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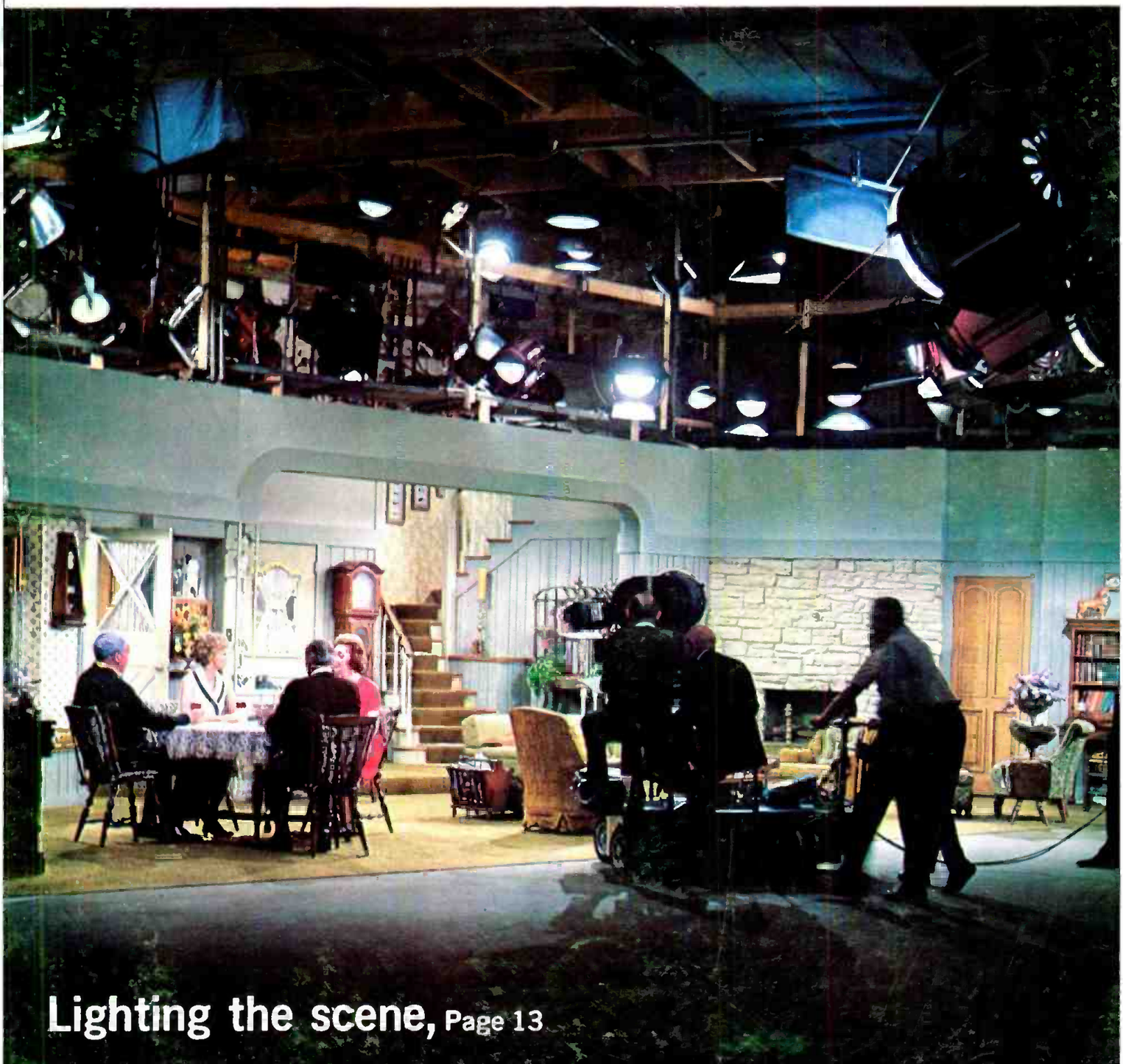
July, 1969/75 cents

Broadcast Engineering

the technical journal of the broadcast-communications industry



Lighting the scene, Page 13

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July, 1969 • Volume 11, No. 7

Broadcast Engineering

The technical journal of the broadcast-communications industry

in this issue...

Lighting The Scene. A basic background in lighting, designed to eliminate "the sledgehammer approach" to lighting. Includes definitions and rules of lighting applicable to TV and CATV. **Morris Courtright.**

TV Proof Of Performance. Part 3 of a 3-part series on Proof of Performance. The author uses the system approach, covers the FCC Rules, and tells how to package Proof findings. **Patrick Finnegan.**

Roll Your Own . . . High Voltage Silicon Rectifier Stacks. A description of how stacked rectifiers were used at WCKY in order to aid in the building of solid-state stacks that can replace bulky rectifier tubes. **James F. Ranney.**

Building A Simple EAN Receiver. How to modify a common 5-tube radio for use as an Emergency Action Notification receiver. Changes require no external circuitry and no additional tubes or transistors. **Ronald Pesha.**

Using FET's And IC's . . . Gain Control Revisited. Taking advantage of solid-state components in the design of gain control circuits. **Walter Jung.**

A Problem In Stability . . . Improving The KFGO Antenna. The story of what one station did to cut down on engineering time on their 20-year-old antenna and at the same time improve their operation according to FCC standards. **Robert A. Jones.**

ABOUT THE COVER

This month's cover picture was taken on the set of "The Mothers-In-Law" TV show. The basic problems of lighting a room or set are covered in "Lighting The Scene," beginning on page 13. Photo courtesy of **Sylvania.**

DEPARTMENTS

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Robert E. Hertel, Publisher

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LETTERS TO THE EDITOR

Dear Editor:

My heartiest congratulations to Raymond F. Guy whose story appeared in the "People in the News" section of the February 1969 issue, regarding his longest experience in broadcasting of any person in the world.

I, too, started about that time, and as an engineer, helped install and wire the master control board and studio equipment for WJB and WEAF at their new headquarters at 711 5th Avenue, New York City. I also fiddled around radio in 1912, (when the Titanic hit an iceberg and sank) and one of my friends heard the news of the disaster. I was fourteen at the time and am now 71 years old.

I am a member of the Pacific Pioneer Broadcasters in Los Angeles, and although retired, am still active as consulting engineer to several radio stations here in San Diego. I guess this makes me #2, and again I say, "Good Luck, Guy," and many more years for us both. Drop me a line.

Warren T. Abbott
16589 Casero Road
San Diego, Calif. 92128

Dear Editor:

I am writing in reference to the article entitled "FM Proof of Performance" which appeared in the May 1969 issue of **Broadcast Engineering.**

On page 16, the writer states under paragraph entitled "Additional Test Setup," to feed the AC calibrating voltage to the noise meter, remove the AC and feed the rectified DC voltage to the noise meter and measure noise in the usual manner.

It appears to me that a step is omitted between the time the AC is fed to the noise meter and the time the DC is applied. Before removing the calibrating AC voltage from the noise meter, it would appear that the noise meter function switch should be placed in the "Calibrate" position and the input control adjusted to full scale or calibrate point on the meter of the noise measuring unit. Now the AC may be removed, and the DC voltage applied, and noise (AM) measured on the lowest scale where a reading may be obtained.

Keep up the good work on a great magazine.

Antonio Vaccaro
Chief Engineer
Portsmouth, New Hampshire

Network Relays

Dave Schick author of "Building An Audio Network Control Unit" (May, 1969) has asked that we pass along the following.

1. Fig. 1 on page 48. Relays 1 and 2 should be shown in the energized position, with continuity between pins 1 and 3 and also 8 and 6 in each relay.

2. Fig. 2 on page 49. Relay K3 should be shown with the movable arms up providing continuity between pins 1 and 4 and also pins 5 and 8.

3. Page 52, last paragraph of column one. Second sentence should read: When a 1000 cycle START tone is received from the network line, advance the sensitivity control R1 until K3 closes and indicator lamp I1 comes on. The relay should have been shown as K1. Also, when a 400 cycle STOP tone is received, the sensitivity control R2 is advanced until K3 is de-energized and lamp I1 goes out.

And just for the record, WGTO news director is at the controls on page 53. Reprint requests already are coming in, and these changes will be made.

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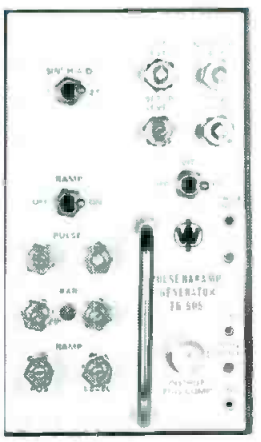

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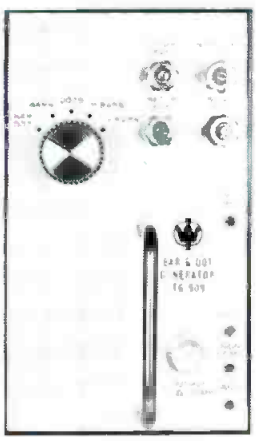

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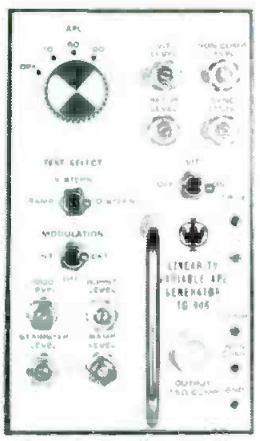

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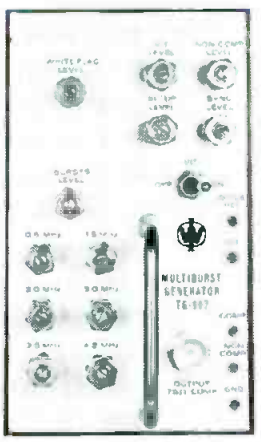

