the B unit for remote operation. Both models offer color capabilities and provide continuous monitoring of video signals from a variety of originating equipment.

The solid-state units automatically adjust video gain and setup, and restore video signals to a predetermined nominal level with input variation of ±6db. Automatic gain-control action over a 2:1 change is provided during the active scan portion of each line. Color burst is passed, without AGC action, through the unit at preset or unity gain. Differential phase and gain are held at 0.6° and 1%, respectively, at the input within the dynamic range of operation. Sync may be added to either or both video outputs when operating with noncomposite video.

The system detects normal studio operations, such as fade-to-black, and protects against adding excessive gain correction; operation returns to normal gain when video is returned to the input.

Front-panel controls adjust the limits of video gain-attenuation servos. A bypass switch, to route the video signal directly to the output terminal, may be operated remotely. The unit is constructed entirely of plug-in modules which mount in a standard relay-rack card housing.

DC To AC Power Inverter

(94)

The **Terado Corp.** Gemini Model 50-128 solid-state power inverter changes the regular storage battery current of a car or boat to 117 volts filtered AC. Capacity of the inverter is 450 to 500 watts. The unit is housed in a copper-clad case with carrying handle and is priced at $88.

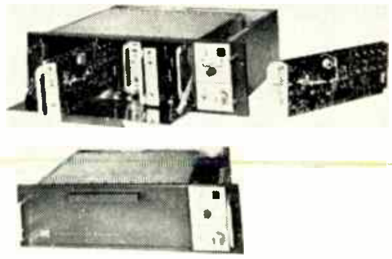
Transistorized Audio Preamps

(95)

Two high-gain audio preamplifiers, designed for internal DC power operation, are called "Mix-Amps" by **Switchcraft, Inc.** These miniature transistorized devices are intended for increasing output of low-level microphones and reducing high-frequency response loss in long microphone cable runs. The devices can be used for impedance matching, fixed-gain applications, and for boosting low-level outputs of attenuating networks and pads.

Specifications of both "Mix-Amps," Model 503 and 504, include response of ±1db from 20 to 20,000 Hz, a gain of 25 db with the impedance switch in the LOW (2000-ohm) position, and a gain of 6db with the switch in the HI (35,000-ohm) position. The "Mix-Amp" has a separate switch to control "Off" and "On" functions, and a standard "AA" cell provides up to 1000 hours of operating time. Model 503 accepts standard ¼" phone plug; Model 504 has the same design features except the output plug is a long-shouldered, standard phone plug.

List price for Model 503 is $16.50 and for the Model 504, $14.50.



Synchronizing Pulse Generator

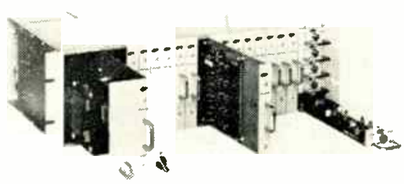
(96)

Integrated circuits are featured in a new synchronizing pulse generator and power supply developed by **Dage-Bell Corp.,** a subsidiary of **Raytheon Co.** Designed particularly for television broadcasting systems, the generator employs solid-state circuits exclusively. It provides composite sync, mixed blanking, and horizontal and vertical drives. The Dage sync generator is available to meet either EIA/FCC, CCIR, or high-scan-rate standards. It is offered in scan rates from 525 to 1203 lines.

An automatic switching accessory insures against outages by instantly shifting sync generators should any of the four sync-generator outputs fail. Other options include a dot-bar generator and color subcarrier to provide all required signals for both black-and-white and color camera chains. A digital countdown feature eliminates further adjustment after the factory setup.

The generator occupies 5½ inches of vertical space in a standard 19-inch rack. Quick-access, plug-in modules with external test points facilitate maintenance.

