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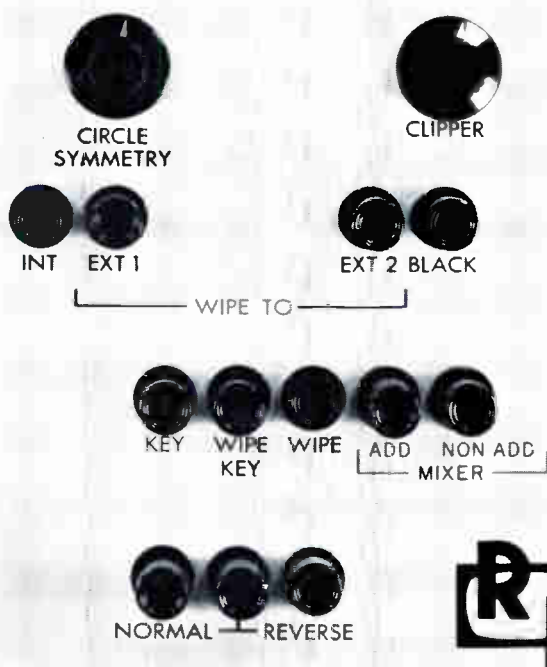


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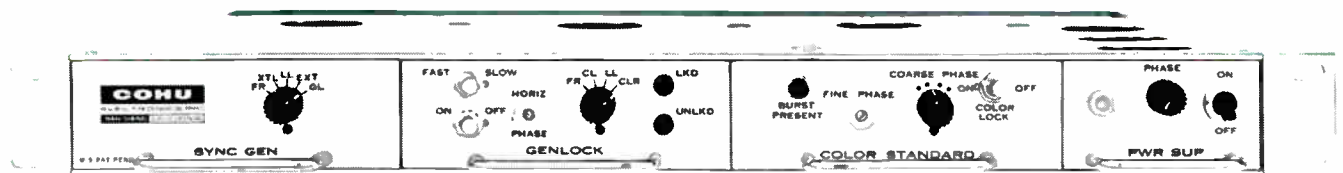


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# Broadcast Engineering

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Our cover simulation of a proof-of-performance map for a hypothetical Class-II station serves to call attention to the feature "Interference Calculations for the Critical Hours." This comprehensive article begins on page 11.



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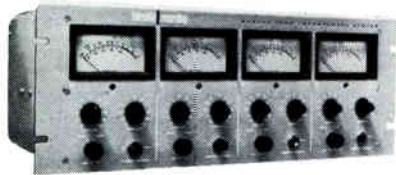
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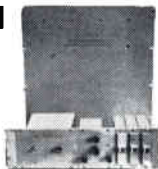


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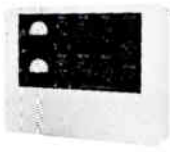
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## Book Review

**Electron Tubes:** Royce Gerald Kloeffler; John Wiley & Sons, Inc., New York, 1966; 262 pages, 6" x 9", hard cover; \$5.95.

This book, written as an introductory text for the junior-college and technical-institute level, describes the operation and application of electron tubes. The text has been written on the assumption that the reader is already familiar with DC circuits and is concurrently studying AC circuits.

Chapters cover electron emission, graphical circuit analysis, vacuum diodes, vacuum triodes, multielement tubes, single-stage amplifiers, multistage amplifiers, power supplies, gaseous tubes, power supplies, and special electron tubes. A group of questions follows each chapter, and answers to some of these are included at the back of the book. A four-page index completes the volume.

A knowledge of simple algebra is essential to the understanding of this book. Where appropriate, explanations employing calculus have been included, but the same points are explained by other means for readers not familiar with calculus. Schematics, graphs, line drawings, and photographs are used throughout to supplement the text.

The author of this volume is Professor Emeritus of Kansas State University. He has been author or coauthor of a number of books on electrical engineering and related subjects.

Though an introductory text, *Electron Tubes* is by no means superficial; yet, a high degree of understandability has been preserved throughout. The reader who has need to learn the basic principles of electron tubes should find this book quite helpful. ▲



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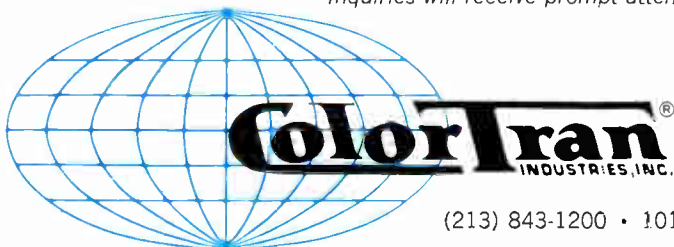


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Walter R. Wright, Electrician (Local 1, IATSE), shown at WNEW's ColorTran Dimmer Control Console. Standing from left-to-right are William Kelly, WNEW-TV Chief Engineer; Joseph N. Tawil of ColorTran and Carl Gaiti, WNEW-TV Lighting Director.

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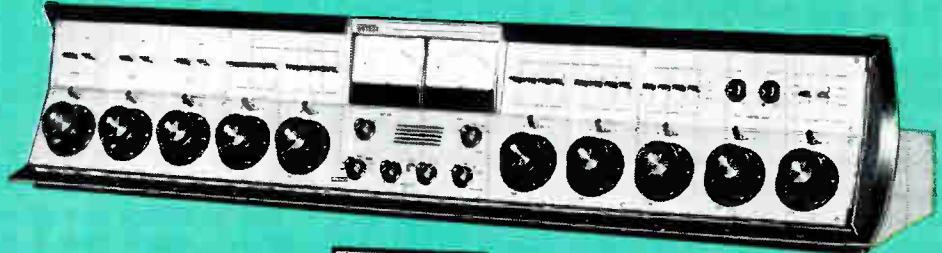


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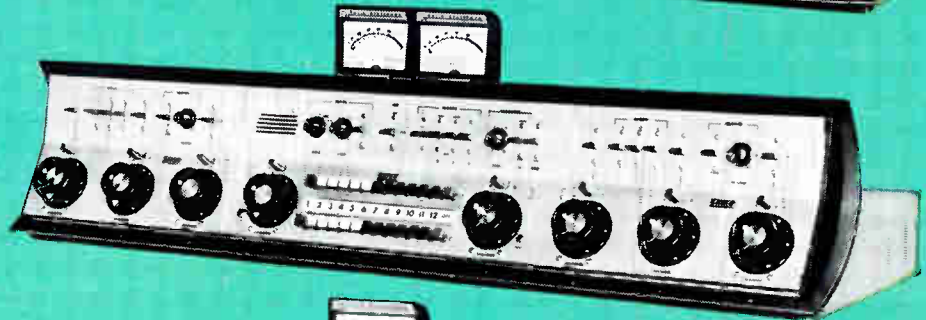
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# INTERFERENCE CALCULATIONS FOR THE CRITICAL HOURS

by **Barnett F. Goldberg\*** —The procedures for predicting interference during this period are described fully.

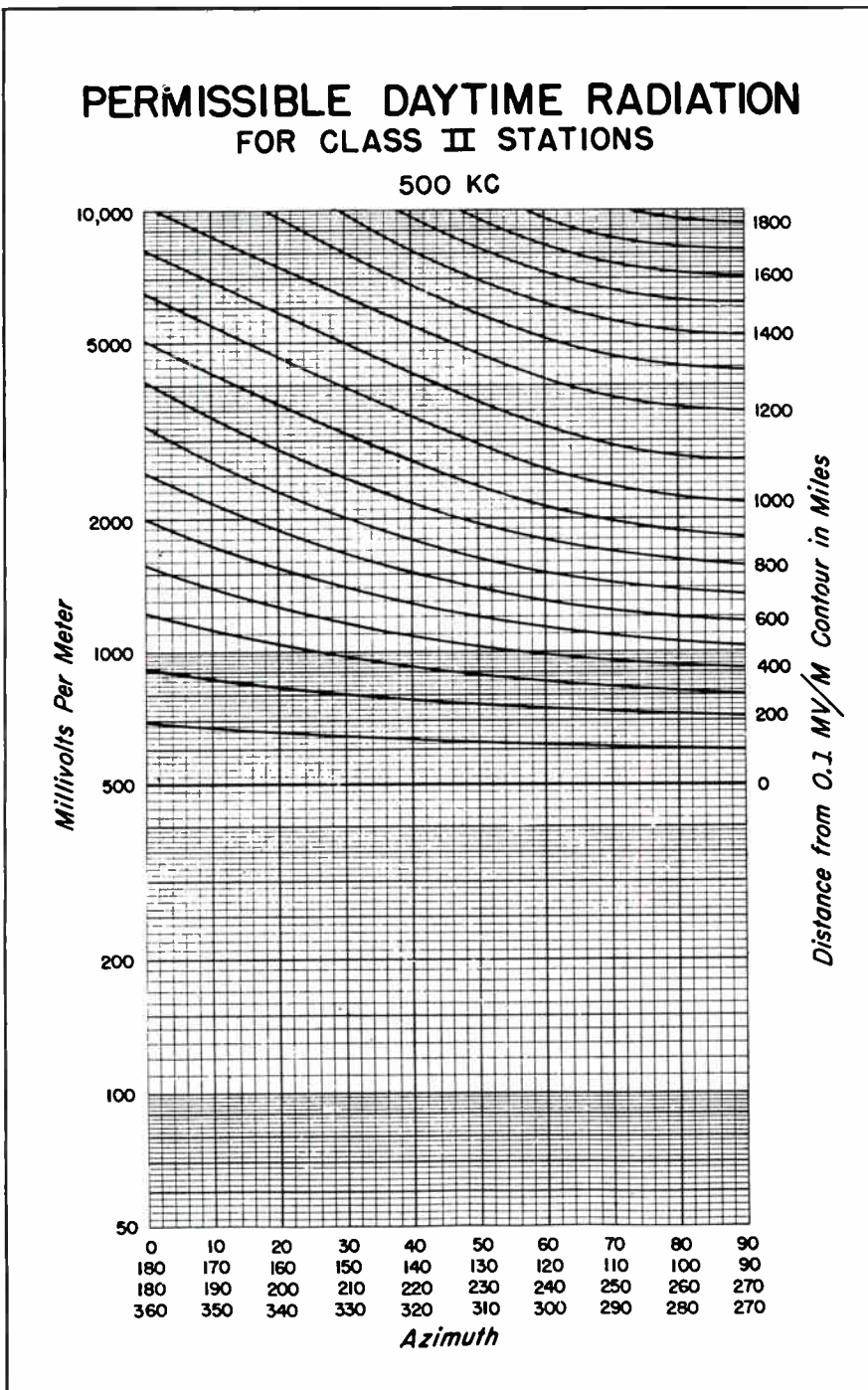


Fig. 1. FCC Figure 9 for use in determining critical-hours radiation limit.

Interference calculations for the critical hours (CH) are required in connection with applications for new or changed Class II standard broadcast facilities, when the proposed operation would be on any of the clear channels assigned to the United States for Class I use. The critical hours are those two-hour periods following local sunrise and preceding local sunset at the transmitter site of the Class II station. During these transitional times, propagation by reflective transmission through the ionosphere is on the wane or rise, and radiation from the Class II station toward the cochannel Class I operations must be restricted below certain maximum values to prevent harmful interference.

It is interesting to note that neither of the terms "critical hours" or "transitional times" appears in the FCC Rules and Regulations. Rather, the two terms are common-usage terminology, adopted by most consultants to describe the body of calculations pertaining to skywave interference during these hours.

The effect of the CH provisions on many Class II proposals is to require a different arrangement of facilities (*i.e.*, transmitter power and/or antenna system) during the critical hours than during the remainder of the daytime hours. While this is not always the case, the CH interference picture does exert some influence over the design of the overall daytime facilities of a Class II station.

The purpose of this article is to examine the critical-hours Rule and the mechanics of its application to practical case studies. From this

\*Consulting Electronics Engineer, Columbia, South Carolina



## FCC Critical Hours Rule

### 73.187 Limitation on daytime radiation.

(a)(1) Except as otherwise provided in subparagraphs (2) and (3) of this paragraph, no authorization will be granted for Class II facilities if the proposed facilities would radiate, during the 2 hours after local sunrise and the 2 hours before local sunset, toward any point on the 0.1 mv/m contour of a co-channel U.S. Class I station, at or below the pertinent vertical angle determined from curve 4 of Figure 6a of § 73.190, values in excess of those obtained as provided in paragraph (b) of this section.

(2) The limitation set forth in subparagraph (1) of this paragraph shall not apply in the following cases:

(i) Any Class II facilities authorized before November 30, 1959; or

(ii) For Class II stations authorized before November 30, 1959, subsequent changes of facilities which do not involve a change in frequency, an increase in radiation toward any point on the 0.1 mv/m contour of a co-channel U.S. Class I station, or the move of transmitter site materially closer to the 0.1 mv/m contour of such Class I stations.

(3) If a Class II station authorized before November 30, 1959, is authorized to increase its daytime radiation in any direction toward the 0.1 mv/m contour of a co-channel U.S. Class I station (without a change in frequency or a move of transmitter site materially closer to such contour), it may not, during the two hours after local sunrise or the two hours before local sunset, radiate in such directions a value exceeding the higher of:

(i) The value radiated in such directions with facilities last authorized before November 30, 1959, or

(ii) The limitation specified in subparagraph (1) of this paragraph.

(b) To obtain the maximum permissible radiation for a Class II station on a given frequency ( $f_{kc/s}$ ) from 640 kc/s through 990 kc/s, multiply the radiation value obtained for the given distance and azimuth from the 500 kc/s chart (Figure 9 of § 73.190) by the appropriate interpolation factor shown in the  $K_{500}$  column of paragraph (c) of this section; and multiply the radiation value obtained for the given distance and azimuth from the

1000 kc/s chart (Figure 10 of § 73.190) by the appropriate interpolation factor shown in the  $K_{1000}$  column of paragraph (c) of this section. Add the two products thus obtained; the result is the maximum radiation value applicable to the Class II station in the pertinent directions. For frequencies from 1010 kc/s to 1580 kc/s, obtain in a similar manner the proper radiation values from the 1000 kc/s and 1600 kc/s charts (Figures 10 and 11 of § 73.190), multiply each of these values by the appropriate interpolation factor in the  $K'_{1000}$  and  $K'_{1600}$  columns in paragraph (c) of this section, and add the products.

(c) Interpolation factors.

(1) Frequencies below 1000 kc/s.

$f_{kc/s}$	$K_{500}$	$K_{1000}$
640.....	0.720	0.280
650.....	0.700	0.300
660.....	0.680	0.320
670.....	0.660	0.340
680.....	0.640	0.360
690.....	0.620	0.380
700.....	0.600	0.400
710.....	0.580	0.420
720.....	0.560	0.440
730.....	0.540	0.460
740.....	0.520	0.480
750.....	0.500	0.500
760.....	0.480	0.520
770.....	0.460	0.540
780.....	0.440	0.560
800.....	0.400	0.600
810.....	0.380	0.620
820.....	0.360	0.640
830.....	0.340	0.660
840.....	0.320	0.680
850.....	0.300	0.700
860.....	0.280	0.720
870.....	0.260	0.740
880.....	0.240	0.760
890.....	0.220	0.780
900.....	0.200	0.800
940.....	0.120	0.880
990.....	0.020	0.980

(2) Frequencies above 1000 kc/s.

$f_{kc/s}$	$K'_{1000}$	$K'_{1600}$
1010.....	0.983	0.017
1020.....	0.967	0.033
1030.....	0.950	0.050
1040.....	0.933	0.067
1050.....	0.917	0.083
1060.....	0.900	0.100
1070.....	0.883	0.117
1080.....	0.867	0.133
1090.....	0.850	0.150
1100.....	0.833	0.167
1110.....	0.817	0.183
1120.....	0.800	0.200
1130.....	0.783	0.217
1140.....	0.767	0.233
1160.....	0.733	0.267
1170.....	0.717	0.283
1180.....	0.700	0.300
1190.....	0.683	0.317
1200.....	0.667	0.333
1210.....	0.650	0.350
1220.....	0.633	0.367
1500.....	0.167	0.833
1510.....	0.150	0.850
1520.....	0.133	0.867
1530.....	0.117	0.883
1540.....	0.100	0.900
1550.....	0.083	0.917
1560.....	0.067	0.933
1570.....	0.050	0.950
1580.....	0.033	0.967

examination, the reader may gain some familiarity with the provisions of the Rule and be in a position to apply this knowledge to situations in which he might have an interest.

## The Critical Hours Rules

The critical hours regulations were adopted by the Federal Communications Commission to protect U.S. Class I operations from harmful skywave interference to their daytime normally protected service contours. It should be noted that a CH study is not required in connection with domestic Class II applications requesting permission to operate on frequencies where no U.S. Class I assignments are made.

Table 1 (on page 22) lists the United States clear channel frequencies. Within the contiguous 48 states, twelve channels are reserved exclusively for use by only one U.S. Class I-A station per channel. The remaining channels are available for use by Class II stations. On some channels these are the specified Class II-A assignments in the western portion of the United States; on other channels, Class II-B (unlimited time) and II-D (daytime) stations may be authorized.

The specific regulation relating to the critical hours is Section 73.187 of the FCC Rules and Regulations, entitled simply "Limitation on daytime radiation." Section 73.187 stipulates a specific procedure which must be used to calculate the Class II CH radiation limits vs azimuth toward the Class I stations. This method is based on a statistical approach to the problem and makes use of charts and graphs supplied by the Commission. Among this material are two frequency interpolation charts, given within the Rule itself, and four graphical figures (6a, 9, 10, and 11), Section 73.190. (These graphs are shown as Figs. 7, 1, 5, and 6, respectively, in this article.)

## The Critical Hours Study

A detailed CH interference study is usually carried out only after a prior daytime groundwave interference (allocations) study has already been done, assuring that the chosen frequency is available on that basis first. Also if the normally protected groundwave contour of a cochannel

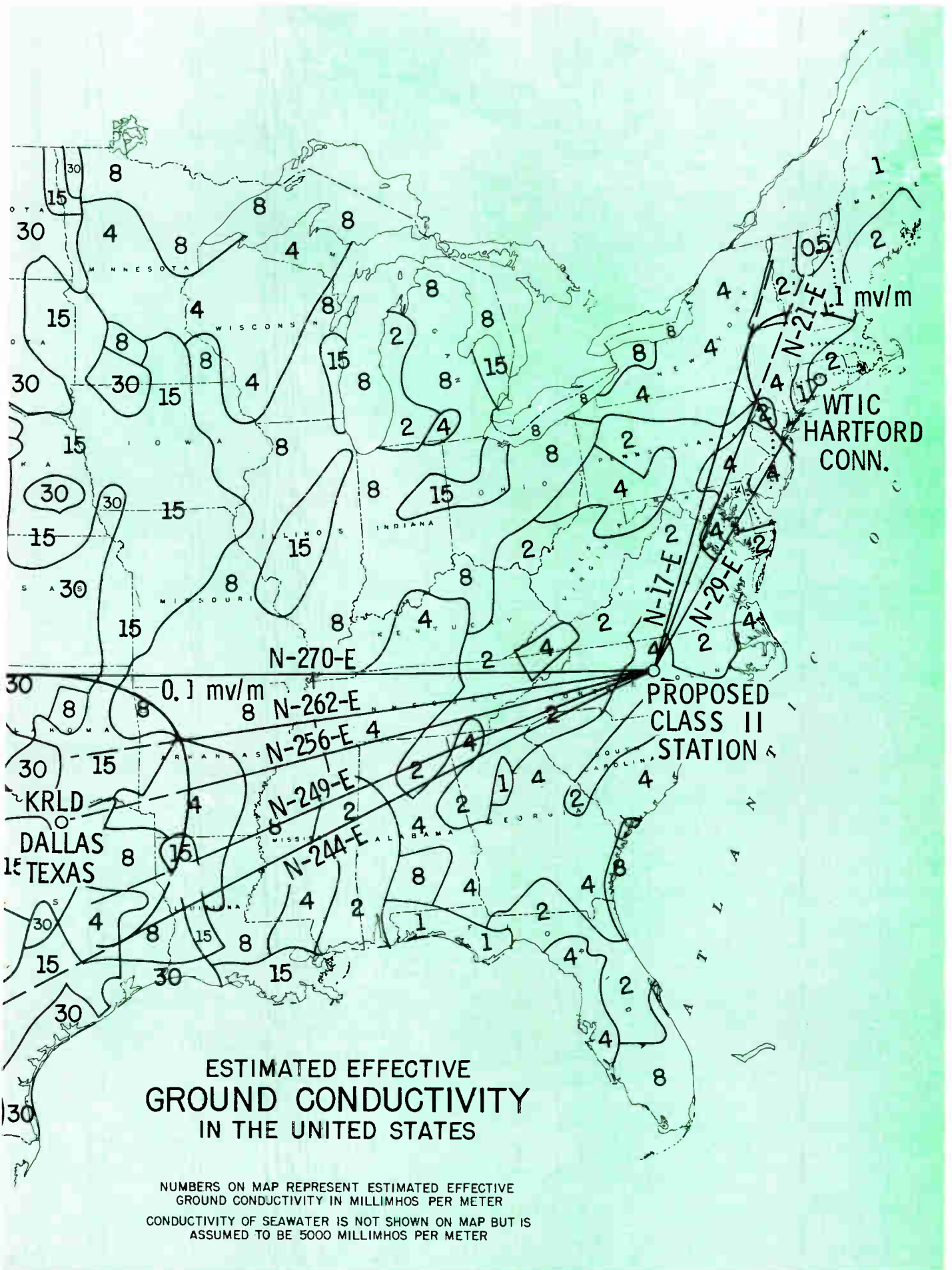


Fig. 2. Two Class-I stations at different distances and widely different azimuths from proposed station are shown.



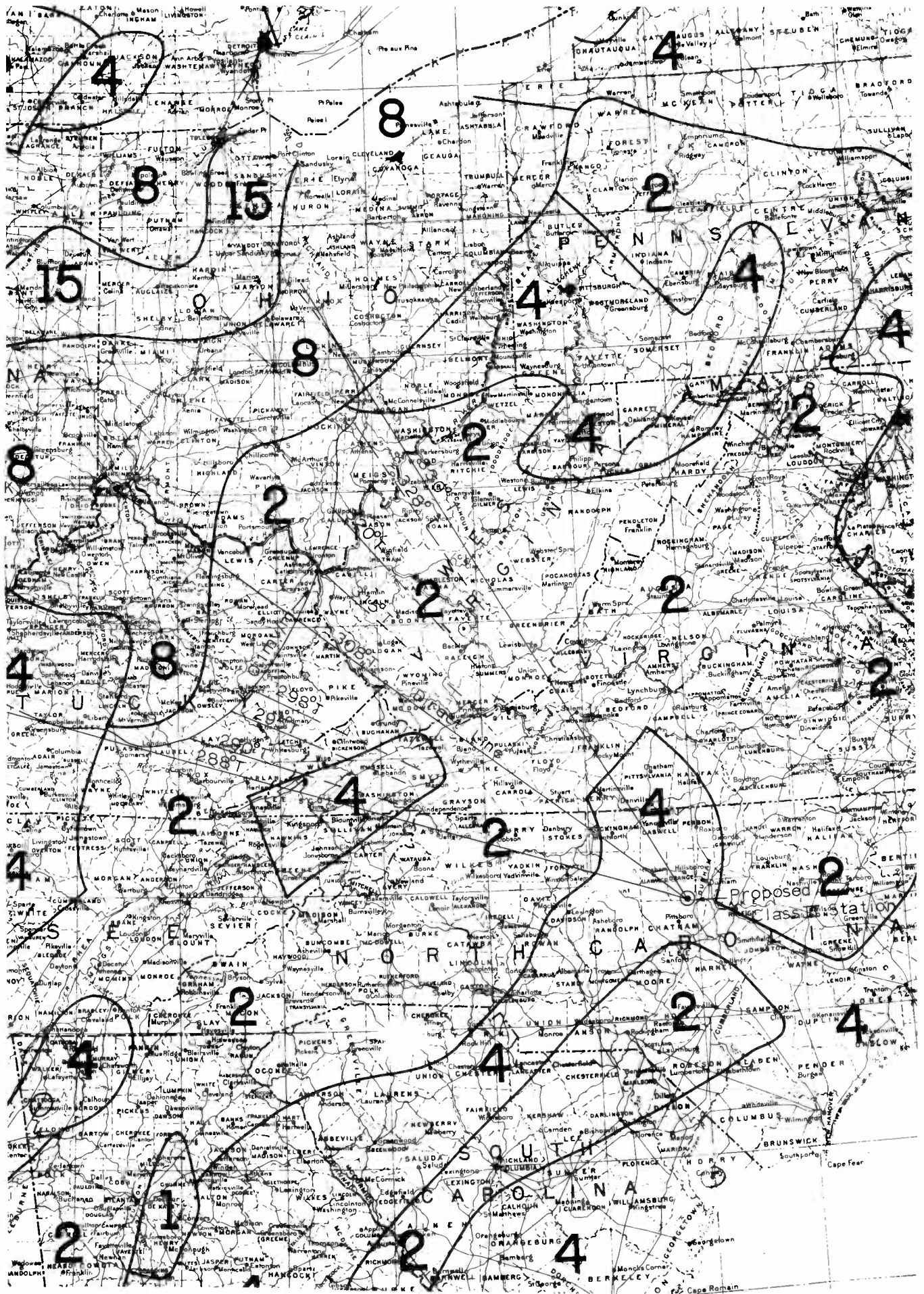


Fig. 3. Greater detail and more analysis radials are needed in the case of a Class-I station relatively close to site.