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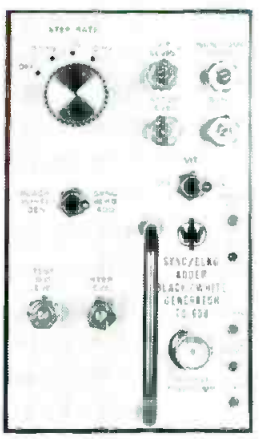

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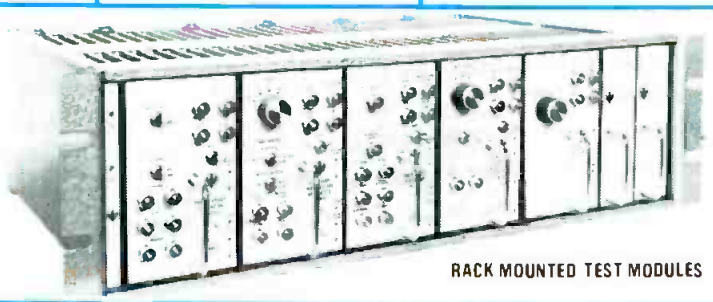

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INDUSTRY NEWS

FCC Changes License Renewal Filing Date

Competing applicants and parties wishing to file petitions to deny broadcast license renewals will have to submit their filings no later than the first day of the last full month of the license period under new license renewal rules adopted by the Federal Communications Commission. The rules also require the licensee to announce publicly that he is filing for renewal within six weeks of the date when the renewal application is due. (Renewal applications must be filed ninety days before a license expires).

Previously, competing applicants and petitioners to deny could file right up to the day before the Commission acted on the renewal application and local public notice followed the actual filing instead of preceding it.

Also under the new rules, if a license renewal application is not filed on time, competing applicants and petitioners have 60 days, following Commission announcement of acceptance of the renewal application for submission of applications and filings.

The new rules are in a Report and Order amending Sections 1.580, 1.227, 1.516, 1.571, and 1.591 of the Rules and Regulations (Docket 19495). All stations whose terms expire on or after August 1 come under the provisions. June 25, 1969, is the cut-off date for stations with applications still pending for renewal of licenses expiring on or before June 1.

The Commission put forward its new rules in a Notice of Proposed Rule Making, released on March 20, 1969. In response to comments by respondents, the Commission said that local publication before filing would have the advantage of permitting a licensee to repeat a public announcement in the event his filing has been returned as defective, and would also allow more time for assembling renewal applications.

In response to comments from respondents asking that competing applications be filed on the same date that the renewal applications are due, the Commission said that it was "questionable" whether later filing gave competing applicants any "significant advantage."

Fixing the cut-off date on the first day of the month before the license term expires would, the Commission said, leave it free to act on renewal applications at any time during the last 30 days of the license period. It maintained that permitting competing applications and petitions to be filed past this cut-off date would impede orderly processing procedures.

NAB And RIAA Form Joint Committee

The National Association of Broadcasters and the Record Industry Association of America have jointly announced establishment of a liaison committee to provide a channel of communications between the two organizations.

The establishment of the committee was announced by Charles M. Stone, NAB vice-president for radio, and Henry Brief, executive director of RIAA.

In a statement, the two men said: "This joint industry committee will concern itself with matters involving either or both industries where one might assist the other. In this manner a line of communication will be established so that each interest knows what the other is thinking and doing, thus enabling a more effective area of mutual planning to meet the challenges of both programming and production of recorded music as used in radio."

Stone said the following broadcasters will represent NAB: Robert L. Pratt, KGGF, Coffeyville, Kans.; Dan Hayslett, KIXL, Dallas, Tex.; Lester M. Smith, KJR, Seattle, Wash,. and Erny Tannen, MEDI-American Stations, Silver Spring, Md.

Brief announced that the following will represent RIAA on the committee: Stanley M. Gortikov, Capitol Records, Hollywood, Calif.; Jac Holzman, Elektra Records, New York, N.Y.; Hal Neely, Starday Records, Hendersonville, Tenn., and Jerry Wexler, Atlantic Records, New York.

FCC To Use New FAA Form

The Commission has amended Parts 1 and 17 of the Rules to designate the use of a new Federal Aviation Administration form. The amendments became effective on April 18, 1969, and were made under Sections 4 (i) and 303 (r) of the Communications Act, and under Section 0.261 of the Rules.

FAA Form 117 "Notice of Proposed Construction or Alteration" (notification of proposed antenna structure construction or alteration) was recently revised by the FAA and re-designated FAA Form 7460-1. On December 11, 1968, Subpart B of Part 77 of the FAA Regulations was amended (effective February 1, 1969) to revise the reference to the form on which notices of proposed construction or alteration are filed to reflect the new form number.

Sections 1.61(c), (d) and (e) of Part 1 and Section 17.4(a), (b) and (c) of Part 17 of the Commission's Rules refer to the filing of Form FAA-117. Since this form is now specified as FAA Form 7460-1, the Rules are amended to note the use of this new form.

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NAB Asks FCC to Drop Proposal For Land Mobile Reallocation

The National Association of Broadcasters has told the Federal Communications Commission that it could ease congestion in the land mobile radio services by requiring proper management practices and therefore should drop its proposal to reallocate TV frequency space for that purpose.

The Commission is considering a reallocation of ultra high frequency (UHF) channels 14 through 20 within the 25 largest urbanized areas, to land mobile use.

In comments filed recently by Douglas A. Anello, general counsel, and John B. Summers, assistant general counsel, NAB said an interim report by the Stanford Research institute, commissioned by the FCC, clearly demonstrates that land mobile congestion is attributable to improper frequency assignment principles rather than a lack of adequate frequency spectrum.

The report's significant findings, NAB said, show that:

- The distribution of users among land mobile channels was found to be seriously inequitable. Some channels showed peak occupancy levels of 80 to 100 per cent, while other channels showed only peak levels of 10 to 20 per cent.
- There is no meaningful correlation between the peak occupancy of a frequency and the number of transmitters licensed for that frequency.
- The FCC records and the local coordinator records alone cannot be regarded as an adequate basis for channel assignment of users.
- Industry user groups and their frequency coordinators do not have the resources, the capability, or the basic mission to solve the radio spectrum problems which have become so acute in large urban areas or to perform effectively the task of regional frequency engineering and management.
- If improperly implemented, a concept of combined intra and inter-service sharing can eliminate most of today's channel congestion problems.

Because of these findings, NAB said, the Commission should abandon its spectrum reallocation proposals and correct the wasteful practices exposed by the report.

U. S. Court of Appeals Affirms FCC Action

Commission action of April 10, 1968, authorizing Vumore Video Corp. of Colorado to begin operation of a CATV system in Colorado Springs, has been affirmed by the United States Court of Appeals for the District of Columbia Circuit.

Pikes Peak Broadcasting Company, licensee of Station KRDO-TV, Colorado Springs, appealed the action, as did Metropolitan Television Company, former licensee of KOAA-TV, Pueblo and Sangre de Cristo Broadcasting Corp., KOAA-TV assignee. Chief Judge Bazelon concurred in part and dissented in part.

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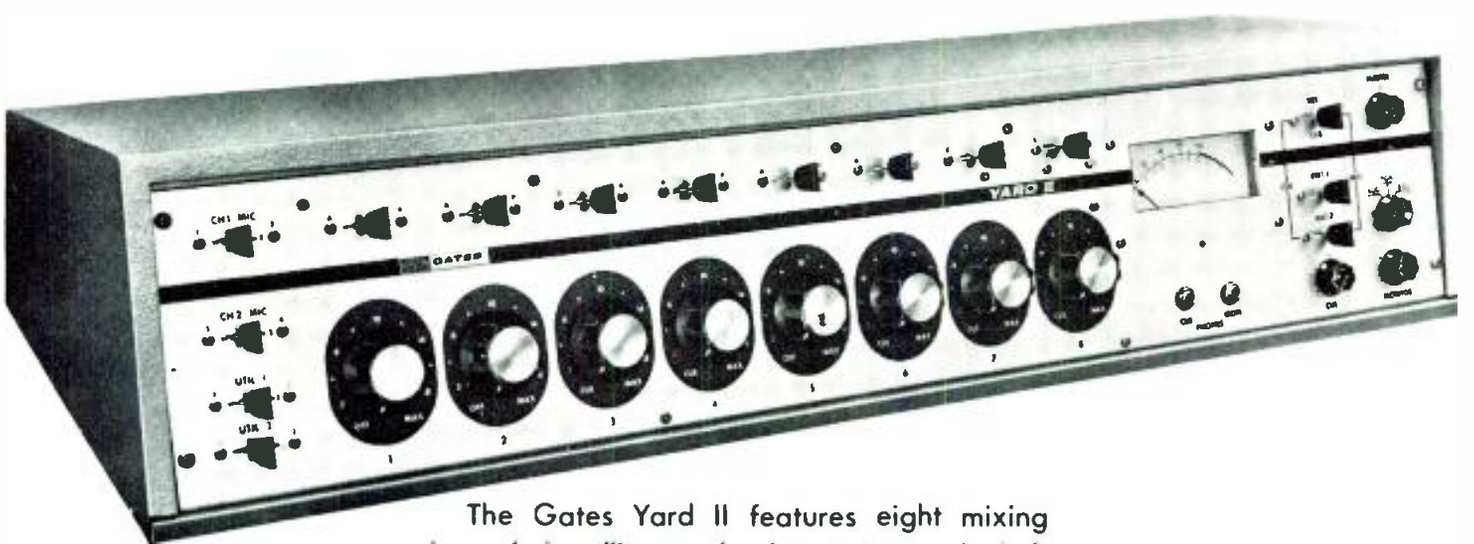