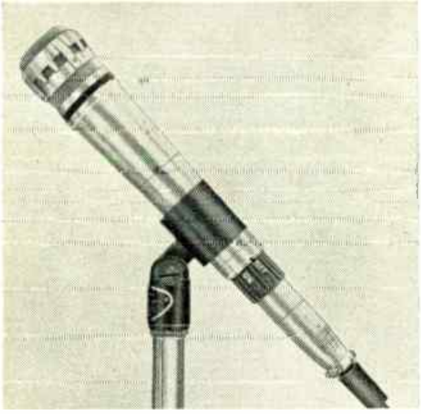
The self-contained unit has provisions for a sync-slave module to provide sync-lock capabilities for remote/local applications. AFC modes of operation include fast, slow, and crystal lock for minimum time disturbance of the signal.



Solid-State TV Switching

(97)

Dynair Electronics is producing a basic Series 5100 switching system which consists of twenty SW-5100A switching modules and five DA-5150B video output modules in a single mounting frame. Each switch module has five switch junctions, providing



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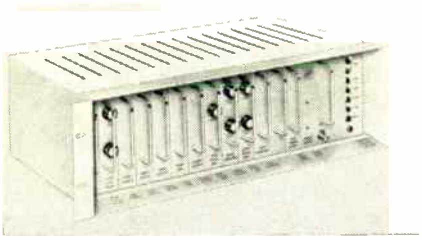

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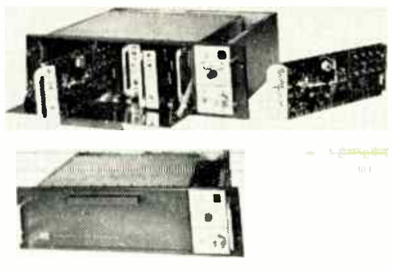

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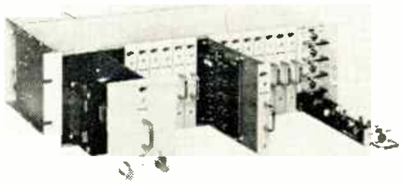

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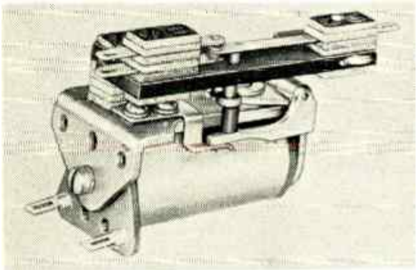
Another version, the Series 5110, is for use in smaller systems. It uses the same modules, except the basic frame has only 15 of the switch modules. Five of the spaces normally used for switch modules are filled with a power supply which provides power for all modules in the frame. This basic building block has 15 inputs and 5 outputs.

The Series 5100 Switching System is available with a variety of local and remote control panels, combining amplifiers, and sync-adding output amplifiers. Control panels may be of the standard lighted or unlighted push-button variety, or, if desired, a standard telephone dial is available for selection of signals.



Telephone-Type Relay Switches

(98)

A telephone-type relay that switches RF (through video frequencies) with low distortion is manufactured by **Magnecraft Electric Co.** Designated the Class 22F Series, these relays may be obtained with either SPST-NO or SPDT RF contacts rated for 3-amp loads at 115VAC or 32VDC, noninductive. They are available with auxiliary contacts rated for 5-amp loads at 115VAC or 32VDC, noninductive. Auxiliary contacts may be specified in configurations up to DPDT.

These relays are built to specific customer requirements. Coils may be obtained single-wound in any resistance up to 20,000 ohms, with any operating voltage up to 230 volts, AC or DC, and with time delay on either the operate or release time. Nominal operating power required is 2 watts for DC operation, or 5 volt-amperes for AC operation. Ten standard catalog numbers are listed.