Class I station is found to be pertinent to the daytime groundwave interference study, this contour will be found to be especially pertinent to the critical-hours study as well.

The purpose of the critical-hours study is to develop a limiting inverse-field contour, below which the proposed station must operate during these times. The procedure for making the study can be outlined as follows.

1. Identify and locate on a suitable map each cochannel Class I station involved with the proposed station.
2. Determine for each such Class I station, in reasonable proximity to the proposed station, its 0.1 mv/m daytime groundwave service contour, over that 180 degrees of the contour which faces toward the proposed station.
3. Prepare a map or series of maps showing the above information to a scale appropriate to each of the CH analysis radials which must be drawn to investigate each Class I 0.1 mv/m contour.
4. Select and draw in the analysis radials necessary to investigate all pertinent segments of each of the 0.1 mv/m contours.
5. From the map, read the distance and bearing of each radial from the proposed transmitter site to the point where the radial intersects the Class I 0.1 mv/m contour.
6. Prepare a worksheet and enter the distance and bearing information onto the sheet.
7. Carry out, in the order indicated on the worksheet, the necessary graphical readouts, computations, etc., leading to a specific inverse field and associated vertical angle of departure for each radial entered into the worksheet.

8. Assemble the resultant limits into the form of a protection graph, which is to be superimposed upon the proposed daytime protection graph so that the composite graph will represent the total critical-hours limitation to the proposal.

#### **Critical Hours Exhibits**

The preceding list shows the general nature and mechanics of the CH investigation. Now attention will be turned to the organization of this study as it would be arranged in connection with a typical station application exhibit. The CH interference study, as submitted among the various other allocations studies of an application, usually consists of one or more map exhibits, a tabulation sheet, and a set of CH service contours.

The key exhibit of the CH interference study is the map or maps showing the relationship between the proposed station and each of the Class I stations concerned. It clearly defines the various Class I 0.1 mv/m contours involved and shows the analyst's choice of radials. The degree of detail involved with this showing will be found to vary inversely with the distance from the Class I station contours; consequently, in some cases more than one map will be needed, especially when two or more Class I stations are involved and are at widely different distances and orientations from the proposed Class II station. Figs. 2 and 3 show examples of such maps and illustrate the degree of detail involved for different station separations.

#### **Preparing the Contours**

The presentation of the respective 0.1 mv/m contours, as required for the CH investigation, can be obtained from any one of the following sources:

1. Such 0.1 mv/m contour information as already might have been determined for a Class I station in close enough proximity to the proposed station to be pertinent to its M-3 groundwave daytime interference study.
2. Information provided by the NARBA Official Notification List used in conjunction with

the Commission M-3 soil conductivity map.

3. Contour and/or inverse-field information gleaned from the file at the FCC Public Reference Room for the Class I station.

Of these sources, number 3 is best, where applicable, with sources 2 and 1 (which are in most cases one and the same) next in that order. Wherever practical, use should be made of the Commission Public Reference Room files, not only to ascertain what the daytime horizontal inverse fields and soil conductivity assumptions for the Class I station are, but also to assure that the contour prediction data are based upon current information. It is well to remember that most of the U.S. Class I stations have been on the air for a good many years, indicating that the prospect of radiation changes at these stations is not too remote.

Where one has already prepared the 0.1 mv/m contour for a particular Class I station, say in connection with the M-3 groundwave allocations showing, it obviously is not necessary to repeat these calculations for the CH study. However, it might be necessary to expand upon this information, because for the CH study there is usually a larger contour arc involved than is the case for the groundwave study at such separation distances. It should be recognized that information from this source will be available only for Class I stations in close enough proximity for the 0.005 mv/m contour of the proposed station to overlap the normally protected contour of the Class I station. It is also well to observe that where such a condition exists, the Class I station is going to exert quite a severe CH limitation on the proposed station.

While reference to the Commission files is the best single source of contour data, it should be noted that for Class I operations far removed from the proposed station, the additional effort to research these contours out to a high degree of precision is not, in many cases, justified.

#### **Selection of Radials**

It is of paramount importance that all 180 degrees of each Class I 0.1 mv/m contour which faces the proposed station be investigated.

Details of Computations for "Critical Hours" Allocations Study

New Standard Broadcast Station  
Blank Radio Corp.  
Anywhere, North Carolina

1530 kHz

1 kw - D 0.25 kw - CH

Daytime only

Computation of Permissible Radiation toward WCKY, Cincinnati, Ohio ( U.S. I-B)

(1)	(2)	(3)		(4)		(5)	(6)	(7)		
Bearing from Proposed Station True Degrees	Distance to WCKY 0.1 mv/m Groundwave Contour	Perm. Radiation ( from Graphs )		Corrected Radiation Factors: ( 0.117 for 1000 kHz ) ( 0.883 for 1600 kHz )		Permissible Radiation 1530 kHz	Maximum Vertical $\frac{E}{e}$ Curve 4 Figure 6a	Proposed Radiation CH		
		1000 kHz	1600 kHz	1000 kHz -	1600 kHz			Ground mv/m	Max. mv/m	at $\frac{E}{e}$ angle
288°	300 mi	291 mv/m	98 mv/m	34.0 mv/m	86.5 mv/m	120.5 mv/m	25.4°	100 mv/m	100 mv/m	0°
290°	280	285	94.5	33.5	83.5	117.0	27.2°	100	100	0°
295°	262	280	92.0	33.0	81.0	114.0	29.2°	100	100	0°
298°	256	277	91.0	32.5	80.5	113.0	29.4°	100	100	0°
308° <sup>1</sup>	255	285	92.5	33.5	81.5	115.0	29.5°	100	100	0°
315°	262	292	94.5	34.3	83.5	117.8	29.2°	100	100	0°
320°	278	306	100.0	35.8	88.3	124.1	27.3°	100	100	0°
328°	305	330	106.5	38.5	94.0	132.5	25.2°	100	100	0°
330°	325	345	110.0	40.5	97.1	137.6	23.5°	100	100	0°

Computation of maximum permissible radiation in accordance with the procedure outlined in Section 73.187(b) of the Commission Standards

<sup>1</sup>Direct Bearing, Proposed Station in North Carolina to WCKY Cincinnati, Ohio

Fig. 4. Sample worksheet based on example of Fig. 3 shows how step-by-step graphical readouts, computations lead to data from which radiation-limit curve is plotted.

This can be seen on the map to involve the investigation of a range of azimuths about the proposed station extending from a radial tangent to the 0.1 mv/m contour on one side to a second radial tangent to the same contour on the opposite side. (See Figs. 2 and 3.) The number of radials chosen depends principally on the proximity of the particular contour to the proposed station. It is customary to select radials separated from 2 to 10 degrees; the smaller angular separations are used normally for contours in unusually close proximity to the proposal.

From Figs. 2 and 3, it can be seen that the range of azimuths involved gives the most readily apparent indicator of the required number and spacing of analysis radials. Where doubt exists as to the degree of limit change with small changes in azimuth, the best advice is to analyze a few extra radials and, depending on the result, either include or exclude them from the final tabulation as submitted to the Commission. As familiarity with mechanics of the study is gained, a feel will be developed for choosing just that number of radials required to assure an adequate but not overly burdensome study.

The direct-line distance (radial) between the proposed station and the Class I station can be seen to divide the total angle roughly in half, but it is important to observe that azimuthal variations in the extent of the 0.1 mv/m contour (resulting from changes in soil conductivity, etc.) will make this division something less than exact.

#### The Worksheet

To make the conduct of a CH study systematic, a worksheet is often used to help in organizing and processing the study data. If properly drawn, this worksheet can also be made to serve as one of the application exhibits, displaying on one tabulation sheet not only the calculated CH results but also a comparison of them with the pertinent characteristics of the proposed CH antenna system.

Such a combination work-tabulation sheet is shown in Fig. 4. It can be seen to organize the respective radial data along horizontal lines, with the distance-azimuth data bit

to the extreme left-hand side of the sheet, followed by the graphical read-outs, computations and frequency adjustment factors, etc., made in progressive steps toward the right-hand side of the sheet. In the final columns, the comparison between the calculated limits and the details of the proposed CH antenna system is made.

The various analysis radials are listed vertically in groups, one such

group for each Class I station studied. These groups are usually listed with the least bearing from true north shown first and the progressively larger bearings following in sequence. It is not absolutely necessary to list the radials in this way; any convenient method of grouping is acceptable to the Commission, so long as it is easily followed. However, no matter how the various radials are listed, it is important

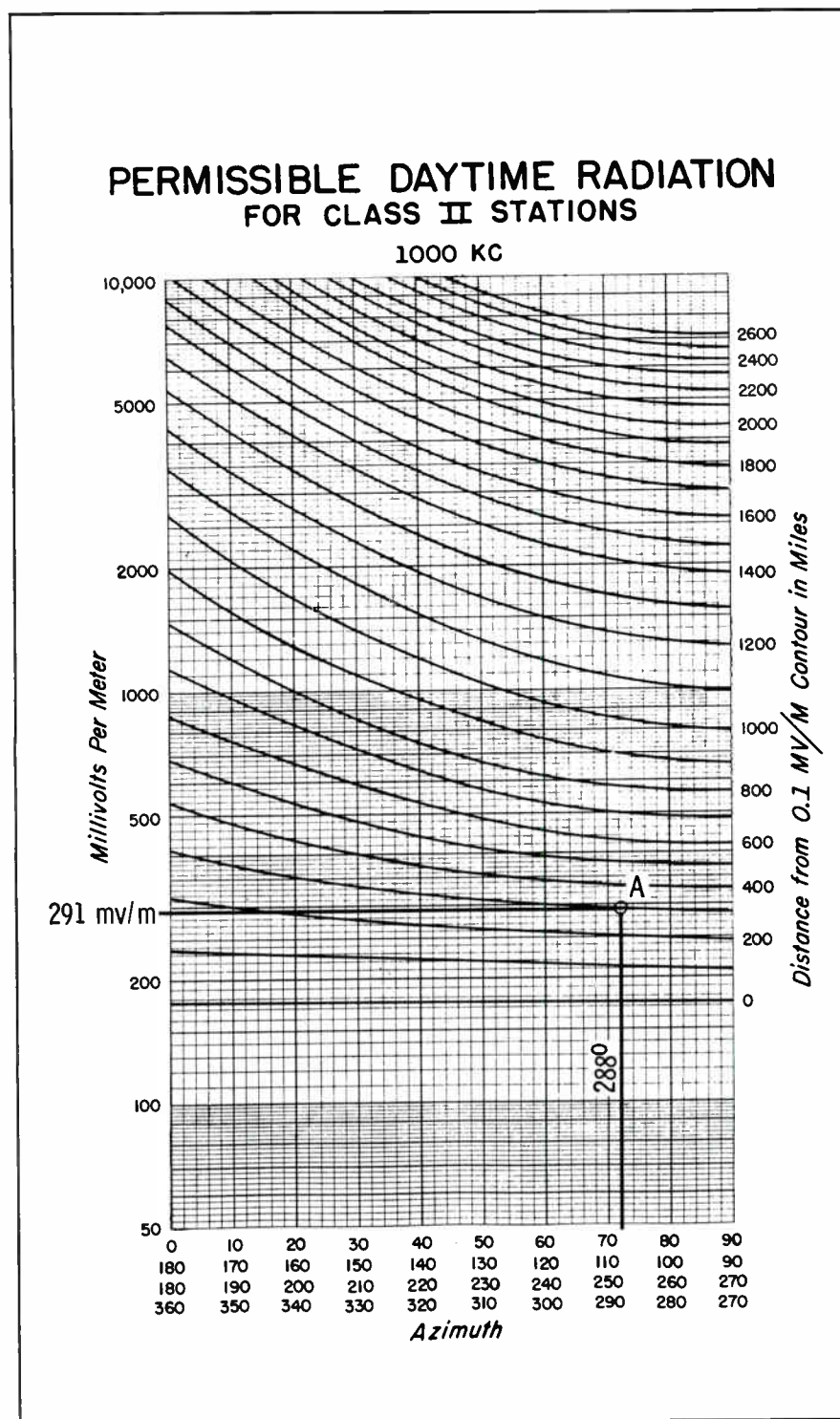


Fig. 5. FCC Figure 10 is used with one of two other curves for the CH study.



that they be keyed to the particular study map from which they are taken and that the map used have a scale and indicator of great-circle distance suitable to the figures which are read from it.

It is also customary to indicate on the tabulation sheet which radial in each group is the direct-line bearing between stations. For some stations this will be the only radial analyzed, while for others it might

be one of three or more radials per Class I investigation.

To illustrate the use of the worksheet, the computations for the radial at an azimuth of  $288^\circ$  in Fig. 3 will be described. The distance to the intersection of the radial with the 0.1 mv/m contour of the Class I station, in this case 300 miles, is scaled from the map and entered in column 2. Since the frequency 1530 kHz lies between 1000 kHz and

1600 kHz, values of radiation must be obtained from Figs. 5 and 6 and then combined. First, the azimuth is found on the horizontal scale of Fig. 5; from this point, a vertical line is extended upward until it intersects the curve for 300 miles (point A). A horizontal line is extended from point A to the left, and the limitation, in this example 291 mv/m, is read from the scale at the left edge of the graph. The same procedure is followed on Fig. 6, and the two radiation limits are entered in column 3 of the worksheet.

The values of permissible radiation must now be adjusted by application of the factors tabulated in Section 73.187. The resulting corrected radiation limits ( $291 \times .117 = 34$  mv/m and  $98 \times .883 = 86.5$  mv/m) are entered in column 4, and their sum yields the figure for permissible radiation on 1530 kHz, shown in column 5.

Finally, the maximum vertical angle of departure listed in column 6 is obtained from Fig. 7. A vertical line is extended upward from the appropriate point on the distance axis to curve 4, and the corresponding angle is found by extending a horizontal line from the point of intersection to the vertical axis. While in the truest sense, frequency does exert some influence on the pertinent vertical angle of departure, the entire AM band is considered as one medium for the purpose of making this angular determination, thus simplifying it accordingly.

In practical cases, there are times when one (or more) of the Class I stations involved with a proposal is so far away that its effect on the calculated CH limit is negligible. When this occurs, it is normally not necessary to show that particular Class I station or its 0.1 mv/m contour on a special CH interference study map, and sometimes it is not even necessary to show any calculations covering it on the worksheet. In such cases, a footnote is usually made to show the approximate distance and bearing of the Class I station from the proposal and to state that calculations show there is no possibility of harmful interference. If desired, there may also be included in this note the actual CH limit which the Class I station would impose together with the value of

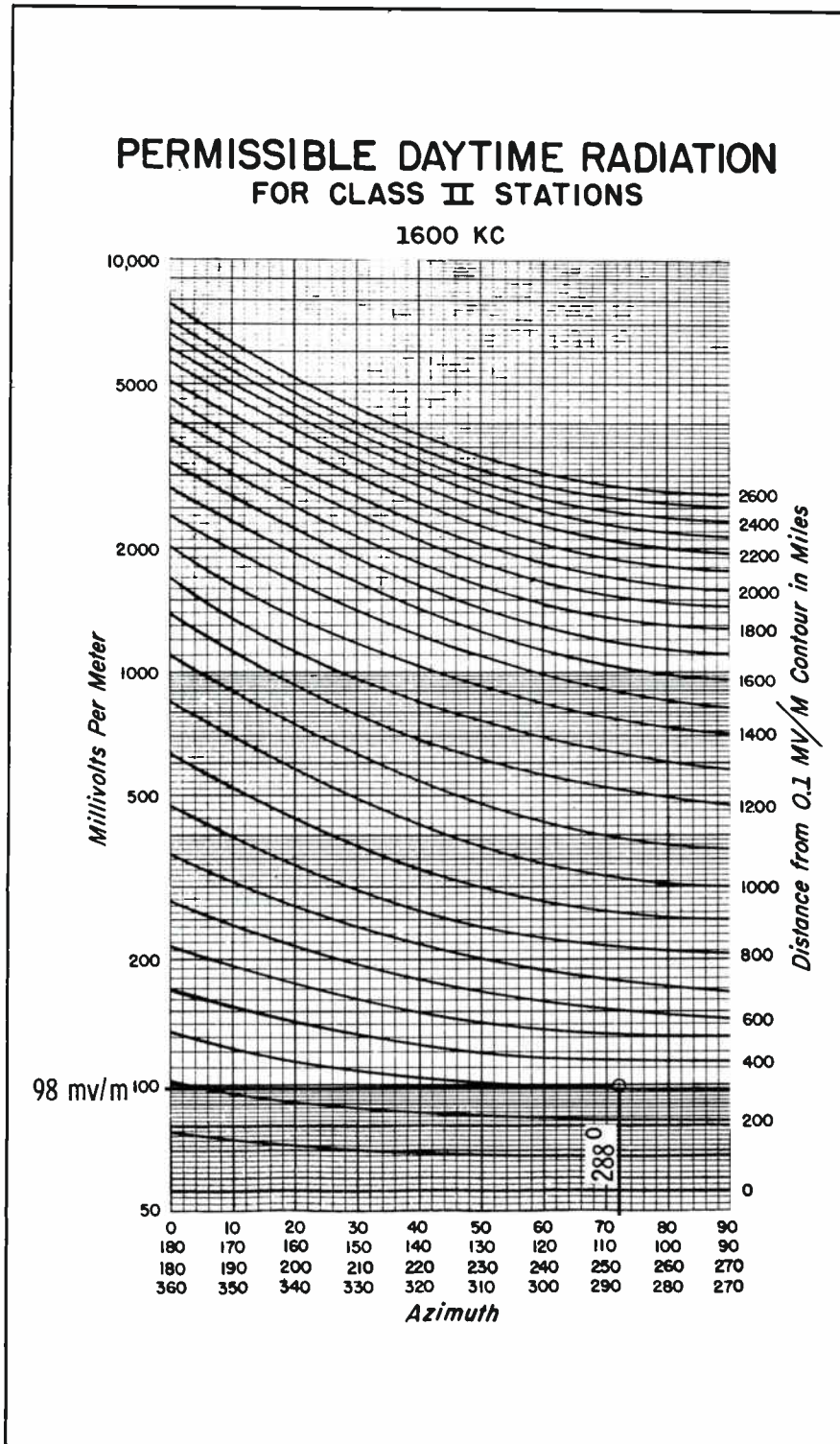


Fig. 6. FCC Figure 11, used with Figure 10 for limit at higher frequencies.

inverse field proposed toward the Class I station; the large difference between the two is then noted.

### Design Considerations

The CH study is complete from a results standpoint when columns 5 and 6 of the work-tabulation sheet are completed. The display of the inverse-field values vs azimuth forms points on a limiting contour arc (Fig. 8), which is the real final result desired. It then only remains to utilize the results of the study to engineer an appropriate facility design which will radiate inverse fields below the limiting values, at and below the pertinent vertical angles of departure.

### Margin of Safety

In this design, it is necessary to provide some margin of protection as a cushion between the expected MEOV of radiation and the calculated specific CH inverse-field limits. This cushion allows for the normal day-to-day variations in power and antenna performance. While the percentage of margin is left to the designer's discretion, it obviously must stand the Commission's scrutiny as to reasonability, and it must be in accord with what modern engineering practice would place as reasonable limits on the stability of the proposed antenna system. In most cases, at least a 10% radiation margin is allowed; that is, the proposed radiation in each azimuth is at least 10% less than the allowable limit. Where practical, an even higher margin of safety is desirable, assuming that it can be obtained without undue degradation in proposed service areas.

### Coverage Limitations

Thus far, this discussion has been concerned principally with determining just what radiation limits would be imposed upon a particular proposal by virtue of its proximity to the various Class I stations surrounding it. Now, assuming that these limits have been calculated, the next step in the design case is to assess the results of the CH study on the proposed station.

The simplest way to handle the CH facilities design is to include its azimuthal radiation limits as an overlay to the daytime protection

graph. The result is a composite graph displaying the entire radiation-limit picture. The significance of this graph is its ability to show where radiation might be increased without producing prohibited groundwave overlap or excessive CH radiation. It also provides a general indication of where the transmitter must be placed if the CH limiting inverse fields are to produce the required minimum signal intensities over the area to be served.

Coverage toward the controlling Class I station can at times be a severe problem in the CH facilities design, especially where the limit is low (low inverse field) and the transmitter site cannot be positioned so that the signal intensities in this direction meet the required minimums. There is no magic formula to get around this situation, save a

petition to waive one of the Commission Rules so that either the lesser signal will be deemed acceptable or a way can be found to move the transmitter site closer to the sub-standard signal area—at the expense of infractions to (and subsequent waivers of) other of the Commission Rules.