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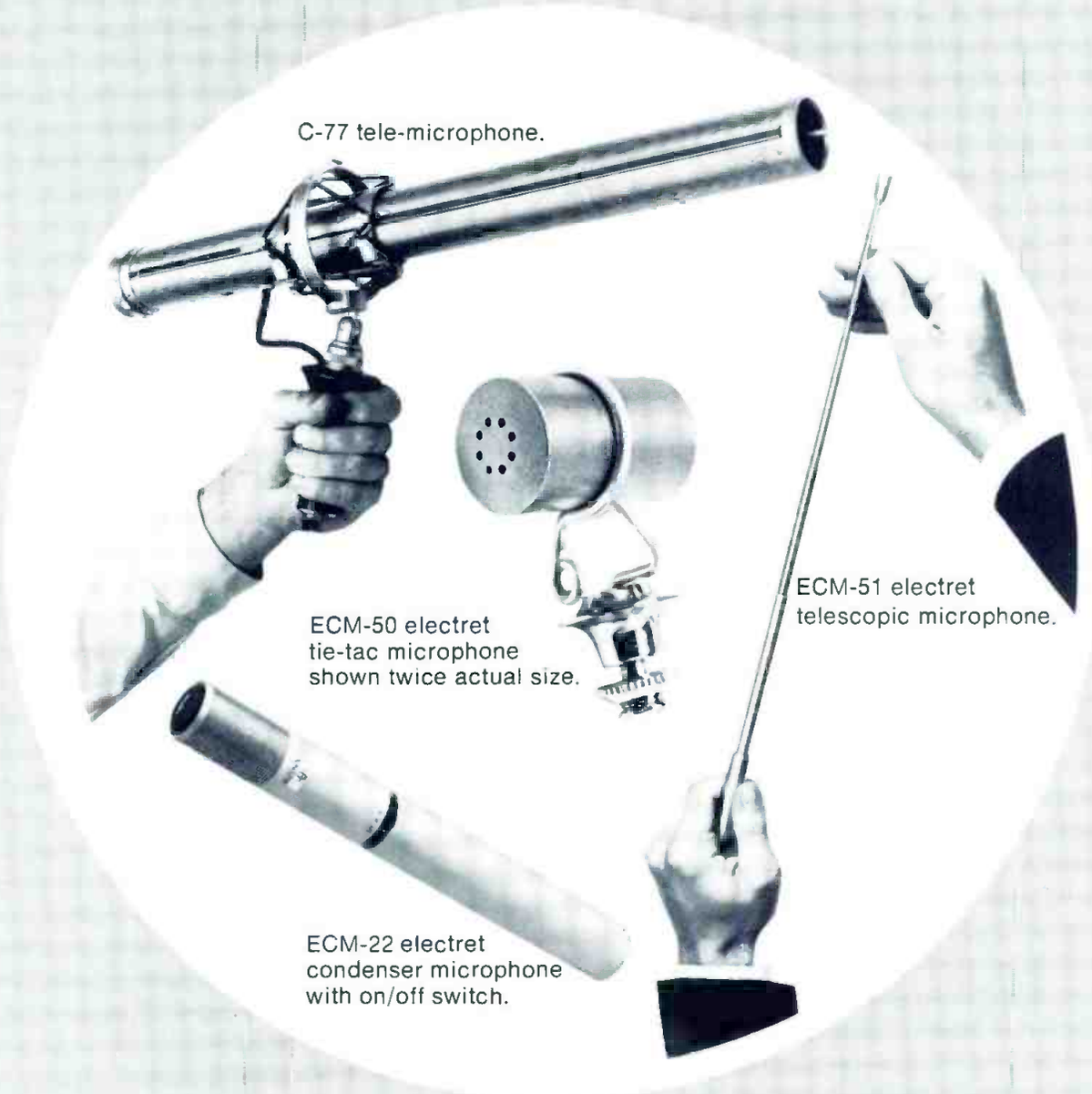

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LIGHTING THE SCENE

By Morris Courtright

Consulting Engineer,
San Jose, California

Primarily a visual art, television broadcasting involves application of lighting techniques similar to those used in theatrical productions. Television crews, however, are frequently faced with the additional problems of field or remote pickups where elaborate lighting systems are either impractical, or just not available. The day also arrives, sooner or later, when the studio lighting that was planned in such excruciating detail must be augmented on short notice for a special telecast.

As a result, station engineers rapidly become adept at brewing up conglomerations of lights, cables and plug boxes; and slowly become hunchbacked from lugging large banks of lights. This is particularly true if the "sledgehammer to drive a tack" approach is used to be sure such gremlins as Vidicon trailing are eliminated. Improved camera tubes have alleviated these problems considerably and acceptable pictures can be obtained at levels as low as 20 footcandles (some below 10 footcandles); however, most telecasters insist on broadcast quality pictures. Roughly translated this means 150-250 footcandles for monochrome and up to 350-500 footcandles for color. Add the rules of thumb such as 25 to 1 contract ratio, or key-lighting or backlighting ½ to 1½, and many engineers automatically throw in a car trunk of extra lights "just in case"... which is great until the fuses and circuit breakers start popping.

A solution, of course, is to employ an electrician to worry about such details as wire or fuse size, number of lighting circuits and the National Electrical Code. Lacking this, the all-capable station engineer becomes the expert and moves from the realm of milliamps and decibles to watts per square foot, footcandles and lumens.

The problem essentially is to convert the camera tube footcandle requirement into light bulb wattages and circuit sizes. Many textbooks have been written, and the number of guidelines are in direct proportion to the number of lighting experts involved. A few basic rules do exist, though, that the station engineer can use to solve his immediate problem (and most likely generate a few more guidelines of his own).

Nomenclature And Terminology

Camera specification sheets will include a sensitivity figure such as 150 footcandles for studio quality. Now, the footcandle is a unit of illumination: one lumen on a one square foot area. So what is a lumen? That is a unit of luminous flux (time rate of flow of light): the flux in a unit solid angle from a one candle point source. Unit solid angle is easy; that is the angle that intercepts a one square foot area on the surface of a one foot radius sphere.

By now you should be properly confused. Fig. 1 shows the relation between footcandles, lumens and candles. Recall that a magnetic field has both a flux density (B) in Gauss and a flux intensity (H) in Oersted and the clouds may clear a little. The important point to keep in mind regarding units is the difference between measuring illumination and brightness.

The brightness of an object is the illumination falling on it multiplied by the reflectance of the object. Footcandles are a measure of illumination and footlamberts a measure of brightness. A footcandle is one lumen per square foot of light falling on or illuminating a surface and a footlambert is one lumen per square foot being emitted by or reflected from a surface. Another term is candlepower — the brightness measured in candles, and 1 footlambert = 3.142 candles per square foot.

Still a bit confusing? No matter, our purpose is to go from footcandles to watts without being an illumination engineer. The two classes of lighting normally encountered are general interior illumination and floodlighting. Calculating interior light levels involves lamp lumens, luminaire coefficient of

utilization and depreciation factor to account for dirt and old age.

$$\text{Lumens Required} = \frac{\text{Footcandles X Room Area (ft}^2\text{)}}{\text{Coeff of Util X Deprec Factor}}$$

The footcandles are established by camera requirements and the room area by the size of the room involved. The Coefficient of Utilization and the Depreciation Factor are empirical data obtained from manufacturer's specifications or various handbooks. Typical Depreciation Factors are 0.60 to 0.65 for indirect or semi-diffused and 0.70 to 0.75 for direct light fixtures. The Coefficient of Utilization depends on luminaire or fixture design, size of the room and reflectance of the walls and ceiling. Fig. 2 shows typical values for semi-diffused fluorescent fixtures installed in a medium light-colored room.

Now that we can calculate the

Fig. 1 Relation of candle, footcandle and lumen: 1 footcandle is 1 lumen per square foot, or the light from a 1 candle source falling on 1 square foot of a 1 foot radius sphere.