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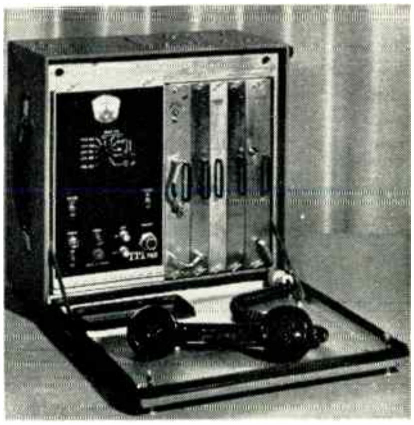


Two-Way Microwave Communications Terminal

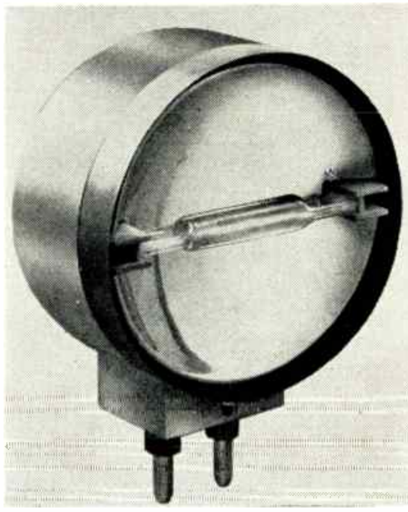
A complete, portable two-way microwave communications terminal approximately the size of an attache case has been developed by the **Federal Laboratories** division of **International Telephone and Telegraph.** The microelectronic Pico® CXL-series terminal can carry multichannel voice, data, television, or radar signals. The terminal contains a receiver, transmitter, order-wire internal signaling, handset, a high-gain planar array antenna, and battery-operated power supply.

The Pico set can be used by television broadcasters to cover events at remote locations. Airlines, railroads, highway departments, and others can use the terminal to carry a large volume of communications traffic. It can also perform emergency chores, such as restoring communications in a disaster area, or temporarily bridging a cable break.

The set is available in four configurations, complete with power sources:

1. No. 1 is packaged around the neck of a horn antenna, and is about the size of a press photographer's camera.
2. No. 2 contains an integral flat-pack antenna, and is the size of an attache case.
3. No. 3 is a rack-mounted, five-watt, one-cubic-foot unit containing an order wire.
4. No. 4 is a torpedo-shaped unit 20" long and 5.5" in diameter, mounted on a pole, tower, or other structure.

Designed to function properly at least one year without servicing, Pico operates from AC power or a pack of nickel-cadmium rechargeable cells.



Spotlight Conversion

The MOGUL-BI® (Mogul Bi-Post Quartz Converta) illustrated here and the MOGUL-PF® (Mogul Prefocus Quartz Converta) from **Packaged Lighting Services** make it possible to convert 8-12" fresnel spotlights to a quartz light source.

The Convertas snap into the existing sockets — no physical changes are required. They are equipped with a telescopic adjustment device which permits the proper lamp-filament positioning through the existing lens. Five varied quartz lamps are interchangeable in the Mogul Convertas: from 1000-watt, 2000 hours, 3000° K to 2000-watt, 150 hours, 3200° K. They can be burned in any position and are made to provide balanced lighting with constant color temperature. Price is $37.50.

ENGINEERS' TECH DATA

AUDIO & RECORDING EQUIPMENT

45. ATLAS SOUND—Catalog S66-67 exhibits complete equipment line including PA loudspeakers, microphone stands, and accessories.
46. EASTMAN KODAK—24-page booklet describes magnetic tape properties, tolerances, and manufacturing processes. Accompanying spec sheet details Eastman types.
47. KRS—Technical Bulletins S-1, SB1, and SB6A provide information and specifications on STACTape® line of cartridges, 1-STACT® cartridge playback machine, and 6-STACT® broadcast-type playback unit.
48. MEMOREX—A new four-page brochure specifies proper-sound-system, high-fidelity, automotive, and radio-TV reties of 75 series precision magnetic tape for helical-scan recording.
49. QUAM-NICHOLS—General Catalog 66 lists public-address, placement speakers.
50. SPARTA—Product Guide illustrates and details new 800C series tape cartridge system using CII-5 deck mechanism.
51. VIKING OF MINNEAPOLIS—Literature is for Model 230 tape transport.