Another factor, and one often overlooked from an economic standpoint, is the retraction in service which occurs during the critical hours because of the reception of skywave interference from all stations on the frequency of the proposed station. It is most essential, especially where substantial portions of the audience of the station will be located between its 2 and 0.5 mv/m contours, that the applicant be aware of this retraction. In substantially rural environments, for example, many Class II operators find that a

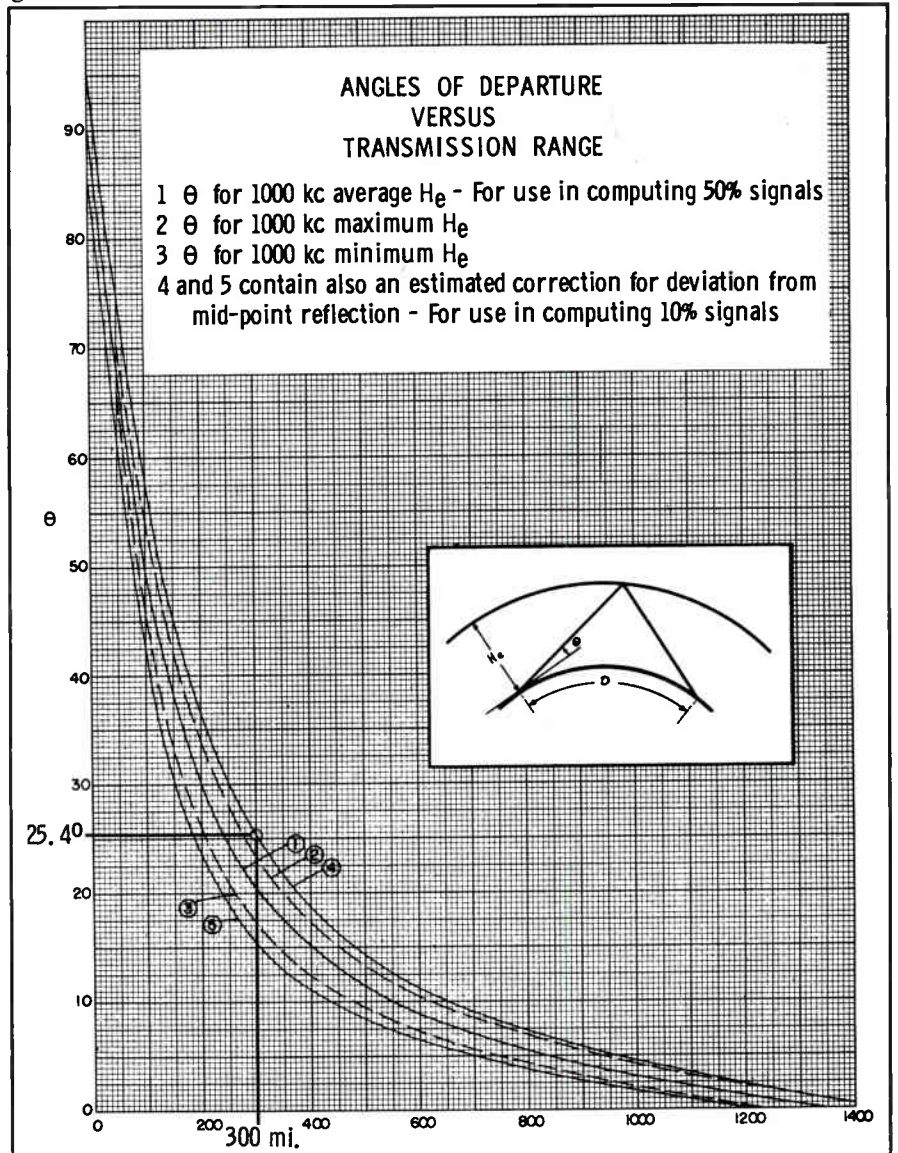


Fig. 7. FCC Figure 6a; curve 4 is used to determine maximum vertical angle.



significant portion of their essential farming audience is lost to them during these hours.

Such daytime skywave interference is not subject to any regulation, and it arises from Class I and II operations alike. Unlike ground-wave interference, cochannel skywave interference, whether during the critical hours or at night, is for the most part omnidirectional in character. Its effect can be calculated, but it diminishes rapidly as the transitional hours grow into daylight. The Commission does not supply graphs to make a daytime RSS determination, nor does it call for such a determination in the Class II daytime showings. However, where the matter is of particular importance to a given proposal, the skywave interference can be estimated

from the nighttime curves appropriately weighted for the time of day being considered. At local sunrise and sunset, almost the full nighttime RSS limit can be assumed, especially during the winter months, even though the curves are drawn for a time two hours after sunset.

#### Possible Solutions

It is apparent that a complete assessment of the CH-facilities design problem includes consideration of possible interference both contributed and received by the proposed station. Briefly, these are the means available to engineer around the limitations encountered:

1. The most obvious approach, where it will work, is reduced inverse field (transmitter power). Where the daytime constants ex-

ceed the allowable CH inverse fields only slightly, reductions in transmitter power (in discrete steps as provided by the Commission rules) and/or decreases in antenna-system efficiency may suffice.

2. Minor relocation in transmitter site, coupled with measures outlined under (1) above. This is primarily a means to place signal-intensity contours in concert with minimum requirements of the Commission.
3. Use of a directional antenna system. This is a convenient, but expensive, means for accomplishing the most in radiation-pattern control. Curve 2 of Fig. 8 shows an example of the use of a directional antenna to make possible the use of higher power during the critical hours (if ground-wave-interference limitations permit).

The CH limit cannot be circumvented, but must be engineered around. Unfortunately, except for the measures cited above, no really effective means can be applied which will significantly lessen the impact of a really severe CH limit. Sometimes, the only way out is to consider another frequency.

#### Conclusion

The intent of this article has been to make the reader aware of the considerations which surround a Class II proposal subject to a CH radiation limit, be it slight or severe. Most of the comments that have been made with reference to the CH picture do in fact apply to almost all of the AM broadcast band.

While it can be fairly said that of all the allocations studies, the CH study is by far the easiest to perform, its results, in particular cases, can be anything but easy to engineer around. For the new station applicant, this adds up to the requirement for exceptional skill on his part and the part of his engineering consultant if a really successful proposal is to be put together.

It is hoped that some of the points touched upon here have been of interest to the reader and will assist him in avoiding some of the more common pitfalls of the CH allocation study. ▲

• Please turn to page 22

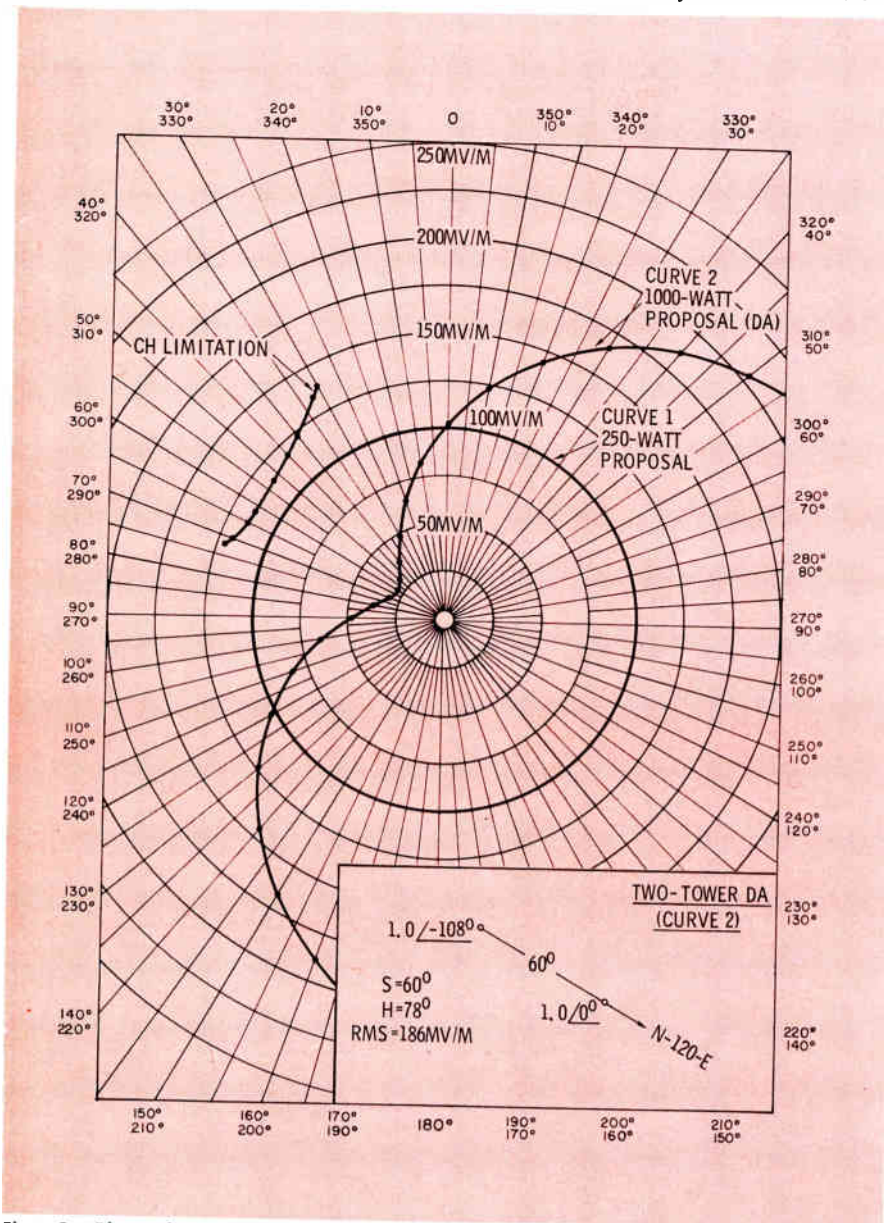


Fig. 8. Plot of computed results shows limitation on station CH radiation.





# CCA OFFERS FROM STOCK AM-FM BROADCAST TRANSMITTERS AT REALISTIC PRICES



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**DUAL RELIABLE 5KW AM**

### QUALITY AM

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250W	\$3,495.	\$8,500.
500W	\$4,545.	\$9,500.
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50KW	\$89,500.	\$104,000.

CCA offers an outstanding line of deluxe and "Dual Reliable" AM transmitters. All equipments stress conventional, high level plate modulation, standard parts, full accessibility, silicon rectifiers, minimum tube costs, minimum maintenance requirement, and lowest power consumption. "Dual Reliable" transmitters represent the epitome of conservative design.

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10W	\$1,295.	5KW	\$9,900.
250W	\$3,495.	10KW	\$13,500.
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CCA is the only major equipment supplier which utilizes high mu, zero bias triodes. The use of these high power ELMAC triodes solve all the problems which "2nd Generation" tetrode designs exhibit. No need to neutralize, no complexities such as bias and screen supplies; and exceptional tube life with tremendous power output capability.



**3KW FM**



**10KW FM**

### SC-1D MULTIPLEX SUBSIDIARY GENERATOR



The CCA SC-1D is an inexpensive but reliable subcarrier generator which can be used with all modern FM transmitters to achieve a 2nd broadcast channel.

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A favorite of many broadcasters is the CCA-LA-1D audio limiter. This "workhorse" prevents overmodulation and performs this task without "thumping" or introducing distortion. Front panel controls for gain, output and "recovery time" make operation of the LA-1D an "engineer's delight".

### CCA TRANSMITTER ACCESSORIES

AMM-1D AM Modulation Monitor	\$595.
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RFA-FM Remote FM RF Amplifier	\$395.
RFA-AM Remote AM RF Amplifier	\$425.
LTU Antenna Tuning Units	.....
AM RF Loads	.....
AM Antenna Phasors	.....
SC-1D FM Subcarrier Generator	\$495.
SG-1D FM Stereo Generator	\$1295.

\*PRICE BASED ON POWER

### MODEL AMM-1D AM MODULATION MONITOR



A popular addition to the CCA product line is our FCC type approved AM modulation monitor. This instrument guarantees instantaneous supervision of transmitter operation and is an essential tool for every broadcaster.

CCA Electronics offer a complete broadcast package including materials supplied by outstanding vendors such as towers, antenna, transmission line and studio equipment. Contact your area CCA representative for a quotation.



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Circle Item 9 on Tech Data Card

# Critical Hours

(Continued from page 20)

**Table 1. United States Class I Clear Channels**

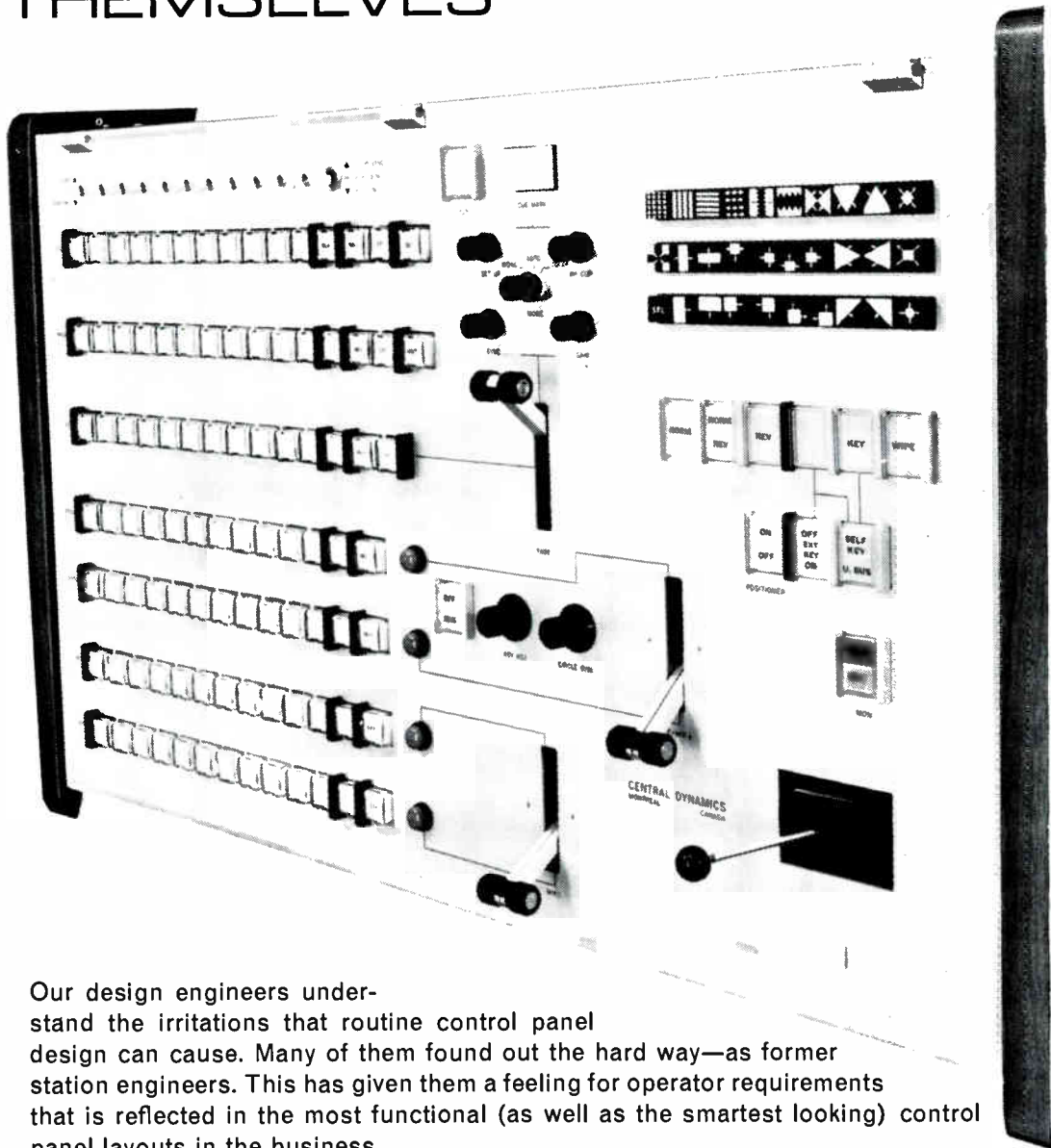
Channel Frequency (kHz)	U.S. Class I Stations	Channel Frequency (kHz)	U.S. Class I Stations
640 <sup>1</sup>	U.S. I-A KFI Los Angeles, California ND—228/kw	1080	U.S. I-B WTIC Hartford, Connecticut ND-D—247/kw
650 <sup>1</sup>	U.S. I-A WSM Nashville, Tennessee ND—246/kw		KRLD Dallas, Texas ND-D—245/kw
660 <sup>1</sup>	U.S. I-A WNBC New York, New York ND—236/kw	1090	U.S. I-B KAAV Little Rock, Arkansas ND-D—256/kw
670 <sup>2</sup>	U.S. I-A WMAQ Chicago, Illinois ND—234/kw		WBAL Baltimore, Maryland ND-D—254/kw
680	U.S. I-B KNBR San Francisco, California ND—225/kw	1100 <sup>2</sup>	U.S. I-A WKYC Cleveland, Ohio DA-1 U
700 <sup>1</sup>	U.S. I-A WLW Cincinnati, Ohio ND—242/kw	1110	U.S. I-B KFAB Omaha, Nebraska ND-D—235/kw
710	U.S. I-B WOR New York, New York DA-1 U KIRO Seattle, Washington ND-D—225/kw	1120 <sup>2</sup>	U.S. I-A KMOX Saint Louis, Missouri ND-250/kw
720 <sup>2</sup>	U.S. I-A WGN Chicago, Illinois ND—251/kw	1130	U.S. I-B KWKH Shreveport, Louisiana ND-D—254/kw
750 <sup>1</sup>	U.S. I-A WSB Atlanta, Georgia ND—236/kw		WNEW New York, New York ND-D—236/kw
760 <sup>2</sup>	U.S. I-A WJR Detroit, Michigan ND—250/kw	1140	U.S. I-B WRVA Richmond, Virginia DA-1 U
770 <sup>2</sup>	U.S. I-A WABC New York, New York ND—236/kw	1160 <sup>1</sup>	U.S. I-A KSL Salt Lake City, Utah ND—248/kw
780 <sup>2</sup>	U.S. I-A WBBM Chicago, Illinois ND—250/kw	1170	U.S. I-B KV00 Tulsa, Oklahoma ND-D—249/kw
810	U.S. I-B KGO San Francisco, California DA—1 U WGY Schenectady, New York ND—238/kw	1180 <sup>2</sup>	WVVA Wheeling, West Virginia ND-D—230/kw
820 <sup>1</sup>	U.S. I-A Shared operation WFAA/WBAP Dallas, Fort Worth, Texas ND—247/kw	1190	U.S. I-A WHAM Rochester, New York ND—234/kw
830 <sup>1</sup>	U.S. I-A WCCO Minneapolis, Minnesota ND—249/kw		U.S. I-B WOWO Fort Wayne, Indiana ND-D—238/kw
840 <sup>1</sup>	U.S. I-A WHAS Louisville, Kentucky ND—256/kw	1200 <sup>1</sup>	KEX Portland, Oregon DA-1 U
850	U.S. I-B KOA Denver, Colorado ND—225/kw	1210 <sup>2</sup>	U.S. I-A WOAI San Antonio, Texas ND—261/kw
870 <sup>1</sup>	U.S. I-A WWL New Orleans, Louisiana DA—1 U	1500	U.S. I-A WCAU Philadelphia, Pennsylvania ND—241/kw
880 <sup>2</sup>	U.S. I-A WCBS New York, New York ND—265/kw		U.S. I-B WTOP Washington, D.C. DA-2 U KSTP Saint Paul, Minnesota ND-D—318/kw
890 <sup>2</sup>	U.S. I-A WLS Chicago, Illinois ND—245/kw	1510	U.S. I-B KGA Spokane, Washington ND-D—226/kw
1000	U.S. I-B WCFL Chicago, Illinois DA-2 U KOMO Seattle, Washington ND-D—237/kw	1520	WLAC Nashville, Tennessee
1020 <sup>2</sup>	U.S. I-A KDKA Pittsburg, Pennsylvania ND—297/kw		U.S. I-B WKBW Buffalo, New York DA-1 U KOMA Oklahoma City, Oklahoma ND-D—238/kw
1030 <sup>2</sup>	U.S. I-A WBZ Boston, Massachusetts DA-1 U	1530	U.S. I-B KFBC Sacramento, California DA-1 U WCKY Cincinnati, Ohio ND-D—252/kw
1040 <sup>1</sup>	U.S. I-A WHO Des Moines, Iowa ND-293/kw	1540	U.S. I-B KXEL Waterloo, Iowa ND-D—220/kw
1060	U.S. I-B KYW Philadelphia, Pennsylvania DA-1 U	1560	U.S. I-B KPMC Bakersfield, California DA-1 U WQXR New York, New York DA-2 U
1070	U.S. I-B KNX Los Angeles, California ND—246/kw		

<sup>1</sup> No new Class II assignments in 48 states (See FCC Rules for conditions of use.)

<sup>2</sup> One Class II-A assignment in 48 states (See FCC Rules for conditions of use.)

<sup>3</sup> Two Class I stations may be assigned.

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Circle Item 10 on Tech Data Card



# REMOTE UNIT FOR ETV

by Charles Colby —This "studio on wheels" was built especially for ETV originations

The rapid expansion of educational television has caused increasingly insistent demands for more professional-quality television programs. The Nebraska Educational TV System has recognized and acted upon this need by the purchase of a mobile unit (Fig. 1) which is capable of on-location production of tape-recorded television programs. The unit is operated by the University of Nebraska (KUON-TV). Programs may be recorded on a video tape recorder installed in the van, or the material may be relayed by a microwave transmitter to one of several educational TV stations in the statewide network.

## The Van

The mobile unit is mounted on a truck chassis that was custom-built for the purpose. The interior of the van structure (Fig. 2) was designed to provide working areas for two fully transistorized video recorders, one audio recorder, a control console, an AC power panel, three racks for the associated camera and synchronizing equipment chassis, and three one-ton air-conditioning units.

\*Special Products Dept.  
Amplex Corp.

There is also inside-access storage for three 4½-inch image orthicon cameras, lens equipment, and microphones; in addition there is outside-access storage space for AC power, camera and audio cable reels, and camera tripods and dollies.

A working platform on the roof is fitted with recessed tie-down rings and a fold-down boom and hoist winch. The boom and winch are used to lift the cameras and tripods onto the working platform. The tie-down rings provide anchor points for stabilization of the microwave dish antenna and one or two television cameras when operating during a high wind or when the van is in motion.

The chassis is equipped with a 390-cubic-inch V-8 engine, a 55-ampere alternator, an automatic transmission, power brakes, and power steering. The 4-wheel trailer chassis of the mobile electric plant is equipped with electric brakes which are coordinated with the hydraulic brakes on the truck.

The truck is equipped with two sets of 12-volt batteries; both are charged by the alternator. One of the batteries supplies power for the

interior lights of the van during any period that line power is not available; when line power is available, a relay transfers these lights to the secondary winding of a step-down transformer. The second battery is provided for standby service, and is connected for use by actuation of a switch.

One of the outside access compartments on the curb side of the van structure encloses a terminal box and connector panel. The latter includes the connectors required for distribution of audio, video, and intercom signals. The inputs and outputs provided on this panel are:

- 1—High-level audio input
- 7—Microphone inputs
- 1—Telephone-line input/output
- 2—Intercom connectors
- 1—Composite-video input
- 2—Noncomposite-video inputs
- 1—Audio-line output
- 4—Video outputs
- 1—Program-video output
- 1—Microwave-antenna connector

## Mobile Electric Plant

The trailer-mounted 25-kva electric plant furnishes all the 110/220-volt AC power required by the equipment whenever line power is not available. The AC power panel includes a switch for the selection of generator or line power. It also includes meters for monitoring each side of the 220-volt single-phase power from either source, isolation transformers, and two voltage regulators for the technical power. When the portable generator is in use, 100-ampere relays bypass the regulators in the power panel to avoid interaction between them and the regulator in the generator. The capacity of the electric plant is ample for the maximum demand of both the equipment and lighting requirements.



Fig. 1. Specially built van houses mobile unit; power plant is in trailer.

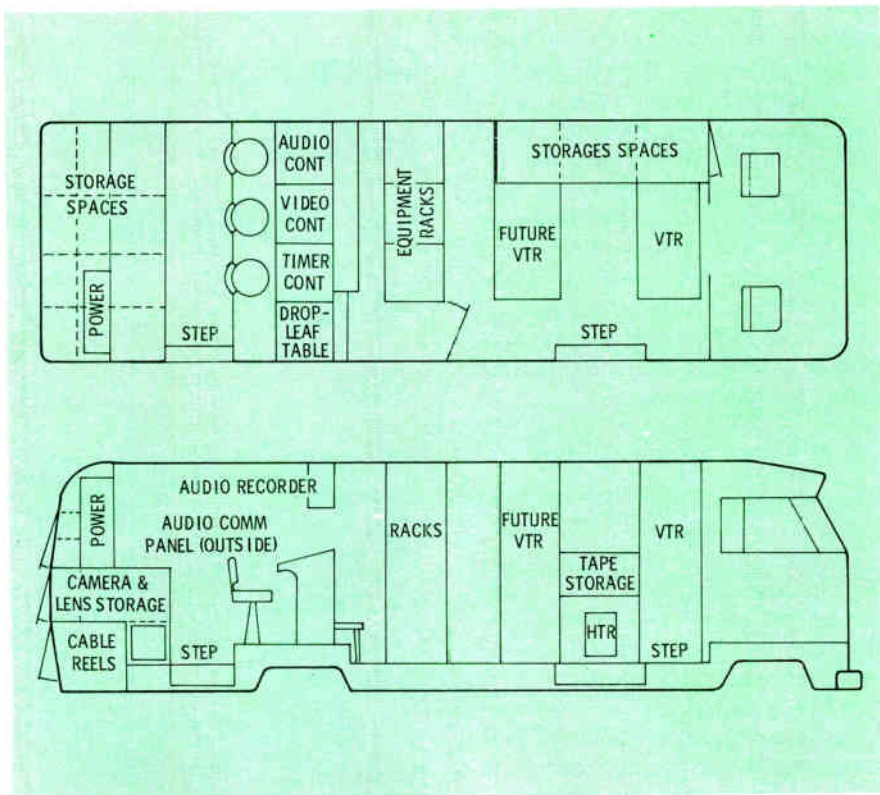


Fig. 2. Efficient layout is required to fit equipment into limited space.