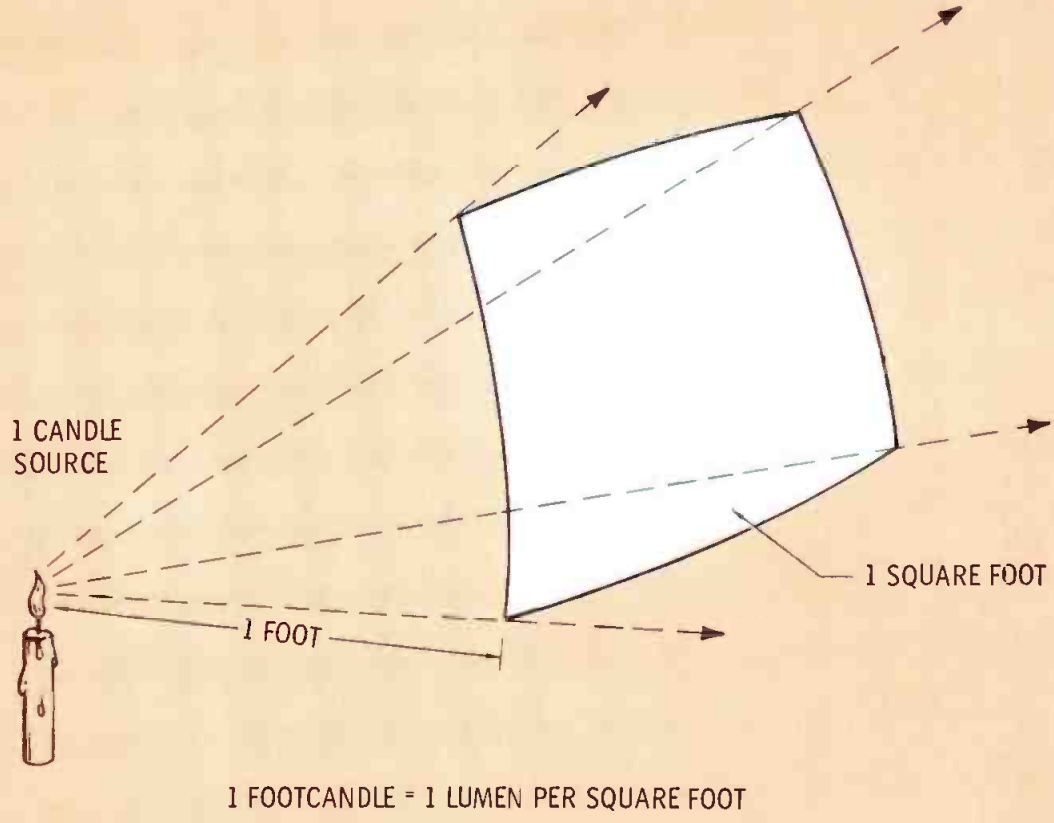
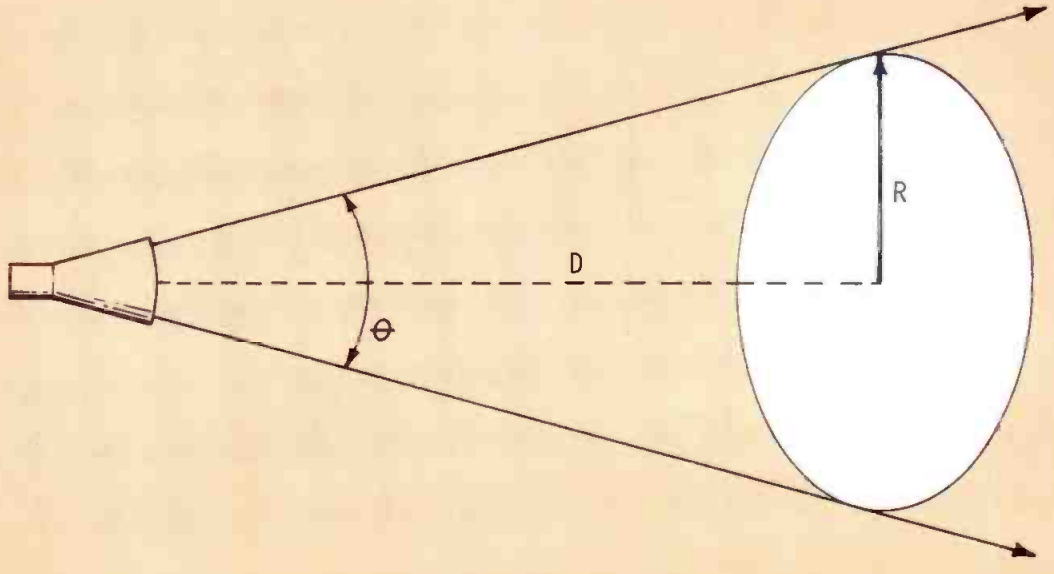


Fig. 4 A lamp beam of angle O will cover a circular area of radius R at a distance of D.



lumen requirements, the final step is to convert to watts. Once again we must refer to specification sheets or handbooks. Lumen output per watts depends entirely on bulb design and construction. Fig. 3 shows a few common outputs.

Thus to achieve a 150 footcandle light level in a 10x20 foot room with an 8 foot ceiling and fluorescent fixtures:

$$\text{Lumens} = \frac{150 \times 200}{.37 \times .65} = 125{,}000$$

If each fixture has four 100 watt tubes, fixture output is 19,600 lumens. Dividing, we find that six of these fixtures will just about provide the light we need. At the same time, six fixtures at 400 watts each tells us we must provide 2400 watts for lighting.

Room Ratio	Wall Reflectance* 50%	30%	10%
0.8	.37	.32	.30
1.0	.43	.38	.35
1.5	.50	.46	.43
2.0	.54	.51	.48
2.5	.57	.54	.52
3.0	.59	.57	.54
4.0	.61	.59	.57

*ceiling reflectance assumed to be 50%

$$\text{Room ratio} = \frac{\text{width} \times \text{length}}{\text{height (width} + \text{length)}}$$

Fig. 2 Typical Coefficient of Utilization factors. The coefficient of utilization is the ratio of the lumens falling on a surface to the total lumens emitted by the light source.

Watts	Bulb	Lumens
100	Inside frosted	1600
150	Inside frosted	2700
200	Inside frosted	3700
300	Inside frosted	6000
150	Reflector Flood*	1500
150	Reflector Spot#	800
300	Reflector Flood*	2900
300	Reflector Spot#	1700
20	24" cool white	1100
30	36" cool white	1900
40	48" cool white	2700
100	60" cool white	4900

*115° beam #35° beam

Fig. 3 Typical lamp outputs. Flood and spot outputs primarily are confined to the beam angle while other lamp outputs spread spherically.

Floodlighting Calculations

So much for general illumination levels. The second item of interest is floodlighting calculations. The simple method is to use floodlights or spots rated in candlepower. Typically, a 375 watt photoflood has about 14,000 candles in a 10° beam. Then:

$$\text{Candlepower needed} = \text{Footcandles} \times \text{Distance}^2$$

Since many common lamps are rated in lumens, a different approach is needed. Looking at Fig. 3 again we see that a 300 watt "garden variety" reflector flood produces about 2900 lumens in a 115° beam.

Referring to Fig. 4, a beam will cover a circle with a radius R = D Tan 0/2. The area covered is:

$$A = \pi R^2 = \pi (D \text{ Tan } 0/2)^2$$

Since footcandles are the lumens divided by the area covered:

$$Fc = \frac{\text{Lumens}}{\pi (D \text{ Tan } 0/2)^2}$$

And with a little formula juggling:

$$\text{Lumens} = Fc \, \pi (D \text{ Tan } 0/2)^2$$

So, to obtain a 150 footcandle level with common 300 watt reflector floods at 10 feet:

$$\text{Lumens} = 150 \times 3.142 \times (10 \times 0.637)^2 = 19{,}100$$

Since each flood is 2900 lumens: 19,100/2900 = 6.5 lamps. Now six and a half lamps are rather hard to come by, so we will settle for six 300 watt floors and put them a few inches closer than 10 feet. Once again we know how much power must be provided for lighting. In this case, 1800 watts. Note that if photofloods were used, one 375 watt unit might be sufficient. 150 footcandles X 10^2 = 15,000 candles, and the photoflood has 14,000 candles.

These calculations are only approximations, but then we are not trying to be illumination engineers or design a studio; merely making a quick calculation to meet a short notice need. Note also that this lighting is rather flat, and provisions should be made for modeling or highlighting. Placement of such lights falls more in the category of art, and is another subject by itself. An idea of the size required can be determined, however. If the overall light level is 150 footcandles, a highlight ratio of 1½ means a spot of 225 footcandles on the desired location. No need to go through extensive calculations though. Just take another 300 watt flood along and put it a little closer to the subject than those used for general illumination.

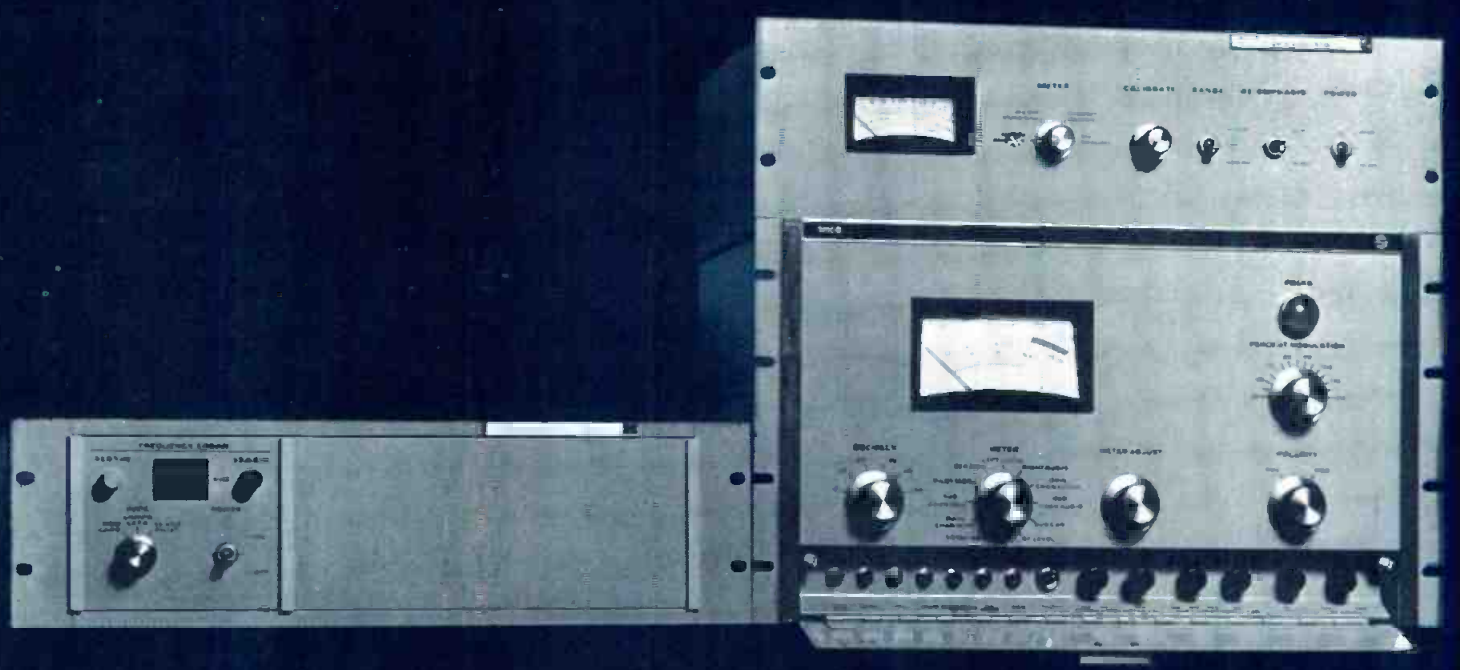
The methods outlined here can also be reversed to determine the footcandle provided by a particular lighting arrangement. It is much easier to use a light meter. Besides, if they are already installed and working, appropriate circuits already exist for them. Our purpose here is to estimate the lighting circuits needed for temporary or special purpose situations.