CATV EQUIPMENT

52. ENTRON—Offer is spec sheet for model MTV multiple-tap directional coupler with variable attenuation.

COMPONENTS & MATERIALS

53. INTERNATIONAL ELECTRONICS—Complete specification data includes characteristic curves for the Mullard 6076/-QY5-3000A transmitting tetrode. Additional general folder lists complete IEC/Mullard special-purpose tube range including the 10M series.
54. SKYDYNE—Complete catalog shows 30 off-the-shelf glass-fiber equipment transportation cases with a variety of shock- and vibration-absorbing interiors. Cases are especially suited for lenses, microphones, cameras, and other delicate equipment.
55. SOLITRON—News release covers Hi-PAC® interconnection system which employs variety of substrates for use as ground, heatsink, or insulator.
56. SWITCHCRAFT—New Product Bulletin 161 is for 14412G handset cradle switches designed to hold WE and other standard telephone handsets.

MICROWAVE DEVICES

57. MICROWAVE ASSOCIATES—Design and performance of 2-gHz all solid-state microwave TV relay system are outlined in 16-page brochure.
58. VARIAN ASSOCIATES—Brochure entitled "Micro-Link . . . Your Guide to Better ETV" tells story of how 2500mHz ETV can be used to link all schools in a given school district.

MOBILE RADIO & COMMUNICATIONS

59. HERB KRECKMAN—8-page Catalog No. 68 illustrates and details line of communications antennas.
60. MOSLEY ELECTRONICS—Catalog lists complete line of 1966 Citizens band equipment.

POWER DEVICES

61. HEVI-DUTY—Bulletin 7-22 supplies data on line-voltage regulator using saturable-core reactor.

RADIO & CONTROL ROOM EQUIPMENT

62. AUTOMATIC TAPE CONTROL—Specification sheet is for automatic program logging models APL and APL-M.

63. CBS LABORATORIES—Information is available on new FM Volumax. Offer extends to description of new wide range Program Monitor with +3 to —57db linear decibel scale.

64. DAYTON ELECTRONICS—Complete technical manual describes S/6 solid-state SCA multiplex receiver with modular construction.

65. KARG LABORATORIES—Data sheet and descriptive article on Model XT-3 crystal-controlled FM tuner for program relay and studio monitor.

REFERENCE MATERIALS & SCHOOLS

66. CLEVELAND INSTITUTE OF ELECTRONICS—New pocket-size plastic "Electronics Data Guide" includes formulas and tables for: frequency vs. wave length, db, length of antennas, and color code.

67. GATES—Two engineering reports "Units of Measurement in Equipment Performance" and "Preventing FM Overmodulation," written by Wallace Kabrick, are offered.

68. HAYDEN BOOKS—New 64-page catalog lists Hayden and Rider technical books for engineers, technicians, and management.

STUDIO & CAMERA EQUIPMENT

69. CLEVELAND ELECTRONICS — A 52-page quick-reference, step-down diecut catalog covers complete information on Vidicon, Plumbicon®, and image-orthicon deflection components. Included are photographs, specifications, technical data, and dimensional drawings.

70. KEMLITE—Series of brochures details specifications and aplications of reflectors, high-intensity electronic flash tubes for photography, and straight and helix second-generation flash units for laser pump and other research applications.

71. TV ZOOMAR—Literature describes Model 10X40C 10-to-1 zoom lens for image-orthicon cameras.

72. ZOOMAR—Booklet includes spec sheets for Zoomar Mark III, IV, VI, XB, and XX lenses. A special "Pocket Guide to Field Coverage of Lenses for Vidicon Cameras" is part of offer.