### Video System Facilities

Each of the three cameras is equipped with a 10:1 zoom lens and a tilting viewfinder, which provide facilities that are adequate for practically any shooting requirements. A separate 14-inch picture monitor and a waveform monitor are provided for each camera.

The video switcher/fader is mounted on the control console (Fig. 3). From his position in front of the racks, the camera control operator has access to each of the three camera control units and to all of the associated equipment in

the racks. Seats are provided in front of the control console for an audio man, a director, and a producer.

All video input and output lines are terminated in a video patch panel to facilitate rapid setup of the system. A separate video line for test purposes is patchable from this panel to the workbench at the rear of the van.

### Audio System Facilities

The audio system facilities are controlled by two 4-channel transistorized mixing amplifiers, each of which is equipped with high- and

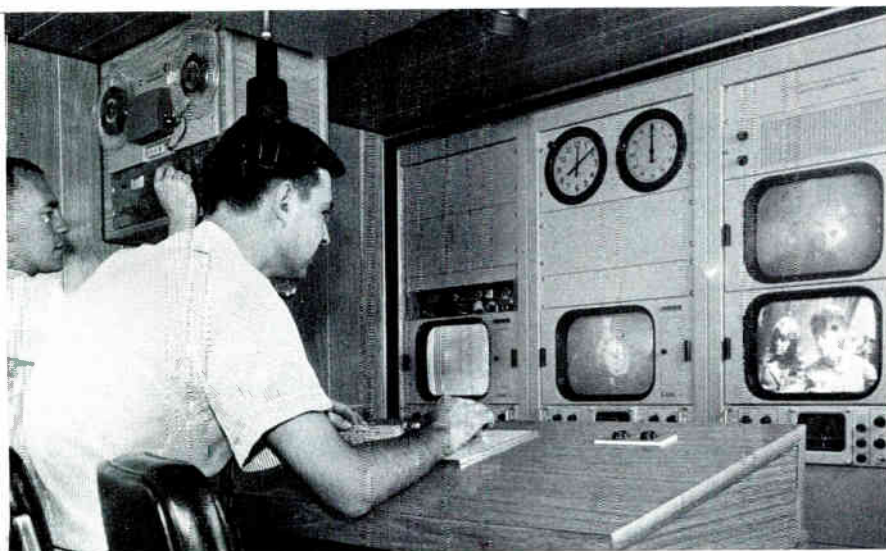


Fig. 3. Video and audio operators at their positions during a remote broadcast.



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2 Phillips screwdrivers,  
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low-level inputs. Both units are readily removable for use at locations other than in the van itself.

The program sound sources include the audio tape recorder, seven microphone input circuits, the remote audio input (received by way of a balanced telephone line), the high-level audio output of a tuner, and the audio line outputs of the video recorders. The control-room audio is monitored by means of a speaker which is mounted in one of the equipment racks.

### Miscellaneous Facilities

Intercommunication is provided among all operating personnel inside or outside the van. In addition, the program audio signal is made available to the camera operators, the floorman, and the program director during on-location work.

A video tuner provides off-the-air video for monitoring the microwave transmitter output during a live telecast, or for the pickup of the video signal from any other television transmitter that is within range. A sync-lock unit provides the facility for locking the sync generator to a composite video signal received from an external source. A multiburst generator provides the facility for setup of the television camera signals as well as for general video alignment operations. A clock and elapsed-time meter is mounted at the top of the center rack.

### Conclusion

This mobile unit for the University of Nebraska, operator of television station KUON-TV, reflects many of the design and construction features of similar units now in use by commercial broadcasters. It was built to give the station a functional arrangement of equipment and layout necessary for a versatile on-location TV studio.▲

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# REDUNDANT REMOTE AMPLIFIER

by Charles D. Sears

Like many stations, WIAN had need for a small, inexpensive remote amplifier for use on ball games and similar originations. The requirements were: battery operation, because power is not always available or reliable; solid-state circuitry, because of the battery operation and in the interest of modern design; at least two microphone inputs; small size; simplicity of operation; and reliability.

The original thought was to build a simple two-microphone remote unit using only one preassembled amplifier. As plans developed, however, it seemed simpler to use two packaged amplifiers instead of building a mixer network with preamps, which would have to be designed and tested. The cost would have been more than the extra amplifier and much more work would be involved in building the preamps and mixer than in simply mounting a second amplifier. If balanced inputs for the microphones were desired, two additional input transformers would be required.

A design using two amplifiers was also attractive because it is desir-

able to have an extra amplifier along for a remote broadcast, particularly if the location is out of town. Under ordinary circumstances, this practice is not practical, because it ties up more equipment, and the announcer usually has too much to carry already. A "redundant" design would overcome these drawbacks.

An unusual feature of the finished design is the microphone switch (Figs. 1 and 2). It is mounted between the two gain controls on the front of the chassis. This switch was added so that an extra microphone could be switched quickly and easily into either amplifier in the event of failure of the other amplifier. A bonus feature is that when all is working well a third microphone can be switched into either channel. This capability could be used, for example, at a basketball game when an interview is called for from the floor during the half-time intermission.

Microphone 1 and microphone 2 normal to their respective amplifier inputs when the selector switch is in the center position. (Refer to Fig.

1.) When microphone 3 is switched to amplifier 1, microphone 1 is disconnected. Microphone 2 is not distributed and remains connected to amplifier 2. When microphone 3 is switched to amplifier 2, microphone 2 is disconnected, and microphone 1 remains connected to amplifier 1.

Since the amplifiers used had a screwdriver-adjustable volume control built onto the printed circuit board, external controls were required. The built-in controls were removed, and leads were run to new controls (of the same value) mounted on the front panel.

Mixing of the amplifier outputs is accomplished with a standard combining (splitting) pad consisting of six 100-ohm,  $\frac{1}{2}$ -watt resistors. Resistors with a tolerance of 5% or less are required for best match. If desired, a 4- to 6-db pad can be added after the splitting pad for full isolation from the telephone line; in this case, the VU meter should be connected between the combining pad and the isolation pad.

Each amplifier is provided with a separate battery so that operation of the unaffected channel can continue if one battery fails. A battery selector switch is provided to turn off either channel in the event of a battery or amplifier failure. Also, if it is desired to use only one microphone, the unused amplifier can be switched off to conserve its battery. The main power switch is on the phone jack, so the amplifier won't be left on when in storage.

The amplifiers used have 50 ohms balanced and Hi-Z inputs; the out-

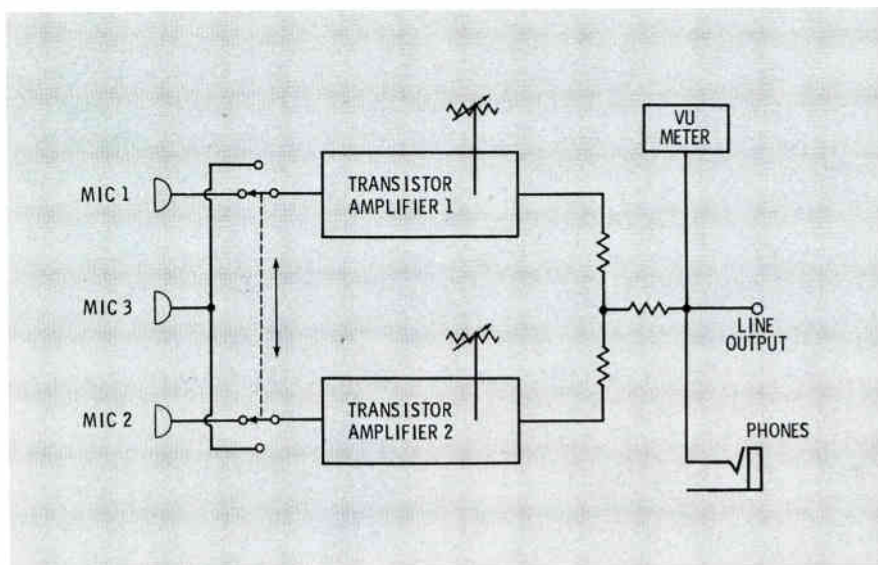


Fig. 1. Block diagram shows use of two amplifiers, switching of microphones.

*Editor's Note: During the preparation of the article on page 18 of the November 1966 issue, several ideas for possible design modifications were discussed with the author. Through error, these changes were included in that article, and the modified circuit was identified as being the design built by the author. Such was not the case. Because it is the aim of BROADCAST ENGINEERING to provide our readers at all times with the most useful and practical information possible, we are publishing the accompanying description of the "redundant" remote amplifier as it was actually built.*

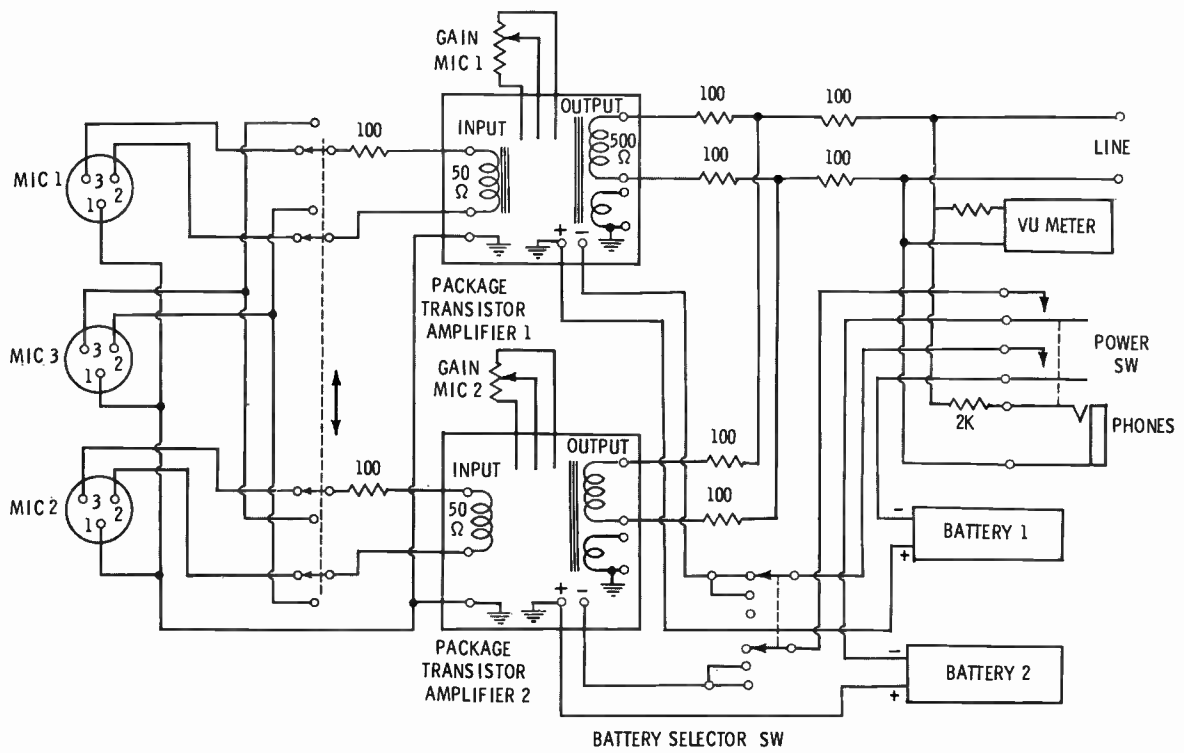


Fig. 2. Schematic diagram of the redundant remote amplifier shows power switching and combining pad for amplifiers.

puts are 500 ohms balanced and 8 ohms. Each amplifier has built-in input and output transformers. The amplifier is rated for 80-dB gain and has an output of 400 mw. These are imported printed-circuit transistor amplifiers; they were not originally designed to be of broadcast quality, but they are satisfactory for this application.

Resistors were placed in series

with the microphone inputs to match more nearly the 200-ohm microphones we use. This does cause a slight loss of level, but the amplifier has sufficient gain to overcome the loss. Operating a 200-ohm microphone directly into the transformer would cause excessive loading on the microphone and, therefore, quality loss. The amount of degradation depends on the particular micro-

phone used.

An imported 2-inch VU meter was installed on this unit, but a 3-inch meter would allow easier reading. Cannon XLR-3 microphone connectors were used, and the microphone selector switch is a Switchcraft 30312L. The amplifiers were installed in a cabinet that was on hand. The total cost of the unit as built was about \$40.

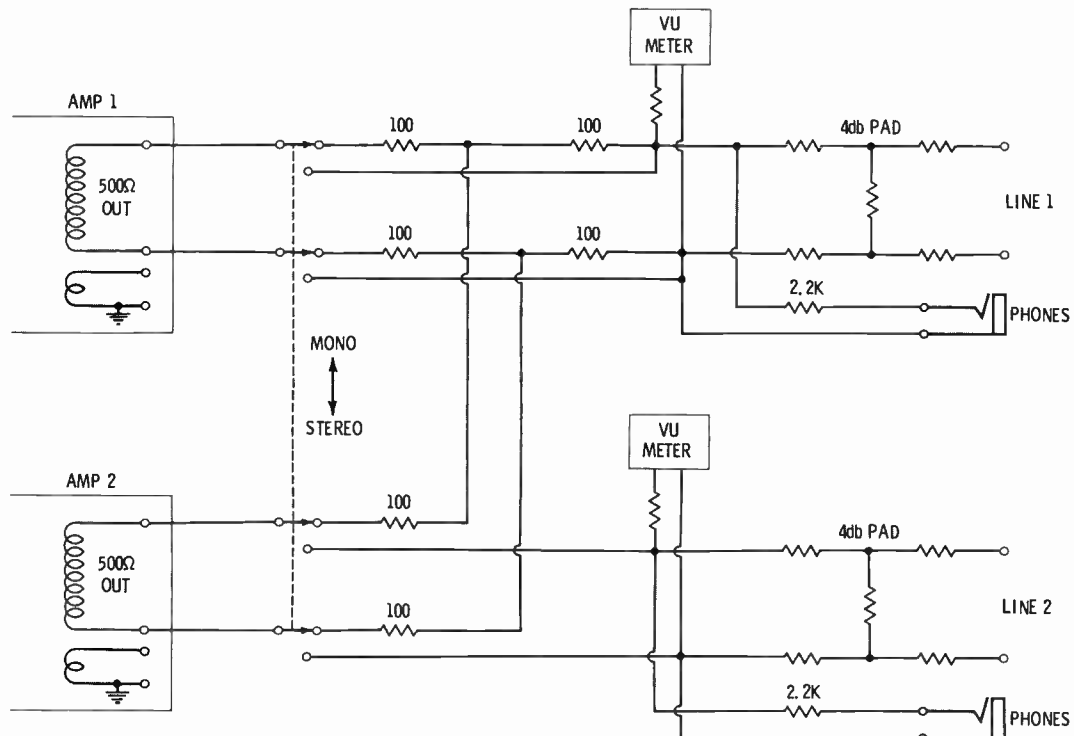


Fig. 3. Output circuit of the redundant remote amplifier modified for operation in monophonic or stereophonic mode.



# The \$73,000 Bargain

... or why the Norelco PC-70 3 Plumbicon\* tube color camera is a better buy than any 4-tube color camera.

To begin with, it's a bargain in the keep-the-sponsors-happy department. With the PC-70, performers do not turn green or magenta, even when moving against a dark background. Nor do white doves, white knights or high-flying washing machines. *The PC-70 has virtually eliminated the dangers of lag.* But 4-tube cameras invite lag. For one thing, they must use a 4-way light split which "robs" light from RGB channels to "feed" the luminance (4th) channel. For another, their optical systems are too complex (more complex optics mean still more light loss).



The picture speaks for itself.

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Don Ferguson, Chief Engineer,  
KXTV, Sacramento, California

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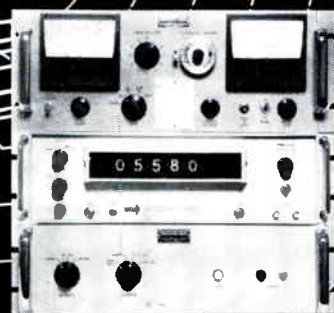
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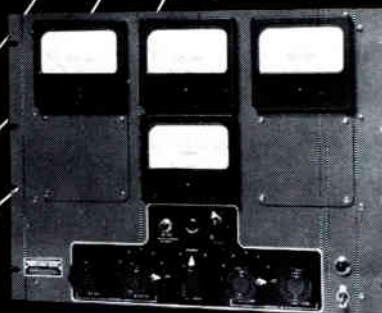
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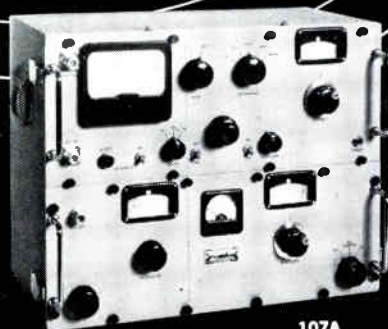
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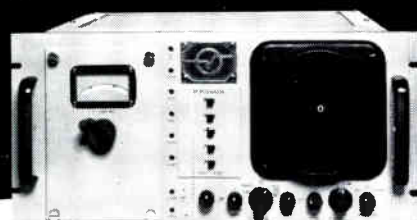
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This amplifier can be expanded for any number of inputs by adding the desired number of amplifiers and changing the combining pad for proper match. Keep in mind, however, that adding terminals to a combining pad increases the loss in the pad.

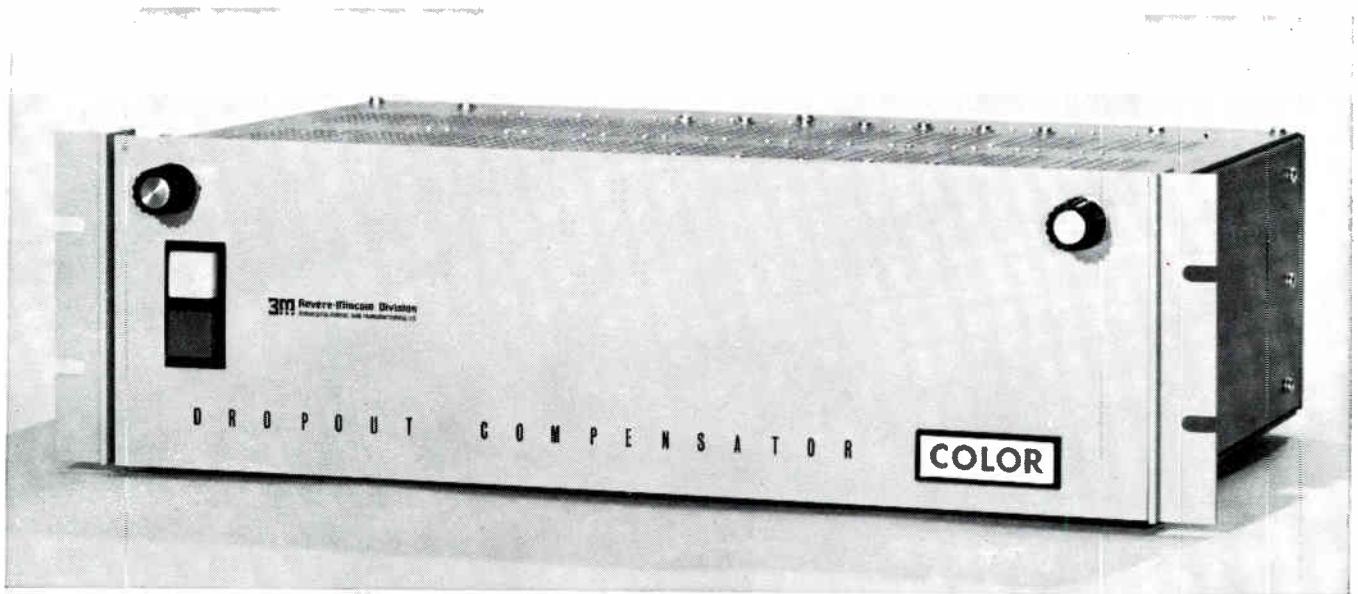
Because this is in reality a dual-channel amplifier, it lends itself easily to stereo. With the addition of a second VU meter; a four-pole, double-throw switch; two line-isolation pads; a pair of line binding posts; and another phone jack for stereo phones, the amplifier can be used easily for either stereo or mono operation. The added phone jack need not be provided with battery switch contacts; power can be switched with the original jack only. Completely split phones, *not* the normal three-wire kind, must be used for stereo, because there are two separate program lines and they can't be tied together. (If stereo phones are used during a mono transmission, audio will be heard in one ear only).

Fig. 3 shows how the stereo conversion can be made. The four-pole, double-throw switch is connected to the output of both amplifiers. In one position, it feeds both amplifiers into the combining pad, to the No. 1 VU meter, through the No. 1 line-isolation pad, and to the line-1 output terminals. With the switch in the other position, each amplifier feeds a separate line-isolation pad and its associated output terminals, bypassing the combining pad. In this case, each VU meter monitors the signal from its associated amplifier. The VU meters are calibrated so that they read the same for the same audio level on each telephone line. The line combining pad is left connected to the line-1 output isolation pad. Because there is no terminating resistor in the center of the pad, it has no effect on the line isolation as long as the amplifiers are not connected to the other end of the splitting pad.

This "redundant" remote amplifier provides reliability for remote broadcasts, which form an important part of the schedule of many stations. And, it provides this reliability in a simple, compact, low-cost package. ▲



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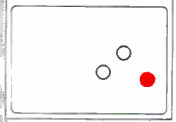
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February 1967

We interrupt this magazine to bring you...

## Late Bulletin from Washington

by Howard T. Head

### NAB Asks Relaxation of Remote-Control Rules

The National Association of Broadcasters has petitioned the Federal Communications Commission for a relaxation in the Rules governing remote control of standard broadcast directional antennas. Under the present Rules, an inspection must be made at the transmitter within two hours of commencing directional operation. This requirement is particularly burdensome for stations employing different directional patterns for daytime and nighttime operation, and scheduling the daily inspections is complicated by changing sunrise and sunset times throughout the year.

Under the NAB proposal, the present requirements would be relaxed where the remote-control equipment includes provision for reading the phase-angle relationships of the directional antenna. The daily inspection would be permitted at any time during directional operation, and, in the case of stations employing two patterns, only one daily inspection would be required. The different patterns would be checked on alternate days.

The proposal does not involve any relaxation of the requirement that an operator holding a first-class license be on duty at all times when the station is employing a directional antenna.

### Broadcast-Station Penalties on the Increase

The Commission continues to levy an increasing number of notices of apparent liability (fines) and short-term licenses for infractions of the Rules. Engineering violations bring the largest number of fines, but severe penalties also have resulted from charges of "payola" and phony promotions.

In a case involving one of the heavier fines, a station on the East Coast was served with a notice of apparent liability for \$5000 for willful failure to have its tower repainted. Commissioner Wadsworth dissented -- he would have fined the station \$10,000, the maximum permitted by law.