Once the lighting requirements have been established and rated in terms of the old familiar watts, circuit calculations become rather easy. Using the above example of 6 general floods plus 1 for modeling, 2100 watts must be supplied.

$$\frac{2100 \text{ watts}}{115 \text{ volts}} = 18.3 \text{ amperes}$$

A quick look at the National Electrical Code shows that such a load can be handled by #12, type K, S, SO or ST hard service flexible cord. All that remains is to attach heavy duty plug and receptacle to an appropriate length of wire, provide suitable fusing and you are on your way. ▲

NEW MONITOR PACKAGE



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900F-1 SCA Modulation Frequency Monitor The 900F-1, an all-solid-state unit, monitors and displays modulation and carrier frequency error on the 67-kHz SCA. Components are mounted on a single circuit board. No tuning or adjustment (which could affect accuracy) is required.

900C-3 FM Stereo Modulation Monitor The completely solid-state 900C-3 operates in the 88- to 108-MHz range, monitoring stereo or monaural operation. Plug-in circuit cards facilitate fault isolation. The unit requires minimum maintenance.

54N-1 Frequency Monitor The 54N-1 offers all-solid-state design, error detection for 0 through ± 2 kHz, fault display, and components mounted on high quality etched, glass epoxy boards. Convenient test points allow ease of maintenance.

For additional information contact Collins Radio Company, Broadcast Marketing, Dallas, Texas 75207. Phone: (214) 235-9511.

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A problem in stability

Improving the KFGO

By Robert A. Jones*

Like many other stations, KFGO has been on the air with the same directional antenna radiation pattern for about 20 years. Like many younger antenna systems, they have exhibited some variations in licensed parameters from time to time. Norris Pederson and the KFGO engineering staff found in recent years that more and more time was being required to comply with all the required values. It was decided that a study should be made of the existing system in order to determine steps which would improve stability, reduce the amount of maintenance time required by the KFGO staff, and lead to a more satisfactory FCC operation of the KFGO directional antenna. The following article contains the steps taken to meet these aims.

*Consulting Engineer, La Grange, Ill

Monitor Points

The first step was a study to determine what changes could be made to reduce the number of weekly monitor point locations to be measured and to establish points that would be more accurate barometers of changes in pattern shape.

Figure 2 shows the original KFGO pattern. The solid dots represent the original FCC Monitor Point bearings. As can be seen, several of these points are not positioned at either a pattern null or on the tip of a minor lobe. The open circles represent the new monitor point bearings. These new points were requested by us, and approved by the FCC staff. As the reader will note, the number of official monitor points has been reduced from five to four. And each point is now on a Null bearing on the tip of a minor lobe.

The KFGO directional antenna consists of three self-supporting towers equally spaced in a straight line, at a bearing of 357° true. This array is considered to produce an in-line symmetrical pattern. For all practical purposes the radiation pattern shape on the east side of the tower line is identical to that on the west side. Because of this universally recognized fact, we were able to delete the former 266° monitor point, it being symmetrical with the 88° point. Likewise, by establishing a new monitor point at 124°, we can predict the true operation at the 230° null. The old 118° monitor point has been moved to the true null at 124°, and the former 238° monitor point has been moved from near the tip of this minor lobe to the exact tip, 242°.

Some readers might ask, why didn't the FCC originally establish correct monitor points in nulls and on tips of minor lobes? This is what they do today. Did they originally goof? No, the FCC didn't. Rather, this highlights a change through the years in the Commission's policy with respect to establishing and selecting monitor point bearings. Years ago, and in most cases, it was a standard practice for the FCC to specify monitor points along bearings toward co-channel stations. The logic behind this approach is both reasonable and self-evident. The reason being, of course, to be certain the protections specified in the theoretical design toward stations to which objectionable interference

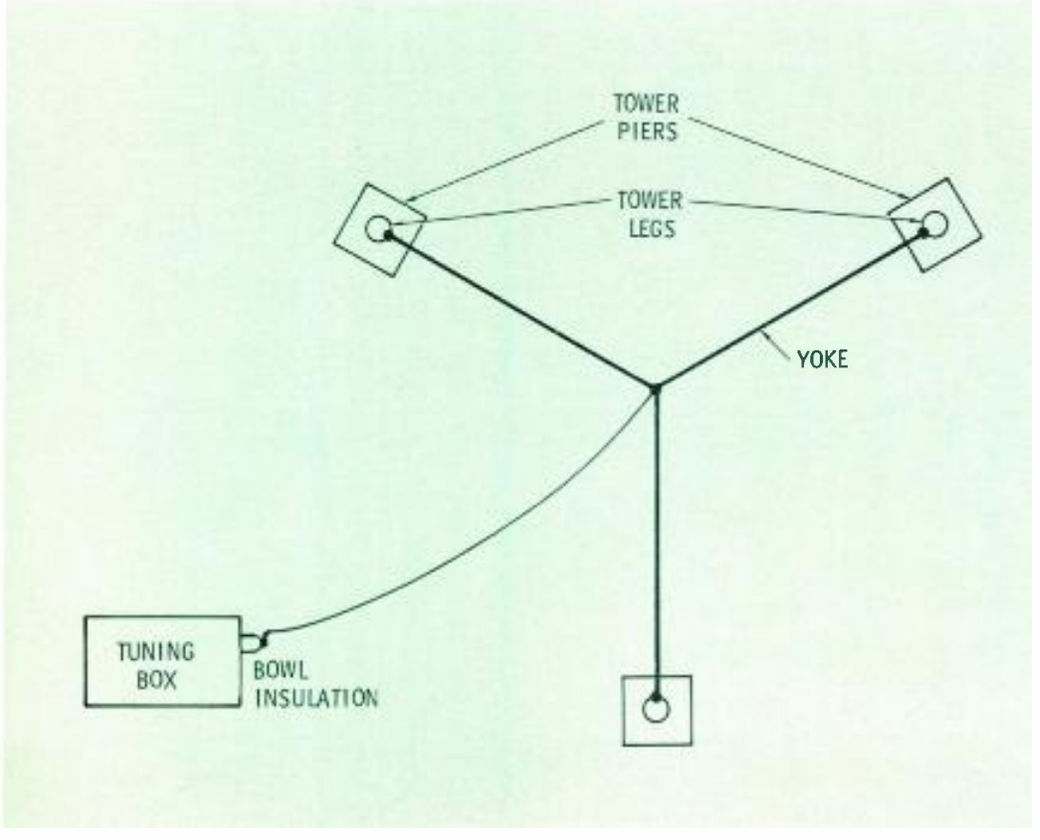

Fig. 1 The KFGO pattern. The solid dots represent the original FCC Monitor Point Bearings.

might result were met. The concern was more toward avoiding interference than it was toward achieving perfect pattern adjustments. Experience has shown that when monitor points are established on the side of a lobe, rather than at the tip or the exact null, there can be greater variations in the field intensity measured at the monitor point. It requires only a minor shift in any one parameter to slide the field intensity up or down a large amount, when it shifts along the side of a lobe. Also, it has often been found that true nulls might be on the wrong side of the monitor point bearing and there would be no way of determining nulls. The present method is better because it yields more accurate patterns.

Writing The FCC

Step Two was to forward a written request to the FCC to change the bearings of certain monitor points and to reduce the number from five to four. There is no standard application form to use. Sufficient data and information should be attached to your request letter to make it clear to the FCC staff just what you propose to change and why. It is also helpful to include a short statement concerning repairs, or improvements you propose to make in the antenna system.

Prior to beginning any such repairs, it is of course required that the reader apply for permission to operate by "indirect measurement of power" during the time repairs are made and other improvements installed.

Step Three

Step three was a physical inspection of the entire KFGO antenna system. This was done several months prior to the installation of repairs. The reason for this was to permit time for ordering some replacement parts and for more favorable weather. Winter in North Dakota is a poor time of the year to make repairs on towers, ground systems, and phasors.

This physical inspection revealed several areas that required improvement. It was found that numerous grounding straps along the rigid coax cable were broken or making poor ground connections. Several of the grounds within the tuning houses and under the towers were of the old copper braided wire type. These were replaced with copper straps. Additional copper straps were installed within the phasor to improve stability.

Another problem KFGO had always had concerned the antenna meter switches. The problem here, as with many other antenna systems, was that when the switch was engaged it would cause the tower current and phase angle readings to shift. This was more noticeable in the end towers than at the center tower. This problem is not uncommon with certain types of meter switches. Switches of the "shorting type" often cause this problem.

The author had corrected this same kind of problem at station KEVE. At KFGO and KEVE it was decided to replace the switches at all three towers with the inductive type. These newer switches add a small amount of inductance to the antenna circuit when the meter is in the "out" position. This inductance is the same as the amount introduced when the meter is engaged (due to lead lengths and meter shunts). The reason for constructing the switch this way is so that the antenna circuit will see the same lumped inductance regardless of whether the meter is in or out.

Phasor Problems

Another problem we encountered with the KFGO antenna system was in the phasor circuit. Several of the rotary coils used to tune the pattern were worn or hand arced so badly when tuning adjustments had to be made, that they were in need of replacement. These were replaced with coils of about the same value. In some cases we found we did not need to use as large a coil as originally installed. For example, one coil had been 32 microhenries, but only 12 microhenries were actually used. In this case we replaced it with a 15 microhenries coil. This saved money and physical size.