TELEVISION EQUIPMENT

73. COLORADO VIDEO—Data sheet gives description of Model 501 "Slow-Scan" TV camera.

74. INTERNATIONAL NUCLEAR—Information sheet concerns reed-relay video switching systems.

75. TELEMATION—Spec sheet is for low-cost video processing amplifier for VR-660 and other video tape recorders.

76. TRAID—New 35-mm stop-motion projector is subject of specifications sheet.

77. VITAL—Data sheets give specifications of Model VI-500 stabilizing amplifier, Model VI-10A video distribution amplifier, and Model VI-20 pulse-distribution amplifier.

Advertisers' Index

Professional Services

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Consulting Engineer
National Press Bldg.
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Telephone District 7-1205
Member AFCCE

CARL E. SMITH
Consulting Radio Engineers
AM, FM, TV and CATV
8200 Snowville Road
Cleveland, Ohio 44141
Phone: 216-526-4386
Member AFCCE

CAMBRIDGE CRYSTALS
PRECISION FREQUENCY
MEASURING SERVICE
SPECIALISTS FOR AM-FM-TV
445 Concord Ave. Phone 876-2810
Cambridge, Mass. 02138

AMPEX HEAD ASSEMBLY RECONDITIONING SERVICE for all Ampex professional model recorders. This professional service features precision relapping of all heads for maximum head life. Your assembly is thoroughly cleaned and guides are replaced as required. Price includes optical and electrical inspection and complete testing on Ampex equipment in our plant. Full track or half track assemblies . . . $35.00. One to two day service. "Loaner" assemblies available if necessary. LIPPS, INC., 1630 Euclid Street, Santa Monica, California 90404. (213) EX 3-0449. tf

VIDEO TAPE RECORDER
AUDIO HEAD ASSEMBLY SERVICE
Precision relapping of all heads and supporting posts, including cleaning and testing. Ampex head assembly with "cue" tracks, $75.00 complete. RCA units also relapped. One to two day service. LIPPS, INC., 1630 Euclid St., Santa Monica, Calif. 90404. (213) EX 3-0449. tf

Classified

Advertising rates in the Classified Section are ten cents per word. Minimum charge is $2.00. Blind box number is 50 cents extra. Check or money order must be enclosed with ad.

The classified columns are not open to the advertising of any broadcast equipment or supplies regularly produced by manufacturers unless the equipment is used and no longer owned by the manufacturer. Display advertising must be purchased in such cases.

EQUIPMENT FOR SALE

RADAR—RCA Model CR-101 marine radar, 120 VAC, in good operating condition. 35KW "X" band transmitter, 12" PPI indicator, ranges to 50 miles. Make a fine local area weather radar. $1500.00 FOB Chicago. Write P.O. Box 71, Northlake, Illinois 60164. 7-66 2t

CO-AXIAL CABLE Heliax, Styroflex, Spiroline, etc. Also rigid and RG types in stock. New material. Write for list. Sierra-Western Electric Co., Willow and 24th Streets, Oakland, Calif. Phone 415 832-3527 5-66-tf

Audio Equipment bought, sold, traded. Ampex, Fairchild, Crown, McIntosh, Viking. F. T. C. Brewer Company, 2400 West Hayes Street, Pensacola, Florida. 3-64-tf

Television / Radio / communications gear of any type available. From a tower to a tube. Microwave, transmitters, cameras, studio equipment, mikes, etc. Advise your needs—offers. Electrofind Co., 440 Columbus Ave., NYC. 212-EN-25680. 8-64 tf

COMMERCIAL CRYSTALS and new or replacement crystals for RCA, Gates, W. E., Bliley, and J-K holders; regrinding, repair, etc. BC-604 crystals; also service on AM monitors and H-P 335B FM monitors. Nationwide unsolicited testimonials praise our products and fast service. Eidson Electronic Company, Box 96, Temple, Texas. 5-64 tf

Trimm 504 Audio Patch cords $4.00. Audio jack panels for 19" racks, 10 pair $8.95. Repeat coils 500-500 ohm flat to 20kc $4.00—Relay racks and equipment cabinets. Write for list. Gulf Electro Sales, Inc., 7031 Burkett, Houston, Texas. 4-66-tf