### Squeeze on Remote-Pickup Frequencies

The Commission has warned licensees in all services that the onset of the approaching sunspot maximum, due to reach its peak in the winter of 1968-1969, will bring about increasing long-distance skywave interference in the 25-50 MHz band. The affected services include the remote-pickup broadcast frequencies, which occupy 26 channels near 26 MHz, as well as other remote-pickup channels scattered throughout several bands from 1.6 to 460 MHz.

In the latter band, the Commission has given notice of a proposal to reduce bandwidths from 100 kHz to 50 kHz. The notice expresses the view that present techniques would still permit adequate audio response even with the reduced bandwidth. This change would free 1 MHz of spectrum space in the 450-451 MHz and 455-456 MHz bands. However, the space would be turned over to the land-mobile radio services rather than being made available for additional remote-pickup channels (20 channels are presently assigned in this band).

### AM-FM Nonduplication Cases Settled

The Commission has now ruled on all requests for exemption from the new Rules regarding AM-FM program duplication in cities having a population greater than 100,000. All FM stations in the larger markets are now required to comply with the new Rules, which require that at least half of the FM programming not duplicate the programs of commonly owned AM stations. A few stations which had requested exceptions were given until April 1, 1967, to effect compliance with the Rules.

Future requests for exemption from these requirements will be acted on by the Chief of the Broadcast Bureau who, for good cause shown, may grant such exemptions for periods of up to three months.

### Short Circuits

The Commission has instituted an inquiry into uses of radio to promote highway safety. . . Commissioner Johnson has called for a vastly expanded program of research into the nation's overall communications system. . . The Commission has authorized direct microwave feeds to television translators -- amplitude modulation is to be used in the 2-gHz band. . . WWV has moved its transmitting facilities from Beltsville, Maryland, to Fort Collins, Colorado. . . The National Association of FM Broadcasters (NAFMB) is preparing a campaign to expand the use of automobile FM broadcast receivers.

Howard T. Head, . . in Washington

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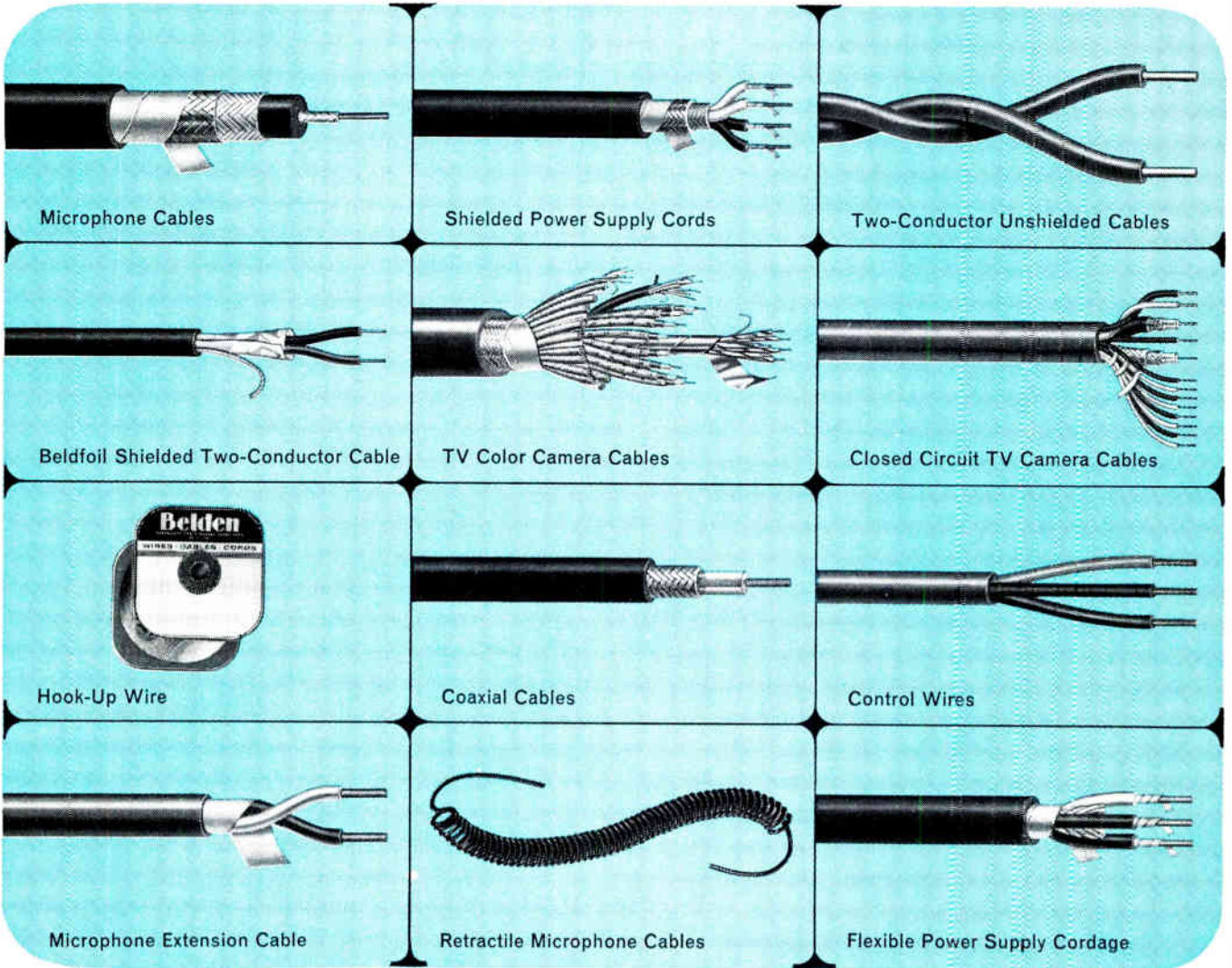
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# NEWS OF THE INDUSTRY

## ORGANIZATIONS

### NAB

The Engineering Advisory Committee of the National Association of Broadcasters is considering a variety of suggested formats for the next edition of NAB's Engineering Handbook. The current edition of the Handbook was published in 1960. Because of rapid advances in broadcast

technology, much of its material now is obsolete.

One suggestion for a new edition calls for a three-ring, loose-leaf book of more than 1000 pages; the book would be from five to six inches thick. As material became outdated, new pages could be printed for substitution in the volume. A suggested alternative was a booklet of the same size in regular hardback form which would be updated and reissued every two or three years.

There were also suggestions for splitting the Handbook into two separate volumes, or "sectionalizing" it into five or six magazine-type booklets that could be used separately or kept in a three-ring folder. Each section would be updated as required.

Vincent T. Wasilewski, NAB president, told 51 broadcast engineers who attended the association's second Engineering Management Seminar at Purdue University that the week-long course was one way NAB could demonstrate the "important role that engineering plays in broadcasting." The Seminar was attended by radio and television engineers who occupy positions of vice-president, manager, chief engineer, or of equivalent supervisory responsibility at stations or networks.

Mr. Wasilewski said the program was developed "to help each of you enhance your understanding of management as an interrelated process of planning, organizing, motivating, and controlling. A basic goal of the program," he said, "was to help you develop your skills in making decisions, in the delegation of authority, and in the communication of management policy."

George W. Bartlett, NAB vice-president for engineering, said the course encompassed all subjects associated with efficient engineering management and was augmented by the case-study method.

### NCSCT

The National Center for School and College Television brought together representatives of more than 40 national education organizations in Washington, D. C., to discuss possible satellite communications to American schools.

The stated purpose of the meeting was to brief educational leaders on the nature of possible satellite communications systems and to enlist their aid in determining the interest of schools in satellites. At the meeting, education leaders received information on the performance characteristics, essential components, major system alternatives, general feasibility, and possible timetable of a communications satellite system.

### NATIONAL

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A device for recording black-and-

# CF<sub>2</sub> ULTRASONIC CLEANER for MOTION PICTURE FILM

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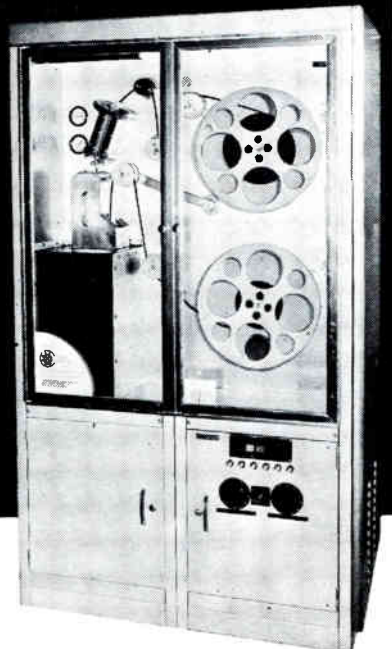
Ultrasonic energy is the most effective and economical way to thoroughly and rapidly clean motion picture film without mechanical scrubbing and wiping. The cold boiling effect (cavitation) of ultrasonic energy performs the entire operation. Only the solvent touches the film and a forced air, flash dry-off removes all solvent and residue.

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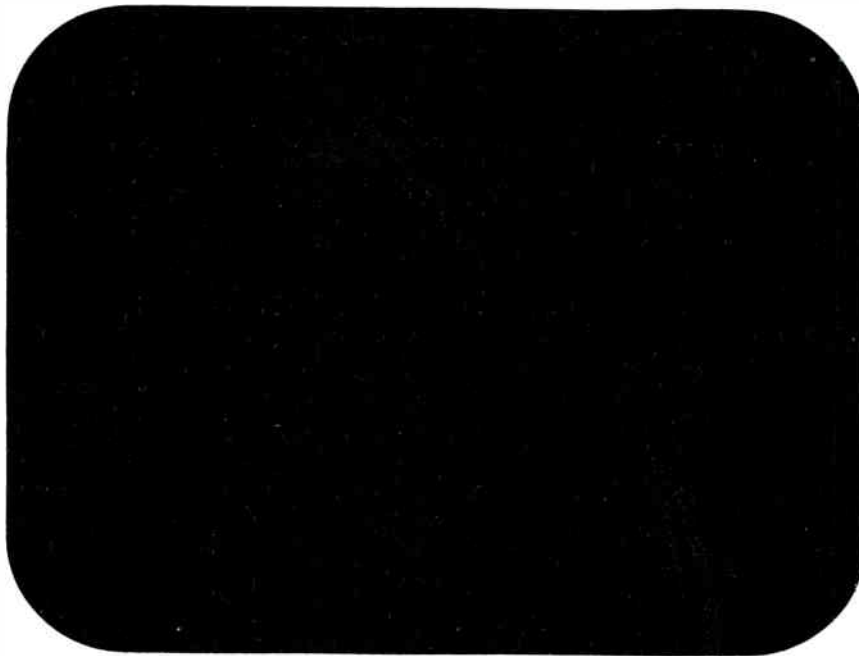
## LIPSNER-SMITH CORPORATION

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## Cold camera



**on the air in 30 seconds at WBAL-TV.**

The MTI Image Orth is a problem solver at WBAL-TV in Baltimore. Crash news programs can be on camera in seconds with a flick of the switch. No need to interrupt camera crews who might be in the middle of a taping session. Operational set-up is minimal too. Here's how WBAL-TV makes use of the MTI Image Orth.

Camera is aligned and locked in fixed position in a small announce booth studio. Few lights are used due to the excellent

low-light capabilities of the camera. And as a result, no additional air conditioning facilities are required. While desk and chair are fixed furnishings, backdrop can be quickly changed to fit any presentation situation.

WBAL-TV engineers claim camera needs little maintenance, has good depth of focus and needs trimming only once per week. Low light levels do not affect picture quality.

You might have other uses for a camera of this size and quality. If so, give us a call. We'll have a sales engineer to see you quickly—but not as quickly as the MTI Image Orth warm-up period.



**mti MARYLAND TELECOMMUNICATIONS, INC.**

York & Video Roads, Cockeysville, Md. / 301-666-2727 / World's largest manufacturer of low light level television cameras.

Circle Item 22 on Tech Data Card



# NEW!



Model 4N-1

## WILKINSON

4-in-1

### Portable Solid-State

1. FIELD INTENSITY METER
2. NULL DETECTOR
3. STANDARD SIGNAL GENERATOR
4. AM MONITOR RECEIVER

□ New Wilkinson Model 4N-1 all solid-state Field Meter combines all the features broadcast engineers have long been awaiting in a completely portable 12-pound unit. □ As a FIELD INTENSITY METER, the Wilkinson 4N-1 measures field strength with 3% accuracy and reduces measurement time. □ As a NULL DETECTOR, for use with a RF bridge to measure impedances, the Wilkinson 4N-1 eliminates the complexity of a multi-instrument AC test set-up. □ As a STANDARD SIGNAL GENERATOR, the Wilkinson 4N-1 is invaluable since its output accuracy of 3% from one microvolt to one volt is essential to many broadcast applications. □ As a MONITOR RECEIVER, the Wilkinson 4N-1 has sensitivity of 5 microvolts



When case is closed, power is interlocked off.

For complete details write:

## WILKINSON ELECTRONICS, INC.

1937 MACDADE BLVD. WOODLYN, PA. 19094  
TELEPHONE (215) 874-5236 874-5237

Circle Item 23 on Tech Data Card

white television signals directly on motion-picture film has been developed by the **Revere-Mincom Division of 3M Company**. In operation, the process eliminates the conventional camera lens, cathode-ray-tube phosphor screen, and glass mask. A photographic film is mated directly to a vacuum chamber, and electrons, which normally produce an image on a phosphor screen, paint directly on the film.

Electron-beam recording is designed to replace kinescoping, and supplements direct production on motion-picture film. Once the image has been photographed, duplication can be accomplished by conventional film duplicators.

The electron-beam recorder, designated Model EBR 100, is expected to be available for delivery in mid-1967, at a price in the \$60,000 range.

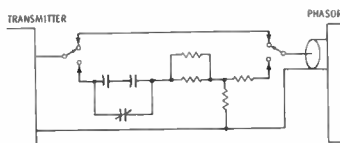
### New Radio Network Center

**Visual Electronics Corp.** has received a contract award from the **American Broadcasting Co.** for complete technical facilities for a new ABC radio network center in New York City. The contract, amounting to over \$500,000, includes seven radio studio control rooms, two tape rooms, two tape-edit rooms, and a complete transmission-recording room facility. An extensive house monitoring system with switching facilities, and a modern maintenance facility are also included in the contract.

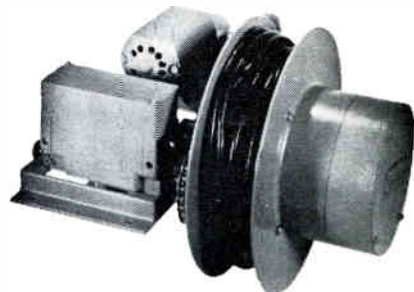
The facilities are to be installed at 1926 Broadway, New York, and are scheduled for completion by the fall of 1967.

### Erratum

In the article "A Presunrise Power-Reduction System" in the July 1966 issue, a portion of one connecting line in Fig. 3 was lost in reproduction. The figure should be as shown here.



# REMOTE CONTROL REELS FOR MICROPHONE CABLE



Industrial Electric's remote control reels are specially designed for retraction of microphones attached to various lengths of multi-conductor cable. 115 volt reversible chain driven motor. Gear limit switch for raising and lowering mikes. Remote operation by drum controller, push button station or relays. Available with 2 to 8 conductor slip rings.

## TAKE CARE OF YOUR CORD WITH A PORT-O-REEL!



Save time. Save wear and tear on microphone cable. Use a Port-O-Reel. Level wind. Holds 150' of cable. Cable will last longer. Can be equipped with power cord for lighting.

Write for catalog No. 61-A

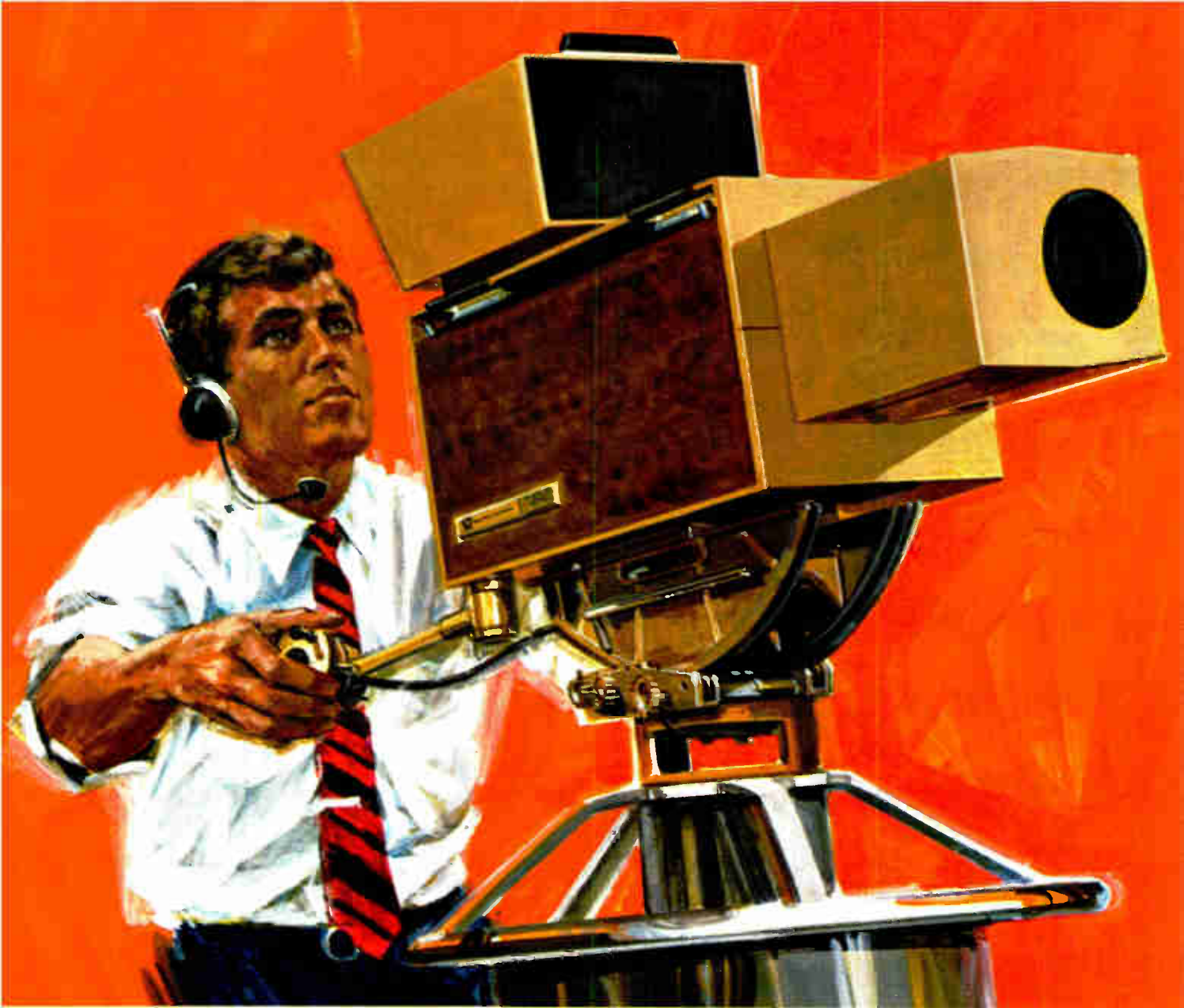
The most complete line of reeling devices and collector rings in the world.



**INDUSTRIAL ELECTRIC REELS INCORPORATED**  
1503 CHICAGO ST.  
OMAHA, NEBRASKA 68102

Circle Item 24 on Tech Data Card

BROADCAST ENGINEERING



## *If You Haven't Seen the Polychrome Camera, You're Missing the Finest Color in Television*

*Not to mention the most advanced  
live color camera on the market*

### **Here's why...**

① Choice of pickup tubes. Some broadcasters prefer the four-Plumbicon\* type camera. Others lean toward the IO-Vidicon tube complement. May even be that the best answer is still to be developed. Makes no difference with the Tarzian Polychrome camera. It accommodates any present or contemplated pickup tube. How's that for flexibility? And you avoid costly obsolescence, too.

② Color fidelity. Exceptional. Original optical design delivers superior color performance—limited only by the capability of existing pickup tubes. Separate luminance channel assures excellent color and monochrome results.

③ Design. Rugged magnesium housing trims size and weight down to what you'd expect to find only with monochrome equipment. Viewfinder is removable for added mobility and accessibility. Bold contemporary styling and textured door panels mark a fresh departure from old fashioned, bulky look.

④ Electronics. All camera and processing circuitry is fully transistorized with plug-in module construction throughout.

More? There's plenty. Like 10:1 zoom lens. Looks built-in, but detaches readily. Powered zoom, focus and remote iris for smooth control. The list is nearly endless.

Exciting? You bet it is. Why waste time. Call today—collect. We're anxious to fill you in on the details. Area Code is 812/332-7251. That's Sarkes Tarzian, Inc., Broadcast Equipment Division, Bloomington, Indiana.

\* Reg. T. M. of N. V. Philips Co., Holland



**Symbol of Excellence in Electronics**



# CENTRAL CANADA BROADCASTERS ENGINEERING CONVENTION

The sixteenth Central Canada Broadcasters Engineering Convention was held in October at the Inn on the Park in Toronto. Representatives of the engineering staffs of thirty-five Quebec and Ontario Stations spent two days discussing mutual problems, inspecting manufacturers' exhibits of broadcast equipment, and attending presentations of technical papers.

The first paper, by W. Wright of Canadian General Electric, covered "Care and Maintenance of AM Directional Arrays." It was followed by "A Program for Tower Maintenance and Repairs," presented by Albert Nightingale of Tower Communications Company. These two papers, plus "The Andrew Antenna Seminar," by Hugh Swain of Andrew Antenna Corporation, demonstrated the care required in designing and maintaining broadcast antenna arrays.

Radio Station CKAC, Montreal, recently moved into new studios, and Chief Engineer Len Spencer presented an excellent paper on his experiences during the design and installation of the studio complex. (Editor's Note: These facilities will be the subject of a forthcoming article in BROADCAST ENGINEERING.)

Ed Victor of CHML, Hamilton, had just rebuilt that station's news facilities. His paper, "Technical Considerations of News Department Operation," showed how efficiently a well designed news operation can function.

John Moseley of Moseley Associates, Inc. discussed the types and uses of studio-transmitter links in his paper, "Microwave Systems for STL and Control." Solid-state components and miniature integrated circuitry have been combined to give reliability in the important link between a broadcast studio and remote transmitter site.

In the video field, Helmut Berger of CFTO-TV showed what an independent TV station can accomplish in the design, construction, and equipping of a mobile color studio. The CFTO trailer handles six color cameras; it was described in the paper "Construction and Design of Television Mobile Equipment."

Sandy Day of CJOH-TV, Ottawa, did some original research when he found himself involved in color, and his paper on "Light Polarization in Color Optics" provided valuable information on an important part of the color system.

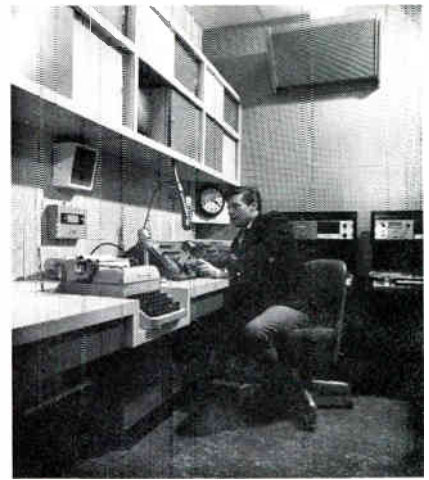
"Switching for Color," by Ron Martin of Richmond Hill Labs, and "Color Tape Recording," by Peter Dare of RCA, Camden, were followed by the paper "Operational Techniques Applied to Camera Tubes in Color Broadcasting," by Walter Turk of English Electric Valve Company.

At the Engineering Luncheon, Allen R. Cooper, Director of Corporate Planning, NBC, talked on "Communication Satellites for Canada's Broadcasters." His talk stressed that in Canada all UHF television channels are available for direct transmission and reception from satellites and that a satellite-to-station system for distributing network programs is now within our capabilities.