The branch currents in each part of the circuit were checked to determine the maximum values needed in replacing some of these old coils. It is obviously more economical to replace a 30 amp coil with a 10 amp coil if the branch current is only 6 amps. Likewise it is better to replace a 20 amp coil that had arced often, if its normal current were 18 amps, with a 30 amp coil.

In the case of KFGO, the original circuit design had been quite good, hence we made very few additions or deletions to it in terms of new parts. I have seen other systems where major improvements were called for in order to improve the system "adjustability" and efficiency. But at KFGO this was not necessary. We did change one or two of the previously tapped coils to rotary coils to add some ease to the pattern tuning.

One of the series phase circuits was modified by changing the series capacitor in order to achieve a wider plus and minus phase shifting ability. On the south tower there had been a single coil that was tapped in such a way that its inductance was used in both the input arm and the shunt arm of this Tee network. Any change in one tap would effect the other arm of this circuit. A second coil was installed to permit individual adjustments with the least amount of interaction between the two arms of this tower circuit.

In general, the changes and repairs to the antenna circuit phasing fall within one of three general areas. Either they were for replacing worn components, for improving flexibility of tuning and maintaining the pattern, or they were for the purpose of improving the pattern efficiency.

Lead Repairs

Another area where repairs were needed was in the leads connecting the tuning units to the towers. The original leads were badly corroded and in some places the fittings and hardware were rusty or loose. Since the three KFGO towers are self-supporting types, it was necessary to feed each leg of the three proportionally. Past experience has shown that in order to achieve the most circular radiation from this type of tower, one must feed each leg with the same amount of antenna current. This we did by constructing a yoke of ¾ inch copper tubing. Figure 2 shows how this was connected and constructed.

By feeding at the center of the yoke, we have equal currents in each leg. Another ¾ inch copper tubing was connected from this center point to the bowl insulator on the tuning unit, at each tower. The AC wires that connect to the tower lights were then wrapped to this copper tubing. The tubing does an excellent job of supporting the wires. The copper tubing was brazed and bolted to each tower leg and at the midpoint. In this way any resistance losses in these connections were eliminated.

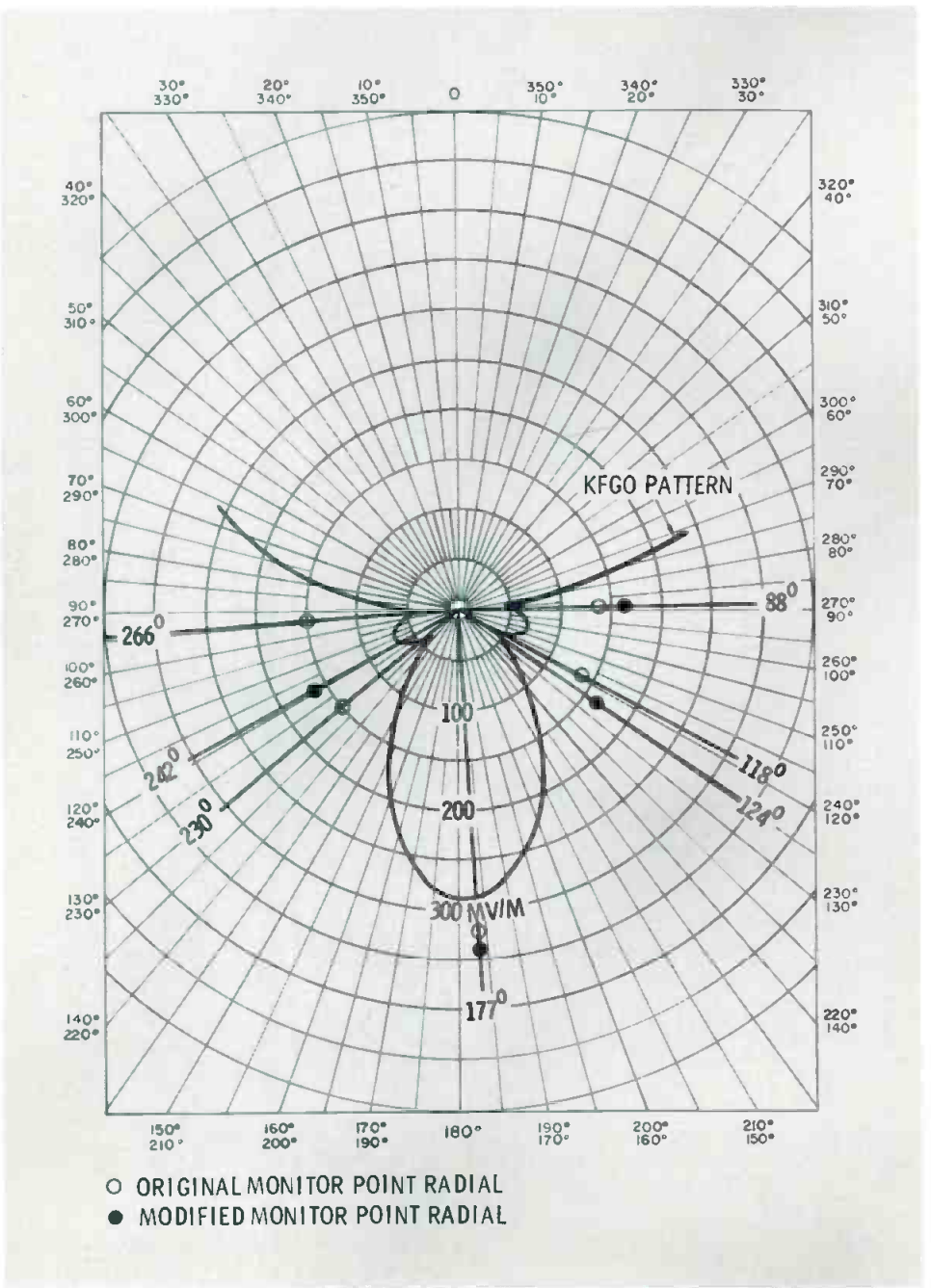

Fig. 2 Yoke was constructed of ¾ inch copper tubing and connected from the center point to the bowl connector.

Proof of Performance

Step four was to conduct a new non-directional Proof of Performance by taking field intensity measurements along the necessary bearings. Several other articles have been written telling how to conduct such tests and how to analyze such data. We do wish to point out one fact that we found at KFGO. The soil conductivity we found, particularly in some directions, was quite different from that shown in the original antenna proof of performance. Several reasons can be found to help explain this.

In the original Proof, as was common in many Proofs taken in the 1940's and early 1950's, not very many measuring locations were taken on each radial. While four, five or six points on a given bearing will yield some usable results, it is obvious that with twenty or thirty points, a more accurate analysis is possible.

A second common explanation for the differences is that both proofs were not taken at the same time of the year. The well known winter to summer effect has been described before and will not be repeated here, except to point out that it is one of the common causes for differences in soil conductivities.

Retuning

The fifth step was to retune the pattern to the previously licensed parameters. Because of our repairs, we found that achieving the original readings did not yield exactly the same pattern. However, the differences were mostly in the nulls. We did experience a bit of unexpected pattern difficulty when we accidently reversed the pattern by 180 degrees. That is, we had the major lobe going south instead of north. This happened because we misread the phase monitor polarity and then followed this with a mistake in reading the field intensity at one of the critical monitor points. These errors were quickly corrected and the proper directional pattern established.

One other problem we corrected was with the KFGO phase moni-

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tor. The old one was about twenty years old and the type that required precise balancing to achieve the true phase angle readings between towers. These knobs have caused problems in the past and introduced some variations from time to time, that may not be caused by actual changes in phase at the towers. It was therefore decided that we would install one of the new type phase monitors. The unit operates on a time interval principle and does not require any balancing or adjusting each time the operator switches between towers. Also these new monitors have a mirrored scale, which helps reduce reading errors due to paralax.

At the end of this antenna improvement operation we hit one last snag. This was in a ground loop that developed at the North tower. Ground loops are well known to audio engineers and have plagued all of us in connection with studio wiring and noise or AC hum levels. After completing our repairs at this tower, we had observed that some heating occurred in the metal tuning box in the vicinity of the ground buss. We had installed a new four-inch copper ground strap from the ground system into the inside of this tuning box. However, we had not removed the old copper braided cable. Normally, the more grounds one adds, the more efficient the ground system, but this was not the case here.

The heating of the steel box told us that we were dissipating some R.F. power in the form of heat. Before the new ground strap had been added there was no heating. We tried removing the grounding lead from the metal box and found that this solved the problem. It also upset the tuning of this tower slightly and required further tuning to reset the KFGO pattern. We don't know for certain what happened, but it appears that we had constructed a ground loop formed by the new strap and the old cable. Apparently this acted as an inductive loop and, due to the high base currents inherent with self-supporting towers, caused a high circulating current to be induced in our loop. The excessive current then caused the heating. This does point up one precaution that should always be taken: check for heat in the system and eliminate it. Heat represents wasted power.

The final step was to prepare a short engineering exhibit for filing with the FCC to cover the repairs and retuning of the antenna, and to show the new monitor points selected. Since some of the base currents and phases had changed more than the amount permitted, it was also necessary to file a new Section II-A of FCC Form 302.