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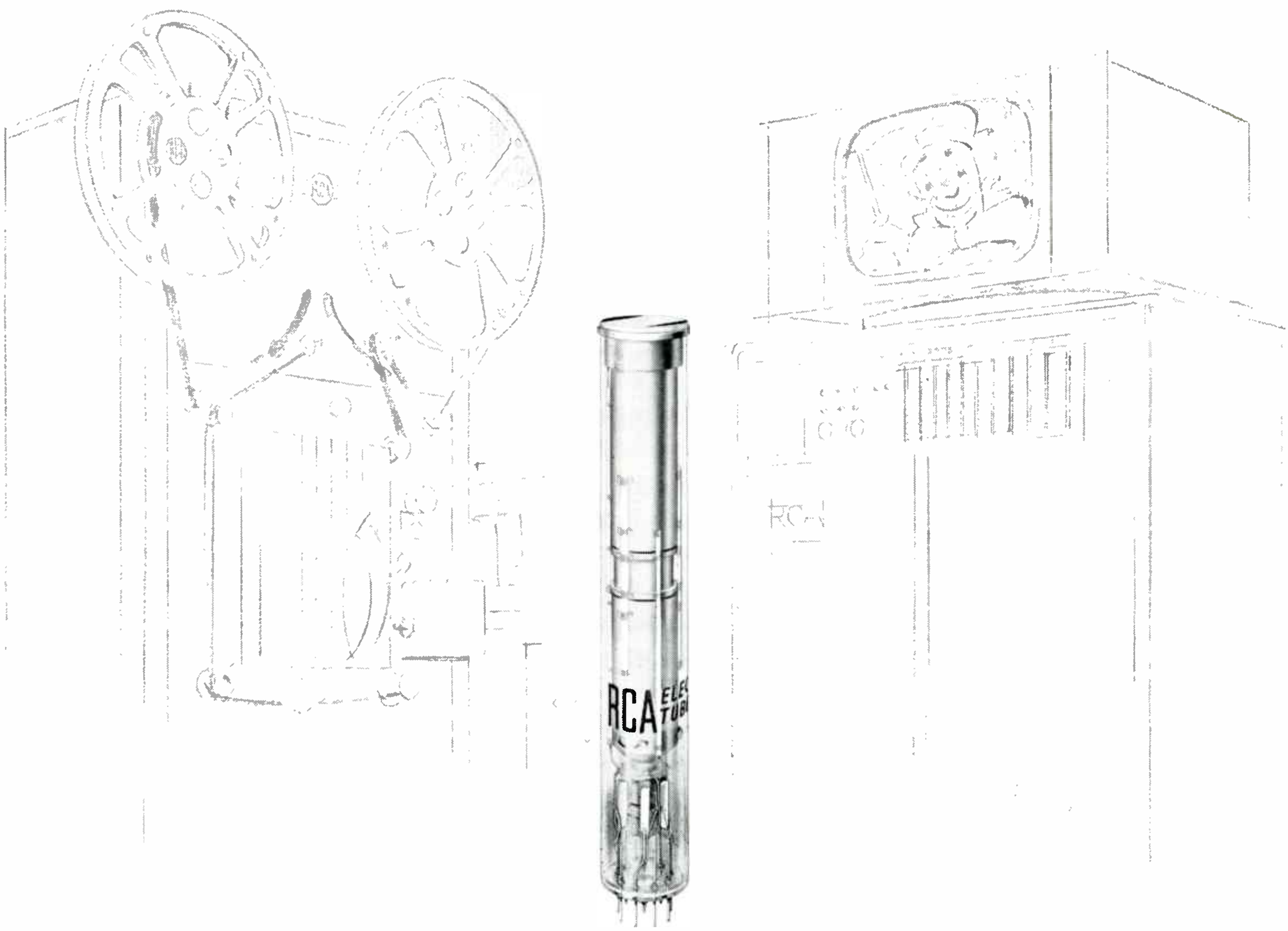

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