The following officers were elected at the business meeting:

Chairman: George Jones,  
CHUM, Toronto.  
Secretary-Treasurer: George Roach,  
CFRA, Ottawa.  
Manufacturers Liaison: Harold L.  
Graves, CHCH, Hamilton.  
Past Chairman: W. Marchand,  
CKLB, Oshawa.

The Convention was organized by the 1965-66 officers. Ron Turnpenny, of CHFI, Toronto, organized the papers that were presented. ▲



CHML newsroom



CFTO-TV mobile color units



Mr. Turnpenny



(l to r) Mr. Graves, Mr. Jones, Mr. Roach



IN CINCINNATI . . .

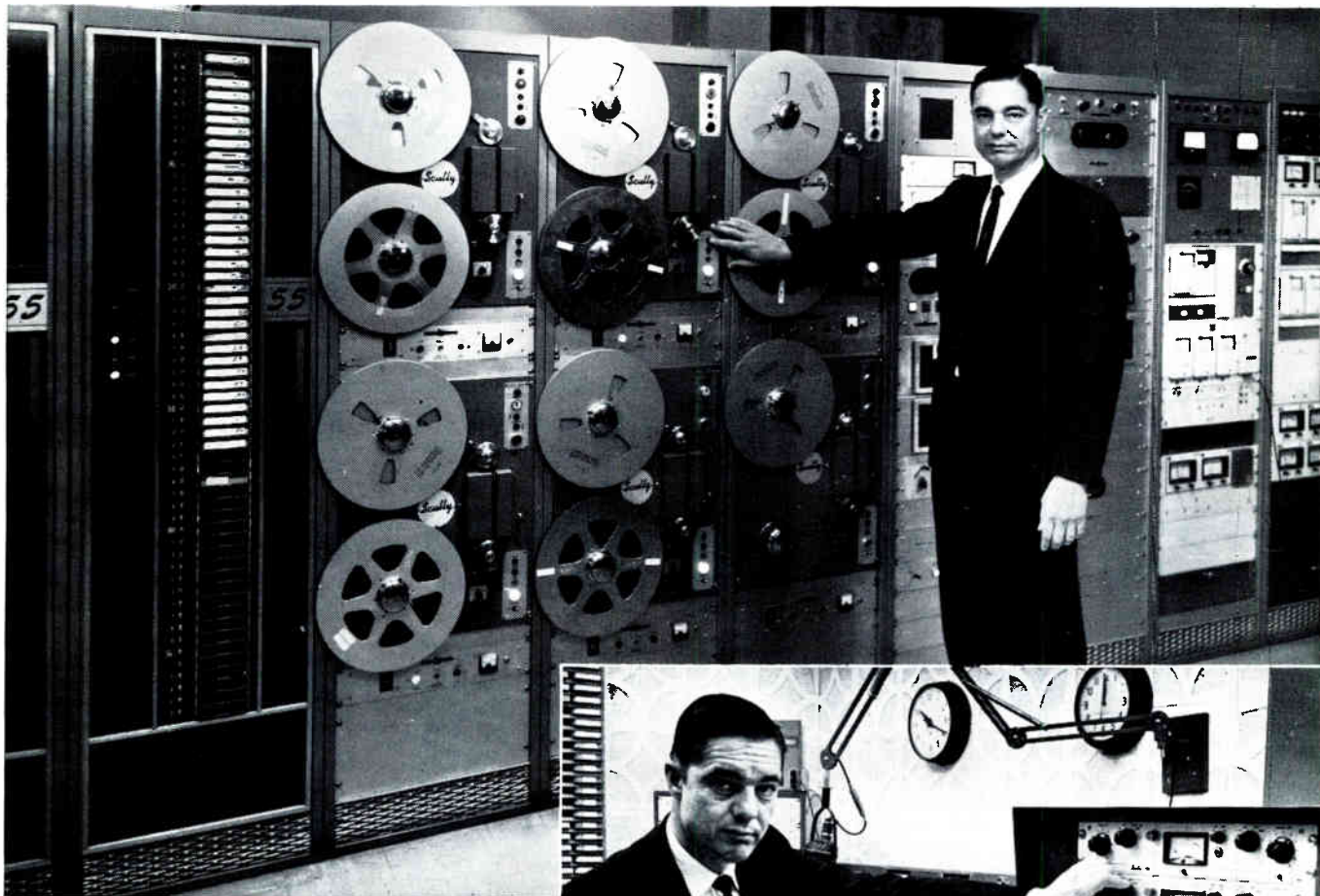
## "Accent on Appreciation"

Six Scully 270's keep WKRC-FM on full-time stereo operation, programming quality music for a discriminating audience.

"Accent on Appreciation" not only defines the program appeal of Cincinnati's first independently-programmed FM station, but typifies the growing list of broadcasters now depending on the advanced features of the Scully 270.

- Full one year guarantee
- Disc brakes
- Fully transistorized, plug in amplifiers
- One-piece solid frame construction
- Plug-in reel hubs
- Direct drive heavy duty motors
- Instant access for maintenance
- Complete one-panel construction
- Automatic start torque tension control

For further information on the 270, the 280-SP/14 and other advanced Scully equipment write or call collect.



It's "start up" time as chief engineer Ray Owen begins another day's run with the Scully 270 long-play tape reproducers.

Mr. Owen checks WKRC-FM's Model 280-SP/14, Scully's 2-channel Solid State tape recorder for 14 inch reels.



### SCULLY RECORDING INSTRUMENTS CORPORATION

480 BUNNELL STREET, BRIDGEPORT, CONN. 06607 • TEL. (203) 335-5146  
Makers of the renowned Scully Lathe, since 1919 symbol of precision in the recording industry.



# NEW PRODUCTS

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



## Solid-State Receiver

(47)

Marconi Instruments has made an addition to the line of Eddystone communications receivers. Model 990S is a fully transistorized single-conversion receiver covering the frequency range 230 mHz through 870 mHz and providing facilities for the reception of FM and AM signals. AM bandwidths are 6 mHz and 1 mHz; FM bandwidth is 1 mHz with a discriminator to accept deviations of up to 250 kHz.

A special feature of this unit is operation from 12 volts DC for mobile or field applications as well as from 110-volts 60-Hz for laboratory use.

Price is \$1365.



## Video Tape Recorder

(48)

The Akai Electric Co. will soon begin marketing a video tape recorder.

The recorder employs a cross field bias head longitudinal recording system, 1/4-inch audio magnetic tape, and recording speed of 30 inches per second. Solid-state circuitry is used throughout the recorder.

## New heads for old!



We can rebuild your head assembly, install three new heads, give it the same specs, same warranty, same performance as a new one, yet save you up to 40%. Your Ampex professional audio distributor will be glad to send us your Ampex 350 series or 300 series full-track head assembly. We will completely rebuild it, including 1) replacement of all heads with brand new, latest model stacks; 2) replacement of all tape guides and minor hardware; 3) precision alignment of all components; 4) complete checkout of the final assembly. All this will be done at the factory and your assembly will be on its way back within 48 hours from time of receipt. (The cost is only \$138.60 and you'll have saved \$92.40.) Similar savings are also available on head assemblies for Ampex duplicators, some 400 series recorders and special head configurations. Prices upon request. Contact your Ampex Professional Products distributor or write Ampex, Dept. 7-14, Redwood City, California 94063 for Bulletin #A120.

# AMPEX

Circle Item 27 on Tech Data Card



## SCA SOLID STATE RECEIVER

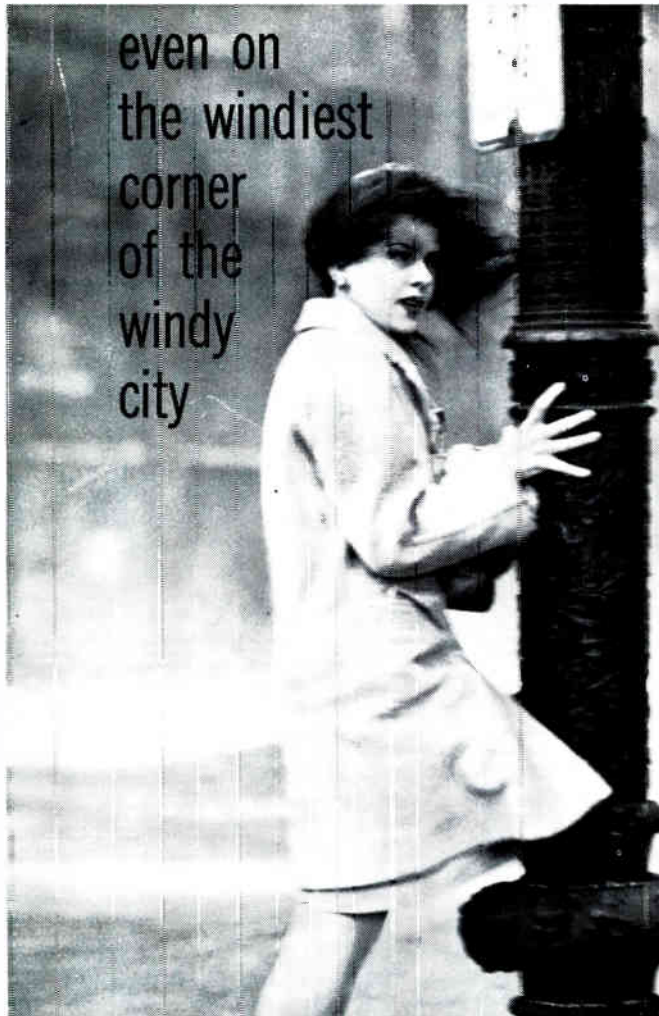
Dayton Electronic Products Company • 117 E. Helena St. • Dayton, Ohio 45404 • 513/461-4951

Circle Item 26 on Tech Data Card

BROADCAST ENGINEERING



even on  
the windiest  
corner  
of the  
windy  
city



...this  
microphone  
needs no  
external  
windscreen

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.

Additionally, the SM50 is the cleanest sounding professional microphone at anywhere near its price class. It delivers highly intelligible, natural and pleasing speech and vocal music that is especially full-bodied and rich in the critical mid-range.

It is extremely rugged and will require little or no down time as the years go by. Too, when comparing it to other moderately priced omnidirectionals, it is lighter in weight, supremely well-balanced for "handability," has a detachable cable, and a rubber mounted cartridge for minimizing handling noises. The SM50 is worthy of your most serious consideration.

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

## SHURE SM50

OMNIDIRECTIONAL DYNAMIC MICROPHONE

SHURE PROFESSIONAL MICROPHONES . . . FOR BETTER AUDIO



**MODEL SM56  
CARDIOID  
DYNAMIC**

Extremely versatile in studio, control room, and remote use. Also widely acclaimed for rhythm recording. Bright, clean sound. Exceptionally uniform cardioid pattern gives optimum control of environment.



**MODEL SM33  
UNIDIRECTIONAL  
RIBBON**

Warm, smooth sound for studio, control room, and scoring stage. Super-cardioid directional pattern. Compact, yet rugged.



**MODEL SM76  
¾" DMIDIRECTIONAL  
DYNAMIC**

Ideal for interviews and audience participation, yet unusually smooth wide range response (40-20 KC) for critical music reproduction. Instantly detachable from stand. Steel case with Cannon connector.



**MODEL SM50  
OMNIDIRECTIONAL  
DYNAMIC**

Self-windscreened and pop-free for news, sports, remotes, and interviews. Also ideal for many studio and control room applications. Comfortably balanced for hand or stand use. Natural response.



# Advanced, Solid State

## Spotmaster

### Super B Series

MEETS OR EXCEEDS ALL NAB SPECIFICATIONS AND REQUIREMENTS

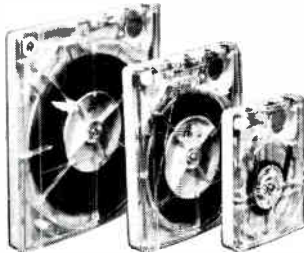


### And Here's the New Economy King COMPACT 400-A



Don't let their low price fool you. New, solid state SPOTMASTER Compact 400's are second only to the Super B series in performance and features. Available in both playback and record-playback versions, these Compact models share the traditional SPOTMASTER emphasis on rugged dependability.

### Top Quality Tape Cartridges



Superior SPOTMASTER tape cartridges are available in standard timings from 20 seconds to 31 minutes, with special lengths loaded on request. In addition, Broadcast Electronics offers a complete selection of blank cartridges, cartridges for delayed programming and heavy duty lubricated bulk tape. Prices are modest, with no minimum order required.

Introducing the Super B, today's truly superior cartridge tape equipment.

New Super B series has models to match every programming need—record-playback and playback-only, compact and rack-mount. Completely solid state, handsome Super B equipment features functional new styling and ease of operation, modular design, choice of 1, 2 or 3 automatic electronic cueing tones, separate record and play heads. A-B monitoring, biased cue recording, triple zener controlled power supply, transformer output . . . all adding up to pushbutton broadcasting at its finest.

Super B specs and performance equal or exceed NAB standards. Our ironclad one-year guarantee shows you how much we think of these great new machines.

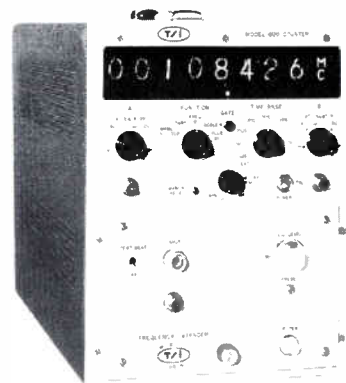
Write, wire or call for complete details on these and other cartridge tape units (stereo, too) and accessories . . . from industry's largest, most comprehensive line, already serving more than 1,500 stations on six continents.



## BROADCAST ELECTRONICS, INC.

8800 Brookville Rd., Silver Spring, Md.  
Area Code 301 • JU 8-4983

Circle Item 29 on Tech Data Card



### Electronic Counter (49)

The Transistor Specialists, Inc. Model 600 is a 100-MHz direct-readout, all silicon-solid-state, universal plug-in type counter. It is capable of performing basic functions, without the use of plug-ins, such as: frequency (DC to 100-MHz, 100 mv, 10K, and 50 ohms are provided by attenuator selector), period, ratio, multiple period, multiple ratio, (DC to 1 MHz in single function, DC to 20 MHz in multiple function), and manual gate control. No fan is used, and power requirements are 50 Hz to 400 Hz, 115-volt AC, with 230-volt AC optional. BCD printer output is supplied as standard in 1-2-4-8 code with negative true logic.

Plug-ins are available for extending counting and measurement capabilities.

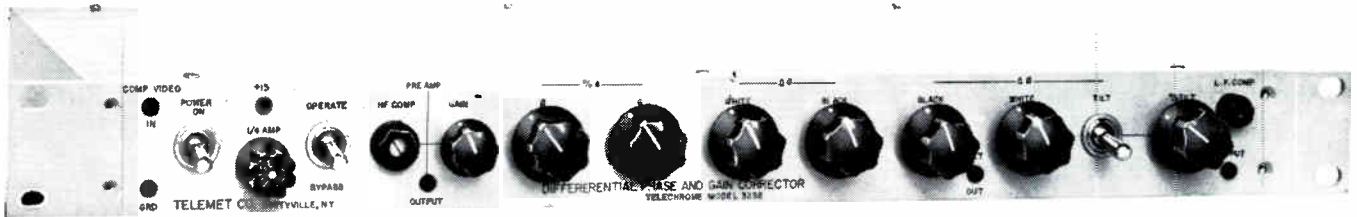
Price is \$2890.



### Wide-Band Probe For Low-Amplitude Measurements (50)

The Type P6045 probe, with DC to 230-MHz bandwidth, is for use with all Tektronix oscilloscopes, including various sampling instruments. The probe is designed to introduce less circuit loading than the usual 10X probe, and with 1X attenuation to permit displays of low-amplitude signals which might otherwise be unobtainable. A DC-offset control allows measurements of very small AC signals in the presence of DC potentials up to one volt.

# DIFFERENTIAL PHASE & GAIN CORRECTOR BY TELEMET



TELEMET MODEL 3252

*For Correction of Differential Phase and Gain Errors in Transmitters and Microwave Links*

## OPERATING CONTROLS

- Delta gain white:** Corrects white compression or white boost.
- Delta gain black:** Corrects black compression or black boost.
- Delta phase white:** Corrects differential phase error at white level and below.
- Delta phase black:** Corrects differential phase error at black level and above.
- Delta gain:** Determines maximum percentage of correction obtainable from the "Diff. Gain White" and "Black" controls through their full range.
- Delta phase:** Determines maximum amount of correction obtainable from the "Diff. Phase White" and "Black" controls through their full range.
- Tilt (slope adjust):** Adjusts slope of differential phase from black to white levels.
- Tilt (slope)  $\pm$ :** Determines if Slope Adjust control corrects for increasing phase error or decreasing phase error.
- Gain:** Adjusts for 1 volt peak-to-peak output.
- Operate-bypass:** Allows incoming signal to either bypass or go through Differential Phase and Gain Corrector.
- Power on:** Applies AC power to the unit.



**TELEMET COMPANY**  
185 DIXON AVENUE, AMITYVILLE, N. Y. • PHONE (516) 541-3600

Circle Item 30 on Tech Data Card

# professional solid state recorders - reproducers loggers



Heavy Duty, Two-Direction Transport—with latest solid state electronics—provides exceptional Performance and Reliability.

Slow Speed Loggers capable of 12-16 operating days of continuous, unattended logging time for any Broadcast or Communications requirement.

All equipment attractively priced; exceeds all N.A.B. specifications.

Write today for six-page brochure and price information.

**metrotech**

# SERIES



# 500

**METROTECH, INC.**  
670 NATIONAL AVENUE  
MOUNTAIN VIEW, CALIF.

Circle Item 32 on Tech Data Card

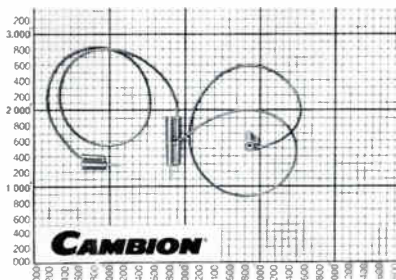
Rise time of the P6045 is specified as approximately 1.5 nsec, input resistance as 10 megohms, and input capacitance as less than 4 pf.

The probe consists of two major parts, a probe head connected by a cable to a compensating amplifier. A separate power supply is provided to power the probe. Supplied with the P6045 are plug-on 10X and 100X attenuators and an AC-coupling capacitor.

Output load impedance is 50 ohms. A switch on the compensating amplifier provides internal 50-ohm termination, or the probe can be terminated externally.

The amplifier is capable of driving lengths of terminated 50-ohm coaxial cable for uses such as coaxial switching in systems applications. It is also possible to extend the distance between the probe amplifier and the oscilloscope if desired.

Price of the P6045 with power supply is \$375.



**Combination Patch Cord**

(51)

Cambridge Thermionic Corp. has produced the new CAMBION 3705 plug/jack patch cord with molded plastic insulation. This latest addition to its .040" line of connectors incorporates the same design and construction of the 3300 shrink-fit insulated series of plugs and cage jacks.

The finger-size 3705's permit multiple patching and component economy. The molded insulation jacket is employed to provide long life with rough

handling. A high dielectric material, molded ABS (acrylonitrile-butadiene-styrene) plastic insulation provides electrical stability, physical strength, and resistance to moisture and most common acids.

The configuration of this plug/jack patch cord permits self-stacking for multiple connections at a single point. The CAMBION 3705 patch-cord unit is made in the international 1-mm (.040") size, providing applications for prototype and production.

The product is available from stock and is priced at 53¢ - 56¢ each in quantities of 500-999.

## SPOTMASTER

RS-26



## Tape Cartridge Racks

RM-100



... from industry's most comprehensive line of cartridge tape equipment.

Enjoy finger-tip convenience with RM-100 wall-mount wood racks. Store 100 cartridges in minimum space (modular construction permits table-top mounting as well); \$40.00 per rack. SPOTMASTER Lazy Susan revolving cartridge wire rack holds 200 cartridges. Price \$145.50. Extra rack sections available at \$12.90.

Write or wire for complete details.

*Spotmaster*

**BROADCAST ELECTRONICS, INC.**

8800 Brookville Road  
Silver Spring, Maryland

Circle Item 31 on Tech Data Card

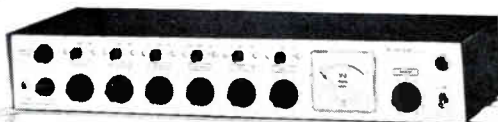
**CHEAP-but...**

**NOT A  
CHEAPY!**

**KUSTOM  
BROADCAST  
CONSOLE**

ONLY

**\$495\***



You, like other satisfied customers, will use words of praise like: "versatile"; "flexible"; "easy to use on remotes"; "great frequency response". But most you'll like the economy price. Fully transistorized. Six input channels. Built in speaker. Full volume control flexibility. Frequency response 40 Hz to 15 KHz. Distortion 0.5% or less. Sold with a full money back guarantee. Write today for full fact sheet.

\*Price F.O.B. Portland. Legs as shown \$23.80 more.

EXCLUSIVELY THROUGH  
**UNITED RADIO INDUSTRIAL**

829 W. Burnside St. /Portland, Ore. 97209 /503-226-6334

Circle Item 33 on Tech Data Card





### RF Directional Wattmeter

(52)

The Model 4311, produced by **Bird Electronic Corp.**, is a portable peak or average (CW) reading directional wattmeter, designed for the measurement of pulsed RF systems such as air navigational aids, telemetry, radar, television, command and control, and single-sideband peak envelope power (SSB-PEP).

The meter operates on the principle of sampling forward or reflected power in a precision 50-ohm line section. Plug-in elements determine the power and frequency range of the basic directional wattmeter, and the same catalog elements are used in the new dual-purpose instrument.

To read the peak power of pulses, the "Peak Read" button is depressed and locked, which inserts a peak reading servo amplifier between the demodulator element and the meter. The amplifier and power supply are self-contained, and neither line power nor an oscilloscope are required for operation in either the peak or average power mode.

Price of the basic unit is \$575. Plug-in elements are \$30 to \$75 each.

#### MOVING?

*Don't Lose Touch . . .*

Receive BE as usual at your new address

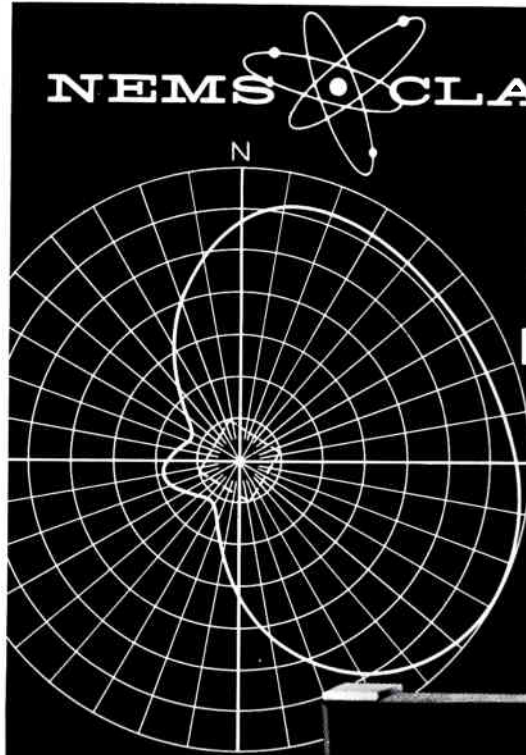
Write: **BROADCAST ENGINEERING**

Circulation Department

4300 West 62nd Street

Indianapolis, Indiana 46206

NEMS • CLARKE



offers a  
**UHR\*AM**  
measurement  
capability  
with the  
**FIM-135**  
FIELD INTENSITY  
METER

(\* ultra high reliability)

- All Solid State
- 175-Hour Mercury Battery
- Taut-Band Meter Movement
- Lightweight
- Crystal or VFO Operation
- Tuning from 540 to 1600 KC
- Front Panel Speaker
- Use as Null Detector



The new Model FIM-135 Field Intensity Meter provides exceptional reliability in the field due to its extremely ruggedized construction, solid-state design, and long life Mercury battery. Its lightweight (9 lbs.), compact (6½" x 10" x 6½"), and simplified design provides ease of handling and operation in the field.