It is our belief that updating and upgrading the KFGO antenna was a step toward better engineering and a more economical operation. It will save money because less time will be required by the staff in maintaining the pattern and keeping the system in adjustment. And by knowing that the pattern is more stable and the metering more accurate, there is little danger a roving R.I. will find anything wrong. Because the FCC is more concerned today about directional antennas, it follows that the station's technical staff should also be concerned. We therefore suggest that any other broadcasters with antennas more than five years old re-examine their own systems to see if, like KFGO, they can improve them. ▲

TV proof of performance

Part 3 of a 3-part series

By Patrick Finnegan

Television shares many similarilarities with its AM and FM Broadcast cousins. In the area of complexity, however, it dwarfs them. Television actually is two distinct systems, aural and visual: the visual being the more complex of the two.

Not only is a television transmitter two transmitters in one, each of these separate but related transmitters uses a different type modulation: FM for the aural, AM for the visual.

While the Proof-of-Performance requirement is spelled out in the AM and FM FCC Rules, this is not the case for the TV Rules. The license renewal application however, asks if a Proof has been made and if not —why not! Rules or no Rules, the television systems by their very nature require a Proof. Their complexity demands it and neglect will soon show up as a second rate air product. The eye is more sensitive and will tolerate less than the ear, so degradation of the picture system soon becomes pronounced, and objectionable.

System Approach

Even though complex, the system approach can still be used for a large part of television. The aural side can utilize the system approach and is treated the same as any FM broadcast station. The technical specifications in the FCC Rules are almost identical with the FM Broadcast Rules, but with some differences in tolerances. The visual side, however, is basically a checkout of the transmitter itself, plus a few overall measurements.

While the transmitters work together in normal programming, one is turned off while making measurements on the other. Interaction between the two should be minimal; but for measurement purposes, each is measured without its counterpart in operation. No tolerances have been set for interaction between the two, so for measurement purposes they are handled singly.

FCC Rules

A review of the FCC Rules, Parts 73.682, 73.687 and the figures and charts in 73.699 will serve as a guide in developing a set of basic Proof measurements.

Many items of specialized test equipment are required to do a complete Proof. Depending upon the amount of test equipment owned or how much can be secured on loan or rental, the station engineer may perform all or only a part of the Proof measurements, hiring out the remaining measurements to an outside firm, such as a Consulting Engineering Firm or one of the Manufacturer Service Companies.

Aural System

This is an FM system. The Rules do spell out the measurements to make and the tolerances.

Response: Measurements at 100%, 50%, 25% modulation. Transmitter with 75usec pre-emphasis, but no de-emphasis in measuring equipment.

Limits: Should fall within curve shown in figure 12 of 73.699.

Distortion: Made at 100%, 50 %, 25% modulation. Use de-emphasis in measuring equipment.

Limits: 50-100 cps 3.5%, 100cps—7.5kc 2.5%, 7.5kc—15kc 3%. No distortion measurements required above 5kc at 50% and 25% modulation.

FM Noise: —55db limit, —AM Noise: —50db limit.

Use de-emphasis in measuring equipment. Measurements referred to 100% modulation only.

One should note that the modulation swing of the carrier is only + and — 25kc as compared to the + and — 75kc swing in a Standard FM station. This smaller swing is the reason of a greater tolerance for FM noise in the TV aural system.

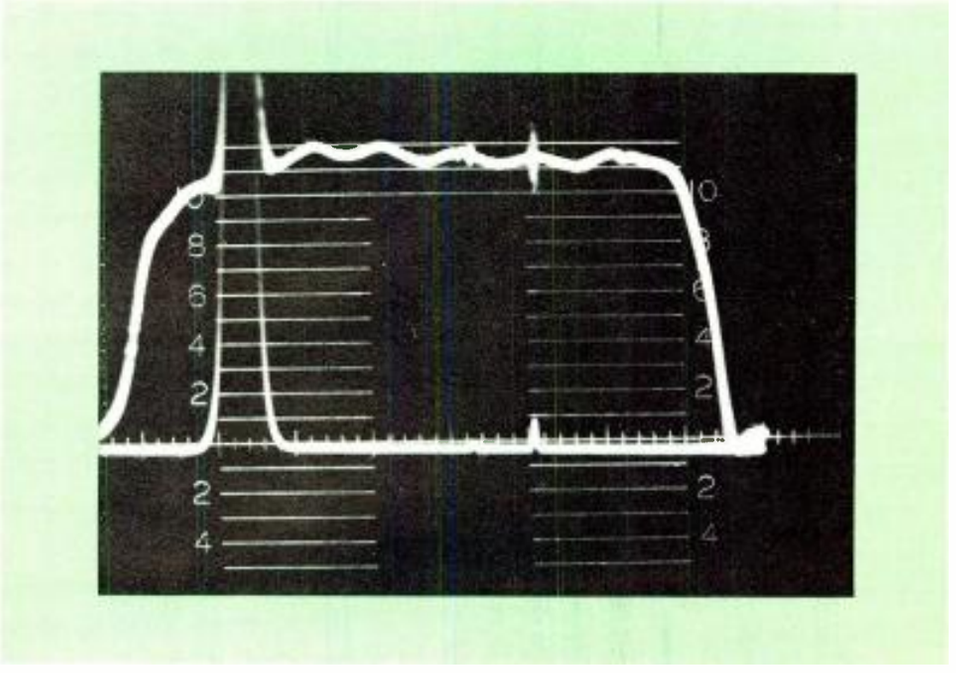

Fig. 1 Video sweep of transmitter showing upper and lower sidebands. The "wrinkles" on the sweep are caused by line reflections from the antenna.

Equipment Required

- Audio generator of good quality with low inherent noise and distortion.
- Transmission or gain measuring set, unless this is incorporated in the audio generator.
- Noise and distortion analyzer of good quality.
- Rectifier for the AM noise measurement.
- Oscilloscope: although not an essential item, will prove helpful in identifying any noise that may be in the system.

Making the Measurements

Shut down the visual transmitter. How you do this will depend upon the transmitter type. In those transmitters which use parts of the RF section in the exciter for both aural and visual, disconnect the earliest stage that can be turned off (at least RF-wise). If it means taking a cable off the output, make sure to use a small load to terminate this stage. Damage can be caused to some of these small power stages if they are left running without a load.

Feed the audio generator to the main microphone pre-amplifier input at a level of about —55 db. Make sure the generator driving impedance matches the pre-amplifier input impedance. Use 1kc as the reference frequency. Disable any AGC or limiting action in these amplifiers. Measurements are made in a normal manner as is done in AM and FM Proofs.

There is one precaution to observe while making the distortion measurements. TV monitors are usually somewhat different in design from AM or FM monitors. The distortion outputs may have a separate gain control. Be cautious in the setting of this gain control: use only enough output from the monitor to calibrate the analyzer. Any excess level may raise the monitor noise level high enough to give erroneous distortion indications. This is especially true when the measurements get into the area of pre-emphasis on the transmitter. The recovered audio levels may be so low that the bulk is really noise.

AM Noise Measurement

To make this measurement it is necessary to rectify the FM carrier (unmodulated). An external AC source must be used to calibrate the noise meter. While the station engineer may make up a fancy box with built-in resistors and switches to avoid calculations, here is a method that is both simple and takes a minimum of calculations.

First, borrow the monitoring diode from the visual transmitter and connect this to a directional coupler mounted after the aural transmitter. If this is a crystal type diode, it may be left unterminated.

a. Adjust the coupler and measure the DC output from the crystal on a regular bench multimeter (using DC scales). Adjust coupler for 3 to 5 volts DC.
b. Calculate 0.707 of this DC value, which gives the required RMS AC voltage for calibration.
c. Measure the output of the audio generator with the multimeter (AC scales) and adjust its output to the value calculated in b above. Use 60-200 cps.
d. Apply this AC voltage from the audio generator to the noise meter and calibrate it.
e. Remove the AC voltage from the noise meter after it is calibrated, then apply the DC voltage out of the rectifier to the noise meter. Read and measure noise in the normal fashion.

Making the AM noise measurement on the TV aural is similar to that made on an FM broadcast transmitter. The only precaution concerns the carrier frequencies that are involved. The top VHF bands, and especially the UHF bands, can make the selection of a rectifier more critical. The rectifier efficiency can be quite low at these high carrier frequencies. That is the reason for borrowing the visual monitoring diode. It probably will be more efficient than a rectifier used for some other purpose.

The Visual

Measurements become more complicated here. Measurements are to be made with the transmitter (including its sideband filter) terminated into a dummy load. Most of the measurements are made by feeding the modulating signal into the transmitter input, which includes its filters and color equalizers.

The basic measurements are these:

- Video bandpass response: These measurements insure that the sidebands are conforming to the required vestigal bandpass. The tolerances are given in the Rules, while the drawings in 73.699 5, 5a, and 11 show the ideal bandpass.
- Differential gain and phase measurements.
- Envelope delay, hum and noise.
- Out of band and channel measurements.
- Overall system check to show conformance with the Standard TV Signal.

Equipment Required:

- Video sweep generator/sideband Analyzer. An alternative would be a single adjustable frequency generator either with or without sync.
- Stairstep generator with 3.58-MHz subcarrier.
- Squarewave generator.
- Fieldstrength meter.
- Calibration oscillator to use with fieldstrength meter.
- Wideband oscilloscope.
- Phase analyzer or vectorscope.

Making the Measurements

Video response: There are several methods which can be used to measure the video response. a) video sweep at transmitter in mid-characteristic operation. b) video sweep and sideband analyzer, c) single frequencies for modulation and single frequencies with sync.

The single frequencies methods are similar to the audio response measurements. Individual sine waves modulate the transmitter and a fieldstrength meter or other detector is used and the individual amplitudes recorded and plotted on a graph. Such methods are most time consuming.

The video sweep/sideband analyzer method is the quickest and best method. It has the advantage that one can see both the sidebands at the same time. Any system irregularities that need correction can be handled easily. Quite often when

making adjustments to the bandpass, corrections in one area will upset another area. The ability to see the whole bandpass on an oscilloscope at one time is thus very helpful.