Dial locks provide a fixed setting at any point across the entire broadcast range. A taut-band meter movement accurately displays from 10 microvolts per meter to 10 volts per meter, making it equally effective for interference studies at low signal strength and for close-in measurements on high-power directional arrays. A special input jack permits receiver use as a null detector for RF Bridge measurements.

v-27

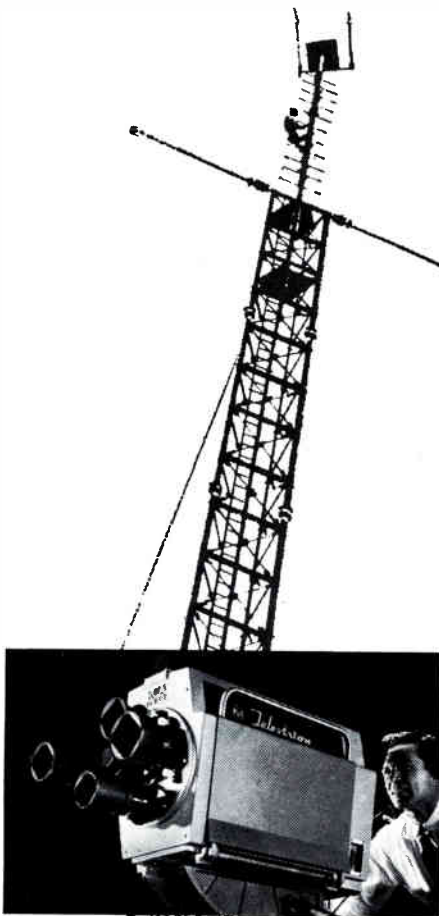
For complete information, call or write:

**Vitro ELECTRONICS**

Producers of NEMS-CLARKE Equipment

A Division of Vitro Corporation of America

919 Jesup-Blair Drive • Silver Spring, Maryland (301) 585-1000



### Equipment Enclosures

(53)

A system of aluminum tubing and self-locking corners is available from **Amco Engineering** for those interested in designing and constructing enclosures and instrument cabinets.

No tools or welding equipment is needed for assembly. The tubing itself is in the form of  $\frac{3}{4}$ " square extrusions. It is available in plain square cross section, or with a choice of 15 flanges running the length of the tubing to accommodate any type of panel mounting desired.

Corner castings come in 3-ear and 4-ear units for right-angle assembly, and there is a hinged unit that allows frame designs with slanted configurations, such as sloping fronts. Each casting is provided with locking clips capable of withstanding a direct pulling force of more than 200 pounds. To assemble, after tubing is cut to length and mitered, corners are simply inserted and pushed until they are locked in place.

The system is now being made available through parts distributors or

direct from the manufacturer. Tubing is supplied in 6-foot or 12-foot lengths.

### Optical Viewfinder TV Camera

(54)

A portable optical-viewfinder TV camera has been introduced by **Shibaden Corporation of America**. The fold-away handle incorporates an on-off trigger that remotely controls operation of any equipment associated with the camera, such as video tape recorder, video monitor, or home-type TV receiver.

The configuration of the Model HV-50 camera (10" long by 3" in diameter) is intended to be of value when viewing fast-moving events such as sports, dramatics, scientific phenomena, etc., and in teaching.

Model HV-50 employs all silicon transistors. Other features include stabilized electric eye, accommodation for all "C"-mount lenses, and both video and RF outputs.

A camera control unit provides remote control of the camera, weighs 3 pounds, and measures 6" x 7" x 2 $\frac{3}{8}$ ".

## Command Performance?

### RCA SERVICE DELIVERS Expert Repair and Overhaul Service

- FOR:
- Video tape recorders
  - TV Cameras
  - Antennas
  - Microphones
  - Transmitters
  - Installation
  - Console
  - TV Projectors
  - Microwave

Dial either of these offices for full information about fast, dependable broadcast equipment maintenance service from RCA:

Chicago (312) WE 9-6117  
Philadelphia (215) HO 7-3300

Or write:

**RCA Service Company**  
a Division of  
Radio Corporation of America  
Technical Products Service,  
Industrial Center, Camden, N. J. 08101



The Most Trusted Name in Electronics

## Solid-State SCA SUBCARRIER GENERATOR



3 $\frac{1}{2}$ " x 19"

MODEL SCG-4T

- All silicon semi-conductors JEDEC registered
- Excellent distortion and frequency response characteristics
- Automatic electronic muting with adjustable delay
- Peak reading deviation meter calibrated in KHz
- New highly stabilized oscillator
- Gold plated, etched copper, plug-in circuit cards

Send For Bulletin #316



**MOSELEY ASSOCIATES, INC.**

135 Nogal Drive, Santa Barbara, California 93105

Telephone (805) 967-0424

Circle Item 36 on Tech Data Card

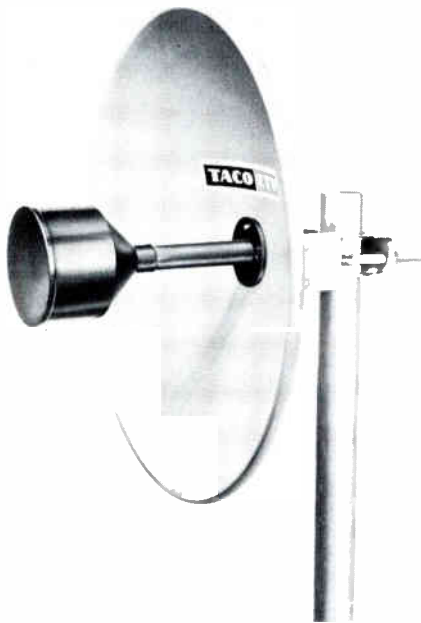
## 10-kVA Voltage Regulator

(55)

Using silicon controlled rectifiers, the new **Electro-Seal** Model 2156-E6 AC voltage regulator has been designed to maintain output voltage within  $\pm 1\%$  from no load to 10kVA. Input voltage may be  $\pm 10\%$  from a preselected level of 170-V AC to 250-V AC in five steps. Other ranges are available.

The unit is frequency insensitive from 47 and 63 Hz, and has a load power factor range of 100% to 64% lagging. Maximum response time is 3 cycles or less, and harmonic distortion does not exceed 13%. The entire regulator is supplied on a standard 19" panel, and is 20½" high and 10" deep. Convection cooling is sufficient. The unit weighs 108 lbs. Efficiencies of 95% minimum and 97% are typical. Output is 230 volts rms.

The principle of operation is comparatively simple. A transformer with secondary taps provides a high voltage or a low voltage output. The load is alternately connected to each tap through a pair of SCR's. The output voltage is held constant by proportioning the time in each half cycle during which the load is connected to each tap. Solid-state control modules fire the SCR's on signal from an error detector monitoring the output voltage.



## ETV Receiving Antennas

(56)

The Government and Industrial Division of **Jerrold Electronics Corp.** offers a series of TACO directive parabolic receiving antennas, designated Series EPA, for educational television. Designed to receive black and white as well as color, the antennas cover the full 2500-2690 mHz range and are available in 2-, 4-, 6-, 8-, and 10-foot diameters.

Reflectors for all Series EPA antennas are of light-weight "Tacoform" aluminum construction, yet meet all EIA windload specifications for structural strength. Allodined, primed, and painted with a specially formulated Vinyl Alkyd sun bronze paint, they are designed to complement school buildings of either modern or traditional architecture.

The antennas can be mounted to masts ranging in size from 2" O.D. to 4½" O.D. Adjustment is provided through 360° of rotation in azimuth and 0° to 7° of tilt in elevation—above or below the horizon. Installed from the rear of the reflector, the slot-dipole feed is radome-protected and may be positioned for either horizontal or vertical linear polarization.

## Color Problems?

# AEM HAS THREE NEW ANSWERS



**BURST GENERATOR**—Here's our new black Burst Generator with CONTROLLED chroma background which allows you to control color fades to black or any hue. The variable chroma feature also acts as a source for coloring backgrounds of monochrome slides and movies. And the price is just as attractive as the performance: Color Burst Generator, just \$595.00; standard black Burst Generator, \$545.00.

**LAP AMPLIFIERS**—The new LDA-series of lap-dissolve amplifiers was developed by AEM especially for color. Photo-electric cells, remotely controlled by DC circuitry, assure a velvety transition between two inputs. All solid state (silicon semiconductors exclusively), the LDA provides the signal handling characteristics of a high performance distribution amplifier. Differential phase and gain do not change even during the lap interval. Embarrassing color shifts and level changes become a thing of the past. LDA-1, \$555.00; LDA-2 (sync adding), \$585.00.

**COLOR SENSORS**—We are also introducing a Color Sensor attachment to the LDA amplifiers which samples both incoming channels and then closes a relay when either input has color burst . . . gives your switching system the information it needs to react properly. LDA-1 with Color Sensor, \$595.00; LDA-2 with Color Sensor, \$625.00.

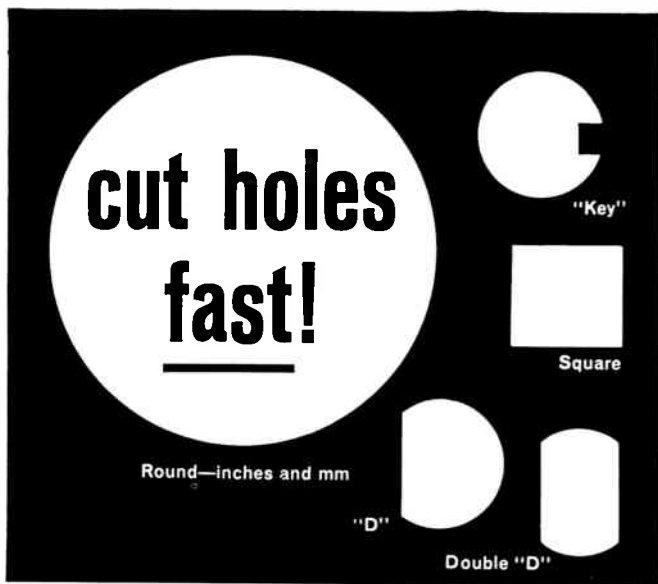
Call or write for more information about AEM video equipment. Feature for feature, there is nothing comparable on today's market!

## APPLIED ELECTRO MECHANICS, INC.

2350 Duke Street, Alexandria, Virginia 22314  
PHONE: (703) 548-2166







## with Greenlee punches

Here's the simple speedy way to cut smooth, accurate holes in metal, hard rubber, plastics, epoxy, etc.

Save hours of hard work . . . punch clean, true holes in seconds for sockets, controls, meters, and other components. Easy to operate. Simply insert punch in a small drilled hole and turn with a wrench. For use in up to 16-gauge metal. Available at leading radio and electronic parts dealers.

 **GREENLEE TOOL CO**  
DIVISION OF GREENLEE BROS. & CO.  
1866 Columbia Avenue, Rockford, Ill. 61101

Circle Item 39 on Tech Data Card

## Audio Standard Flutter Meter

(57)

The MICOM 8100/8100-W audio standard flutter meter requires no operator calibration for full accuracy. This all-solid-state instrument is designed to measure to both U. S. (NAB) and International (DIN) Standards.

The meter is built to provide consistent accuracy in the simultaneous measurement of both speed and flutter. The unit operates from reproduce-electronics output or directly from the playback head. Options include a tuneable wave analyzer (8100-W) to determine frequencies of observed flutter, thus facilitating determination of the cause of flutter.

The unit features these specifications: full-scale flutter ranges of 0.01%, 0.03%, 0.1%, 0.3%, 1%, 3%, and 10%; full-scale drift ranges of  $\pm 0.03\%$ , 0.01%, 0.3%, 1%, 3%, and 10%; demodulator output accuracy of  $\pm 2\%$  on all ranges; frequency range of DC to 200 Hz; RMS and peak measurements NAB weighted or unweighted; advanced solid-state construction; and automatic input-level indication and simultaneous indication of drift and flutter.

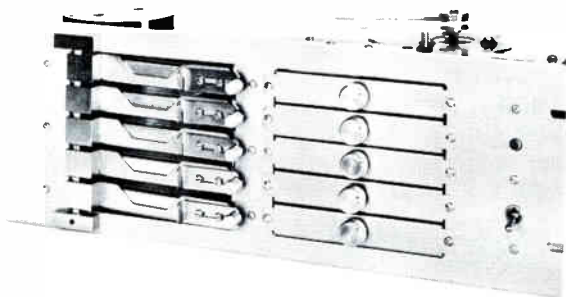
## FM/Stereo Monitor

(58)

Latest addition to the McMartin line of FM monitors is the all-transistor TBM-4500, an FM/stereo monitor which simultaneously reads right and left channel modulations. It has a 19-kHz pilot indicator light which shows that the station is transmitting stereo; it also measures pilot injection at any time without affecting modulation.

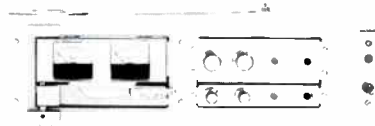
# MACKENZIE PROGRAM REPEATERS

UP-DATED *for today's* BROADCASTER

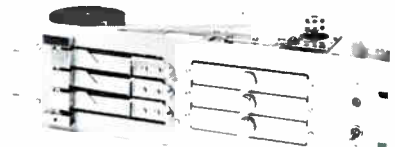


**MODEL 500**  
**FIVE MAGAZINE SELECTIVE**  
**PROGRAM REPEATER**

## NEW STEREO MODEL 100/PR/ST



**STEREO TWO-TRACK RECORD-PLAY**  
**PROGRAM**



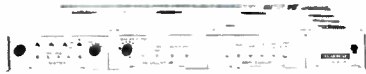
**MODEL 300**  
**THREE MAGAZINE SELECTIVE**  
**PROGRAM REPEATER**

**ALL MODELS AVAILABLE STEREO OR MONAURAL**  
**SPECIAL MODELS FOR PROJECTOR CUEING.**

INSTANT CUEING • NOISELESS OPERATION • RAPID MAGAZINE CHANGES  
RUGGED AND DEPENDABLE • EASY MAINTENANCE • PLUG-IN PRE AMPS • ALL SILICON DESIGN  
SINCE 1958 — QUALITY PROGRAM REPEATERS FOR BROADCASTING INDUSTRY  
FOR CATALOGUE, SPECIFICATIONS, PARTS LIST, AND PRICES WRITE:

**MACKENZIE LABORATORIES**

**1367 NORTH FAIR OAKS AVENUE, PASADENA, CALIF. 91103 • (213) 798-6220**



**Color Encoder**  
(57)

A silicon-transistor, color video encoder designed to meet all applicable NTSC and FCC specifications is available from **Cohu Electronics, Inc.** The Model 9830-071 encodes video from three-tube or four-tube cameras. Either one or two of the three video outputs is composite. Only sync, blanking, and subcarrier inputs are required in addition to the video inputs.

Special features include an integral full and NTSC split bar generator luminance channel aperture correction, notch filter, 370° subcarrier phase shifter, and integral burst-flag generator.

Luminance correction for four-tube cameras compensates for the gamma error introduced when the monochrome video is used in lieu of matrixed luminance. A front-panel switch permits routing of the green input to the luminance channel, providing compatible monochrome outputs, which may be used in the event of red or blue signal failure.

The encoder requires 1¾ inches of vertical space in a standard 19-inch rack or cabinet, and is available with remotely controlled options. Price is \$3500.



**Professional Audio Recorders**  
(58)

A new generation of professional audio recorder/reproducers has been placed on the market by **Ampex Corp.** The AG-440 Series recorders are advanced versions of the company's 350 and 351 Series.

A precision milled die-cast transport plate provides rigid mounting of all mechanical components to reduce flexing problems and maintain tape-to-transport alignment for studio and

mobile operations. Quarter-inch head assemblies are standard on all one-channel and two-channel recorders. Half-inch head assemblies are standard on all three-channel and four-channel recorders. An operator can select 1/2-inch or 1/4-inch operation or change track configuration by removing three screws and inserting a new assembly. Other features include plug-in solid-state modular electronics, three-way editing capability, and scrape flutter idlers.

A single-channel full-track AG-440 can be built up to a four-channel, four-track recorder by adding 3½-

inch electronic panels to the over-bridge and installing the proper head assembly, without making the existing components obsolete. A single-channel console model is 40 inches high; a four-channel version is 50½ inches high.

The AG-440 is available in console, portable, and unmounted versions. An AG-445 playback-only version also is available. Prices range from \$1970 for a full-track unmounted unit to \$4540 for a four-track console version. The new recorder/reproducer is available in both 50- and 60-Hz versions.

**CHECK** these **ADVANCEMENTS** in our

**'67 MODEL**

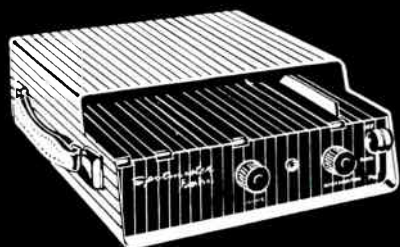
**AC-155 AUDIO CONTROL & REMOTE UNIT \$1095.**  
Also Avail. in Stereo.

- 5 MIXING CHANNELS**  
The all transistorized A-15 audio console has increased mixing to help you expand your remote and studio production potential.
- 14 AUDIO INPUTS**  
The AC-155 will now accommodate six low level audio sources, including the right and left turntables, and eight high-level sources.
- NEW LEG DESIGN**  
Leg supports are of sturdy two inch chrome tubular steel. Foot rests are molded at outward angles to provide a solid jar-proof foundation. Leg units are removable for easy transporting.
- ADDED FLEXIBILITY**  
Perfect as a full broadcast facility for production or recording studio, main studio control or any remote assignment. Solid state console is removable. Additional features include 3 speed custom turntable, lift-leaf work surface and all channel monitor / cue system.

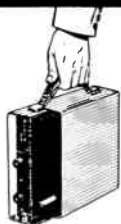
**SPARTA**  
**ELECTRONIC CORPORATION**

5851 FLORIN-PERKINS ROAD • SACRAMENTO, CALIFORNIA • (916) 383-5353

# SPOTMASTER



## PortaPak I Cartridge Playback Unit



Your time salesmen will wonder how they ever got along without it! Completely self-contained and self-powered, PortaPak I offers wide-range response, low distortion, plays all sized cartridges anywhere and anytime. It's solid state for rugged dependability and low battery drain, and recharges overnight from standard 115v ac line. Packaged in handsome stainless steel with a hinged lid for easy maintenance, PortaPak I weighs just 11½ lbs. Vinyl carrying case optional.

Write or wire for full information.

*Spotmaster*

**BROADCAST ELECTRONICS, INC.**

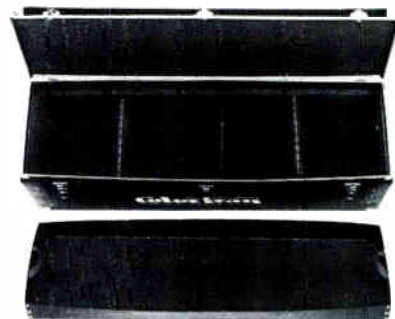
8800 Brookville Road  
Silver Spring, Maryland

Circle Item 42 on Tech Data Card



## Phase Sampler (59)

This small broadband phase sampler has been developed by **Bauer Electronics Corp.** for use in almost all AM directional systems. Known as the Model 180, it is seven inches long and can be mounted within antenna coupling units, thus eliminating the need for sampling loops and isolation coils. The Model 180 phase sampler sells for \$165.



## Carrying Cases (60)

A wide range and selection of light-weight carrying cases designed to accommodate various combinations of ColorTran lights and related accessories has been announced by **Color-Tran Industries, Inc.** The cases are made of heavy-gauge, vulcanized fibre, fortified with plywood. Corners are metal reinforced, and handles are of nonbreakable plastic. Some styles are completely foam lined, with adjustable foam-lined partitions to give protection to each piece of equipment.

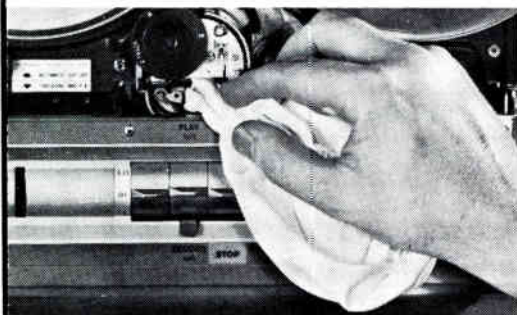
The cases are available in weights of six to eighteen pounds and are priced from \$21 to \$66. ▲

*In the March Broadcast Engineering . . .*

## ANNUAL PRE-NAB CONVENTION SUPPLEMENT

# SPRAY/WIPE TEAM REMOVES ALL OXIDE BUILD-UP

**mag/tape heads . . . drives . . . capstans . . . guides  
. . . tapes wherever non-contamination is essential**



**TEXWIPE** a disposable 100% cellulose LINT-FREE CLOTH designed for cleaning critical areas where non-contamination is essential.

**Non-Contaminating** — pure lint-free and fuzz-free.

**Non-Abrasive** — featuring the Twill Weave, a raised thread pattern.

**Static-Free** — does not require anti-static finishes to neutralize static charges. **Non-Raveling** — is cut on a bias to prevent raveling.

**High-Absorbency** — no additives to impede instantaneous absorption.

**TEXWIPE** is available from stock in the following sizes: Bias 9" x 9", 12" x 12"; Hemmed 18" x 14". Texwipe is packaged for complete protection from outside contamination.

**"FREON"™ TF** Solvent Cleaner a safe selective solvent for cleaning Computer-Video-Sound Tape Heads and Films.

**Selectivity** — removes oxide build-up, grease, oils, dust & grit without damaging materials or equipment.

**Safety** — non-explosive, non-conductive, non-flammable, non-corrosive, odorless and virtually non-toxic. Can be used on operating equipment.

**Low Residue** — "FREON" solvents leave essentially no residue on evaporation. **EXCELLENT PENETRATION** — Because of low surface tension, "FREON" has superior wetting properties . . . will enter the tiniest openings and pores to replace soils. **EXTENSION NOZZLE** — Pin-Points spray into hard to reach areas. "FREON" TF is available in the large 16 oz. Aerosol Industrial size.

**Write for details.**

© DuPont T.M.



**THE TEXWIPE COMPANY** • HILLSDALE, NEW JERSEY 07642

Circle Item 41 on Tech Data Card



# Engineers' TECH DATA

## ANTENNAS & TRANSMISSION LINES

75. ANDREW—Literature describes 1½", 50-ohm coaxial transfer switch for frequencies up to 2.9 GHz.
76. BAUER—Information is offered concerning Model 380 current sampler for phase sampling in critical AM directional arrays.
77. FINNEY—Form No. 20-353 contains descriptions of Finco-Axial 75-ohm antennas for UHF-VHF-FM.
78. FT. WORTH TOWER—Subjects of literature are passive reflectors and equipment buildings.

## AUDIO EQUIPMENT

79. KOSS—Two leaflets illustrate and give specifications for turntables, tone arms, and personal listening products.
80. MARANTZ—Data sheet is for solid-state Model 15 stereo and Model 14 single-channel audio amplifiers with output of 60 watts per channel (8-ohm load).
81. QUAM-NICHOLS—General Catalog No. 66 lists replacement speakers for public-address, sound-system, and other applications.

## AUTOMATION EQUIPMENT

82. GATES — Sixteen-page, two-color brochure describes systems for automatic programming of radio stations. Literature offer includes price list.
83. I. G. M. — Material provides information on the following control units for radio-station automation: 500, 500 with Actan® and 600 Series.

## CATV EQUIPMENT

84. TIMES WIRE & CABLE — Twenty-page booklet contains descriptions and specifications of semiflexible coaxial cable and connectors; two brochures give data on CATV cable and connectors.

## COMPONENTS & MATERIALS

85. BENDIX — Eight-page leaflet tells about B-5000 transistor capable of delivering 25 watts at 100°C in amplifier applications.
86. MAGNECRAFT — Offer includes 80-page "Designers' Handbook & Catalog of Reed and Mercury Wetted Contact Relays," 16-page Catalog 267 of stock relays, and Engineering Bulletin 465A on coaxial relays.

## MICROWAVE EQUIPMENT

87. TELONIC ENGINEERING — New edition of Catalog No. C-101 includes information on RF and microwave filters and instruments. An "RF filter performance slide rule" is included in a pocket inside the cover.

## MISCELLANEOUS

88. AIR SPACE DEVICES — Brochure STC 5-65-10M discusses "SAF-T-CLIMB," a device for preventing falls when climbing structures.
89. BRADY — Bulletin 405 shows Quick-Label Embossing Machine for making self-adhesive plastic labels for electronic equipment.
90. MAGNE-TRONICS — Literature gives information about motivational background-music service for FM-multiplex and/or telephone-line transmission under franchise arrangement.

## MOBILE RADIO & COMMUNICATIONS

91. MOSLEY ELECTRONICS — 1967 catalog lists line of Citizens-band antennas.

# RUSSCO

HEAVY DUTY—PROFESSIONAL QUALITY

## Broadcast Turntables

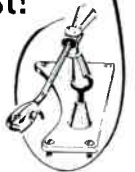


Approved  
Performance

By Top Radio Stations  
from Coast-to-Coast!

Unconditionally  
Guaranteed  
—against defects in  
material or work-  
manship when given  
normal maintenance

- Single lever controls 33 & 45 speeds, plays 45 RPM'S without adapter
- Illuminated speed indicators
- Instant acceleration to required speed in 1/10 to 1/16 of a turn
- Sold with or without arm
- Adaptable for any make tone arm



SEPARATE TONE  
ARM MOUNTING  
PLATE—EASY  
TO INSTALL

SOLD DIRECT  
—OR TO DEALERS

LOW  
PRICED \$149.50 & \$179.50

# RUSSCO

BROADCAST PHONO

## Preamplifiers

STEREO MODEL  
I-S \$96

MONAURAL  
MODEL I-M \$48



- Fully Transistorized for years of dependable service
- Built-in audio level controls

SPECIFICATIONS  
HARMONIC DISTORTION: less than one  
tenth of one percent

NOISE LEVEL: better than minus 65 DB.

OUT PUT IMPEDENCE: 150-600 ohms

RUSSCO POWER SUPPLY UNITS model 1-P  
supplies power for up to 4 mono units  
... price \$40

Call or write  
for folder

**RUSSCO Electronics Mfg.**  
6879 N. SUNNYSIDE, CLOVIS, CALIF.  
PH. 299-4692

## New from TeleMation

# VIDEO PROCESSORS MODEL TMV 501 SERIES

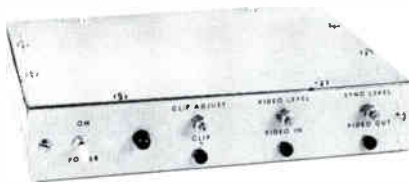
Ideal for broadcast and ETV facilities . . .  
wherever video distribution requires isolation,  
level adjustment, sync stretch or improvement.



**TMV-501 A** Direct retrofit video processor for use with Ampex VR-660 recorders. Supplied mounted on replacement end panel grille. Simple internal wiring and installation. May also be used with external equipment and for record input. Power supplied from VR-660.

**TMV-501 P** Line-powered and self-contained. Ultra-compact for difficult mounting requirements. 8½" w x 7½" d x 1¾" h.

**TMV-501 PR** Standard 19" rack mounting version. Line-powered and requires only 1¾" rack space.



### GENERAL DESCRIPTION

The TMV-501 processors offer a low-cost solution to the problem of sync degradation encountered in tape recording and playback. Sync pulses are completely reshaped to comply with RS-170 standards. Adjustable clip level eliminates problems encountered with dropouts or switching transients when dubbing. Provides necessary sync stretch when used with 2500 MHz transmitters. Three video outputs with sync optional on each; also provides 4V. sync output into 75 ohms, can be used as a sync adding amplifier. Looping input on AC models.

For detailed specifications on these new processors  
call or write:



## TELEMATION, INC.

Dept. TMV  
2275 South West Temple  
Salt Lake City, Utah 84115  
Telephone (801) 486-7564

Circle Item 44 on Tech Data Card

### POWER DEVICES

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

### RECORDING & PLAYBACK EQUIPMENT

93. BROADCAST ELECTRONICS — Literature on SPOTMASTER tape-cartridge equipment includes specifications and prices on recorder/reproducer units, reproducer only, TEN SPOT multiple units, audio distribution amplifier, remote amplifiers, equalized turntable preamplifier, tape-cartridge winder, and cartridge racks.
94. METROTECH — Series 500 professional tape recorders, reproducers, and slow-speed loggers are subjects of six-page brochure.
95. VIKING OF MINNEAPOLIS — Leaflet contains photos, features, and specifications of Model 230 tape transport, including options and accessories.

### REFERENCE MATERIALS & SCHOOLS

96. CLEVELAND INSTITUTE OF ELECTRONICS — Pocket-size plastic "Electronics Data Guide" includes formulas and tables for: frequency vs wavelength, dB, length of antennas, and color code.
97. HAYDEN BOOKS — Catalog gives listing of texts, professional books, and references for scientists, engineers, and students.
98. HOWARD W. SAMS — Literature describes popular and informative technical publications; new 1967 catalog of technical books is included.

### TELEVISION EQUIPMENT

99. AMPEX — Information sheet is concerned with Model EF-100 special-effects generator and four-channel video integrator.
100. BLONDER-TONGUE — New catalog of closed-circuit television-system products features solid-state vidicon cameras, camera accessories, distribution and auxiliary equipment, and RF equipment with 82-channel capability.
101. CLEVELAND ELECTRONICS — A 52-page quick-reference step-down die-cut catalog covers complete information on vidicon, Plumbicon®, and image-orthicon deflection components.
102. COLORADO VIDEO — Data sheet is for Model 601-A laboratory TV synchronizing generator.
103. DYNAIR — Illustrated 26-page book, "Video Switching Techniques," is about commonly used methods of switching video and audio information; brochure contains information on MINI-Series of audio-video modulators, switchers, and amplifiers.
104. MICRO-LINK/VARIAN — A 24-page booklet tells about the 2500-MHz ITV networks established by eight U.S. school systems.
105. TELEMATION — Descriptive material concerns Model TMM-203A three-source optical multiplexer which uses motor-driven mirrors.
106. VITAL — Information is given for Model VI-10A video distribution amplifier and Model VI-20 pulse distribution amplifier.

### TEST & MEASURING EQUIPMENT

107. BOONTON — Technical bulletin provides functional description, circuit analysis, and specifications of Model 95A DC microvolt/picoammeter.
108. DELTA — Data sheets are for Model OIB-1 operating-impedance bridge, Model CPB-1/1A common-point impedance bridges, and Model TC-1 transport case for Model OIB-1.
109. TELEMET — Material gives information on video test equipment, effects generators, and video processing equipment.
110. VITRO — Nems-Clarke FIM-135 field-intensity meter is described.

### TRANSMITTERS & ASSOCIATED EQUIPMENT

111. CCA — Catalog sheets have reference to Model AMF-1D AM frequency monitor, Model AMM-1D AM modulation monitor, and Model SC-1D FM subcarrier generator.



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## Professional Services

**VIR JAMES**  
CONSULTING RADIO ENGINEERS  
Applications and Field Engineering  
345 Colorado Blvd.  
Phone: (Area Code 303) 333-5582  
DENVER, COLORADO 80206  
Member AFCEC

**JAMES C. McNARY**  
Consulting Engineer  
National Press Bldg.  
Washington 4, D. C.  
Telephone District 7-1205  
Member AFCEC

**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

**CRYSTAL AND MONITOR SERVICE** — Frequency change and repair service for AM monitors including G.R., RCA, Gates, W.E., and Doolittle; also H-P 335B FM AM monitors bought and sold. What have you, what do you need? New or regrinding of AM crystals for RCA, Gates, Bliley, W.E., and J-K oven holders, repairs, etc. Fastest service, reasonable prices. Over 25 years in this business. Eldson Electronic Co., Box 96, Temple, Texas 76501, Phone 817 773-3901. 2-67-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 fifteen 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

**CO-AXIAL CABLE** Helix, 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

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

**OBSOLETE TUBES**—80% discount — 6SD7, 7E6, 19V8, 1616, DF91, 6C8, 6J7, 6L7, 12K8, 14H7, 14R7. Large variety of other obsolete numbers. List free. H. Goldman, 28 Joseph, Bethpage, N.Y. 11714 10-66-6t

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

**"AUDIO EQUIPMENT** — Whatever your needs, check us first. New and used. Ampex, Altec, AKG, EV, Fairchild, Neumann, Langevin, Rek-O-Kut, Uher, Viking. Send for equipment list." Audio Distributors, Inc., 2342 S. Division Ave., Grand Rapids, Michigan 49507 6-66-6t

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

Everything in used broadcast equipment. Write for complete listings. Broadcast Equipment and Supply Co., Box 3141, Bristol, Tennessee. 11-64-tf

**RADIO AND TELEVISION STATIONS** for sale in all parts of United States. Qualified buyers may receive further details by writing to Inter-Media Communications Corporation, 246 Fifth Avenue, New York, New York 10001. 1-67-12t

For Sale: Fairchild Stereo Conax for FM control of modulation. \$350. KPEN, 1001 California, San Francisco, California. 1-67-2t

**50 KW-HG Westinghouse transmitter.** Good condition. For full description write Manager, WPTF Radio Company, Box 1511, Raleigh, N. C. 2-67-2t

**G. E. Phono cartridges** for broadcast use. Prompt service. Send for price list. Ridge Audio Co., 91 E. Lake Rd., Skaneateles, N.Y. 13152. 2-67-4t

**For Sale:** 129 foot AM Radio Tower 20 years old, 21 sections, approximately 20' to a section. Galvanized steel construction, insulated guy wires, guy and bottom section of tower 12 years old. John J. Duane Co., Inc., 600 Southern Artery, Quincy, Massachusetts 02189. 2-67-1t

**IMMEDIATE SALE**—1-510 ft. Dresser-Ideco Company TW 5-50 AB television transmitting tower, including marker lights and one beacon, one flasher, one photoelectric cell, and approximately 10,000 ft. of guy lines with insulators. 2 RCA-MI 27791-3 elbows. 720 ft. of RCA-MI 27791-1A transmission line. Complete package \$18,648.12, excellent condition, ready for destination. Contact Harry Ladas, Exec. V-Pres. & Gen. Mgr. of Wagenvoord Broadcasting Company, 611 N. Rampart St., New Orleans, Phone 504 529-7516. 2-67-1t

**Bird Model 693 R.F. Wattmeter.** Guaranteed like new with \$150.00 extra accessories. Price \$369.00. Write for details. Glen Ritchie, Box 26, Salem, Virginia 24153. 2-67-2t

**One RCA TK-41C Camera Chain,** nearly new, plus four RCA TK-31-A1 Camera Chains, in first-class condition. Dept. 167, Broadcast Engineering. 2-67-1t

**1 4-section Collins ring FM antenna** tuned for 99.7 meg. mounted on 1-5/8 inch rigid transmission line. Will need a good cleaning up and new de-icer heater elements. Best offer. 2 GL-2H21 Phasitron Tubes—1 new and 1 used but OK. Best offer. Contact David McGowan, Chief Engineer, KWPC, Muscatine, Iowa. 2-67-1t

**TWO MODIFIED RCA TK-40A COLOR CAMERA CHAINS** in working condition. Exceptional value. Immediate delivery. Write P.O. Box 18131, Tampa, Florida 33609, or phone area 813, 253-0447, Tampa. 2-67-1t

**TALL TOWERS,** Guyed. Self-supporting, Inspections—Registered Engineer, Antenna, Towers repairs and painting. Globe Industrial Contractors, Inc. Henderson, Kentucky. AC 502-827-1831 2-67-1t

## EQUIPMENT WANTED

**We need used 250, 500, 5K & 10K Watts AM Transmitters.** No Junk. Broadcast Equipment and Supply Co. 1314 Iturbide St., Laredo, Texas 78040. 3-66-tf

**WANTED TO BUY** — Used MacKenzie Program Repeater equipment regardless of condition or age. Write with details. Box 168 Broadcast Engineering. 2-67-2t

## EMPLOYMENT

**Free Meals and Lodging** save your Pay. Technicians needed Caribbean Island Tracking Stations, and Cape Kennedy. Information \$1.00. Research, Box 334C, Cape Canaveral, Fla. 32920 2-67-1t

**NEEDED IMMEDIATELY:** experienced TV Broadcast Engineers with first phone for expanding staff of WTMJ-TV, Wisconsin's leading AM-FM-TV broadcast facility. Pioneers in color broadcasting. Presently operating from new studios with latest color equipment. Excellent pay and benefits when you work for this employee owned company. Call or write to Chief engineer, WTMJ-TV, Milwaukee. (414) 271-6000 2-67-2t

**WANTED:** Technicians for RCA closed circuit television—systems planning — color television — video tape — TV cameras — maintenance — sales engineers etc. RCA representative, 143-08 94th Avenue, Jamaica, New York, 212-297-3336 9-66-tf



## OVER-SEAS OPPORTUNITY

International television organization is presently seeking engineer applicants for near-east and far-east projects.

Minimum 5 years maintenance and operating experience in such positions as Chief, Transmitter, Mobile Van and Studio engineer.

Professional challenge with growth opportunity; Overseas benefits and congenial associates. 2-67-1t

BROADCAST ENGINEERING  
Box 170, 4300 W. 62nd St.  
Indianapolis, Indiana

## PROJECT ENGINEERS

Project Engineers, all levels for challenging assignments in the design of audio, video & control facilities for color TV studios. BSEE and minimum of 2 years experience, preferably in broadcasting, required.

Location: CBS Headquarters  
Building, midtown Manhattan

Please send resume and salary requirements, to:

WILLIAM JR. REILLY, JR.  
Personnel Dept.

COLUMBIA BROADCASTING  
SYSTEM, INC.  
51 W 52 St., N.Y., N.Y. 10019  
12-66-3t

## TELEVISION ENGINEERS

We are interested in contacting Station Engineers capable of design or field engineering. Excellent opportunities in TV Development Engineering and Systems Engineering with Sarkes Tarzian, Inc., Broadcast Equipment Division.

TV station engineering experience required, BSEE or equivalent desirable. Send resume of experience, or call, Mr. Biagio Presti, Broadcast Equipment Division, Sarkes Tarzian, Inc., Bloomington, Indiana, Area Code 812, 332-7251.



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**RADIO ENGINEERS** — Earn extra money part time. P/M Associates is national headquarters for contract engineering services. Many current openings for 1st class engineers. For full information write: Personnel Manager, P/M Associates, Inc., 203 Pond Street, Natick, Mass. 01760. 2-67-3t

**WTOC-AM-FM-TV**, Savannah, Georgia, has opening for first class engineer with experience. Reply by letter to Chief Engineer, WTOC, P.O. Box 858, Savannah, Georgia 31402. 2-67-3t

**TELEVISION SYSTEM SPECIALISTS** — Positions open on the Apollo Program with General Electric at Cape Kennedy, Fla. Duties include adequacy reviews of TV installations at the launch site, liaison work in support of operational TV systems used for checkout and launch of space vehicles, preparation of installation and test procedures for TV systems, support of design and system engineering on all television installations. BS degree preferred, but not essential; or U.S. diploma with industrial training school or training courses desirable. 4 years' industrial experience desirable with at least 1 year's work involving television or communication systems. Write to: Mr. F. G. LaMotte, Apollo Support Dept., General Electric Co., Room 1180-B, P.O. Box 2500, Daytona Beach, Fla. 32015. (An equal opportunity employer, M/F.) 2-67-1t

**AUDIO COMMUNICATIONS SPECIALISTS** — Work on the Apollo Program with General Electric at Cape Kennedy, Fla. The position involves working with operational intercommunication and paging systems required for checkout and launch of space vehicles, and includes launch readiness reviews, design modifications, and component analyses. BS degree preferred, or U.S. diploma with 4 years' industrial experience including 1 year experience in communication and special audio systems. Write to: Mr. F. G. LaMotte, Apollo Support Dept., General Electric Co., Room 1180-B-1, P.O. Box 2500, Daytona Beach, Fla., 32015 (An equal opportunity employer, M/F.) 2-67-1t

## EXPERIENCED CATV ENGINEER WANTED

System to begin construction. Located out of Pittsburg, Pa. Area.

Send Resume

BROADCAST ENGINEERING  
Dept. 169 2-67-2t

**TV technician** for operating helical scan VTR, studio video and audio equipment. Some maintenance. Experience preferred. Complete benefit program. Degree work possible. Instructional Broadcasting, Eastern Michigan University, 15 Sill Building, Ypsilanti, Michigan 48197. 2-67-1t

**REPRESENTATIVES WANTED** — Large established Eastern Manufacturer needs representatives for FCC TYPE ACCEPTED AM and FM broadcast transmitter line. Selected territories available throughout U.S. Established broadcast equipment representatives preferred, but will consider individuals in related areas of the broadcast field. Interested parties are requested to reply to Mr. L. K. Peetoom, American Electronic Labs, Inc., P.O. Box 552, Lansdale, Pa. 19446. 2-67-2t

**Job Headquarters** for all Radio and Television Engineers. Immediate openings exist in 9 western states and elsewhere for qualified engineer and technical personnel. All categories from trainees to experienced transmitter maintenance, chief, assistant chief, live color video maintenance and technical operations. Send us your complete resume now. The AMP'S Agency, 3974 Wilshire Blvd., Los Angeles, California 90005. Telephone DU 8-3116. By Broadcasters — For Broadcasters 11-tf

## Broadcast Equipment Marketing & Field Sales

A leading producer of broadcast communication equipment operating on a continuing planned growth program requires the addition of several new personnel in marketing.

### Product Management

High level marketing position requiring marketing and sales experience in communication equipment. Involves product planning, technical proposals and other marketing management functions. Requires college degree and at least ten years' experience. Top salary plus incentive bonus.

### Export Sales

Sales manager position for export of communication equipment. Must be college graduate with proven sales ability, technical background and 2-5 years export experience. Fluency in Spanish or French desirable. Salary and bonus commensurate with experience.

### Field Sales

Travel and sell electronic communications equipment primarily to AM, FM, and TV stations in exclusive territory. Must be a sales minded self-starter. BSEE or equivalent plus a minimum three years in field of radio broadcasting. Excellent salary plus commission.

To receive complete information concerning the position, company and community send resume to Dept. 171, Broadcast Engineering.

## TV ENGINEERING PLACEMENT ALL EMPLOYER PAID FEES

Check Area of Interest

- Director of Eng. ....   
Xmtr supervisor .....   
Studio supervisor .....   
Xmtr technician .....   
Studio technician .....   
Video tape technician .....   
Allied fields .....   
Other .....

Name.....

Address.....

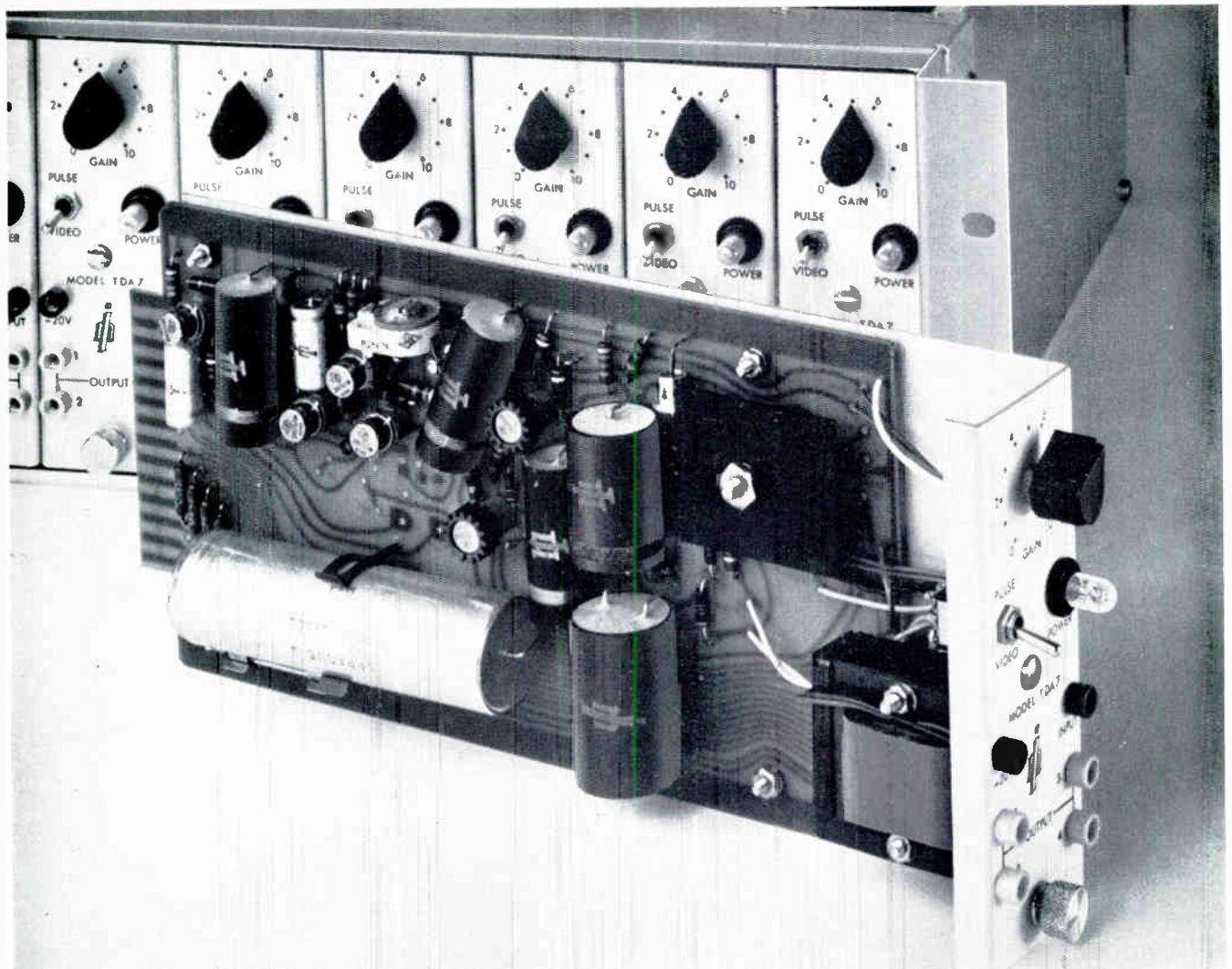
Salary Desired.....



Broadcast  
Personnel  
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PLEASE INCLUDE A RESUME



## Will history repeat itself -- again?

Six years ago, International Nuclear introduced the TDA2 Distribution Amplifier to the television industry. This first transistorized unit became the standard of excellence for transistorized distribution amplifiers.

A long line of transistorized units for television and other industries has followed. From this history of excellence comes the TDA7 Plug-In Transistorized Video/Pulse Distribution Amplifier.

Each TDA7 plug-in unit contains its own built-in regulated power supply and serves both video and pulse distribution

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TDA7 .....	\$295.00
TDA9 (with sync-add feature) .....	\$320.00
TMF7 Mounting Frame .....	\$270.00
TME7 Module Extender .....	\$ 70.00
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 615 - 254-3365



"Transistorizing  
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