The sideband analyzer is a special type receiver which not only accepts the RF carrier and detects it, but also provides the video sweep modulation signal to the transmitter. At the same time, its detected output and synchronized sweep provide the horizontal sweep for the oscilloscope.

Before going into the techniques for using this testing method, it may be well to discuss briefly what is meant by mid-characteristic operation of the transmitter. In operating the transmitter this way, an attempt is made to draw a hypothetical axis for amplitude modulation in what is otherwise a pulse modulated system. In a standard AM modulation system, the peak power for a 100 per cent modulated carrier is equal to 4 times the peak unmodulated power. Thus, the TV transmitter is placed into a mode of operation comparable to a standard AM transmitter and treated in a similar fashion.

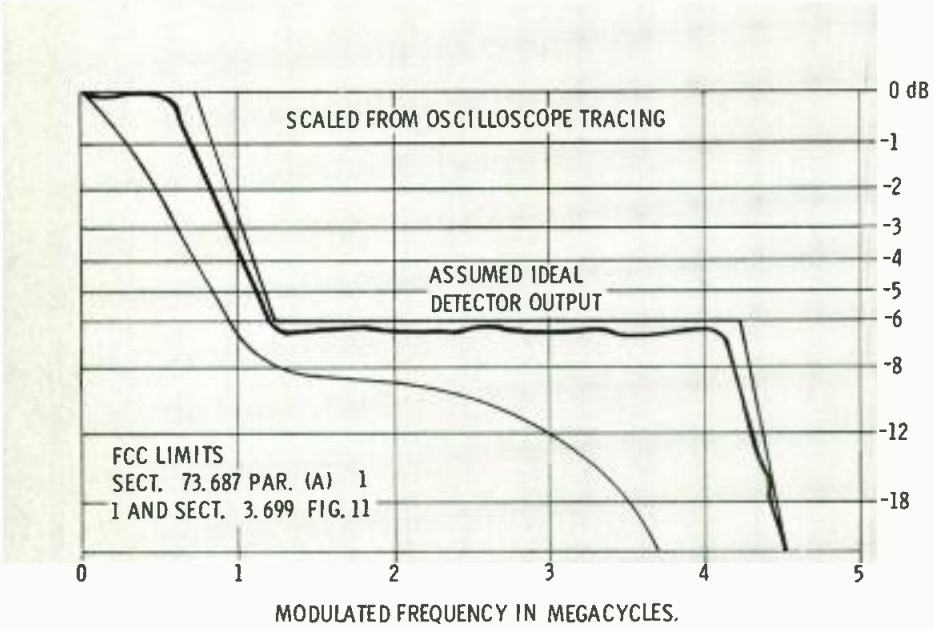

Fig. 2 Tracing from oscilloscope of the diode response curve.

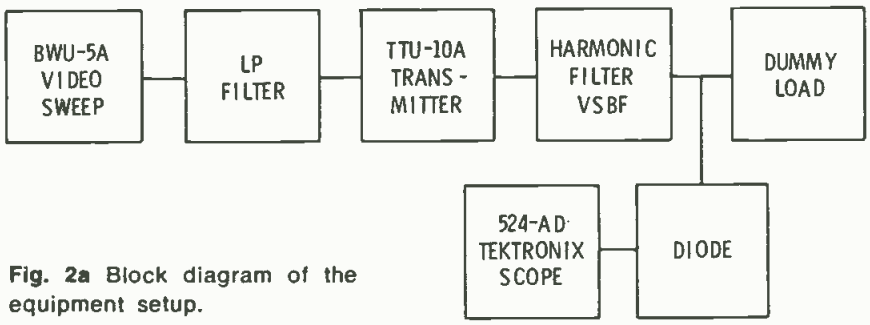

Fig. 2a Block diagram of the equipment setup.

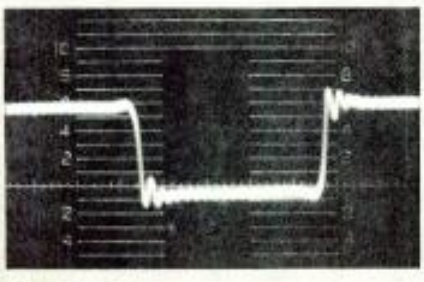

Fig. 3a Square wave response through system before equalizers are switched into system.

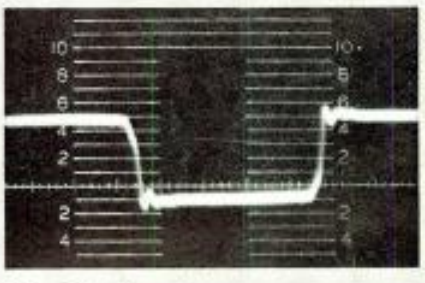

Fig. 3b Square wave response through system with equalizers in system and adjusted.

To place the transmitter into this mode (mid-characteristic), first disable the transmitter clamp circuits and replace them with a fixed DC bias. Reduce the output power with bias or drive so that the output meter reads 25 per cent power. The output meter is a peak power reading device. The transmitter is then modulated at 25 per cent modulation with video sweep voltage.

Since the sideband analyzer is a special receiver and is coupled directly into the transmission line by directional coupler, care must be taken so that the RF input is not high enough to permit overload conditions. The output should be viewed carefully on the oscilloscope display for any compression that would indicate overload. If necessary, add an RF pad in the line to the analyzer. If the analyzer is overloaded, it will not give correct sideband displays. The sweep pattern on the oscilloscope will show "wrinkles" or periodic cycles if the antenna is terminating the transmitter instead of a dummy load. These "wrinkles" are caused by reflections in the line.

Once a suitable display is achieved and the bandpass is correct, a tracing should be made of the oscilloscope display. So as to establish a reference point, a 20 db RF pad should be inserted in the RF line to the analyzer. This will reduce the oscilloscope display considerably, but no adjustments should be made, except perhaps the positioning controls on the oscilloscope so that the base line still coincides with the baseline that was obtained previously. Make a tracing of this new display on the previous tracing. The final tracing should look like Figure 5 of 73.699.

Diode: Remove the 20db pad from the RF line. From the same directional coupler, connect a diode. Feed the diode output to the oscilloscope. It may now be necessary to increase the RF coupling as the diode is less sensitive than the analyzer. The oscilloscope will be the standard diode display as in Figure 11 of 73.699. Hum pickup in the oscilloscope is sometimes a problem and will offset the baseline of the detected display. There is a way to overcome this. Do not terminate the diode. When left unterminated, the display on the oscilloscope will show both sides of the modulation envelope along with the video sweep frequencies. Make a tracing of both envelopes. Any hum can then easily be observed and discounted when drawing up the pattern from the tracing.

Lower Sideband

The sweep method previously described will give a good overall measurement of both the upper and lower sidebands, but the oscilloscope display cannot show much more than about 20 db in amplitude of the sidebands. This is alright for the sound notch and the edge of the lower sideband shoulder, both of which must be down at least 20 db from full modulation. However, the lower sideband and especially the area around 3.58MHz below picture carrier must be down at least —42db.

Proper measurement of this 3.58MHz suppression can be done best with a fieldstrength meter, while the transmitter is modulated with single sine wave frequencies and the transmitter in mid-characteristic operation. The fieldstrength meter is coupled directly to the transmission line by a directional coupler, just behind the sideband filters and harmonic filters.

To make the measurement, modulate the transmitter with a single frequency of about 1 MHz, at 25 per cent modulation. With the fieldstrength meter, tune in this signal on the sideband and adjust the meter reading for zero db. This is the reference. Next, modulate the transmitter with 3.58MHz subcarrier and tune in the 3.58MHz on the lower sideband. Adjust the pads and read the amount of suppression.

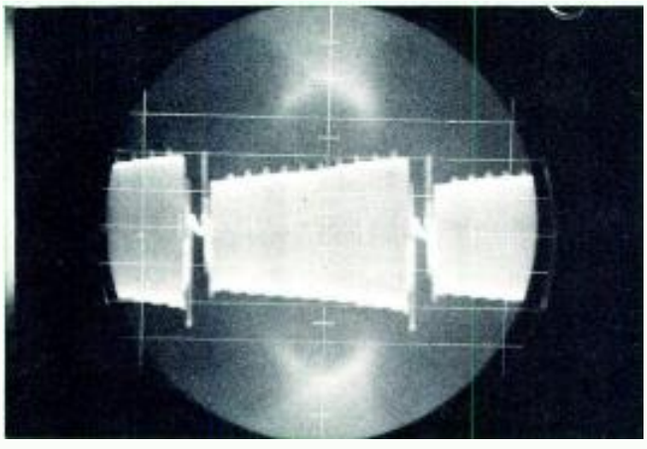

Fig. 4a System linearity measurement. Shows predistorted input.

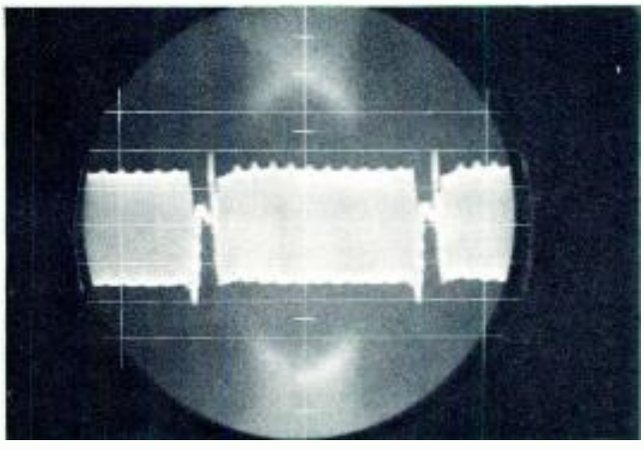

Fig. 4b Transmitter output corrected.

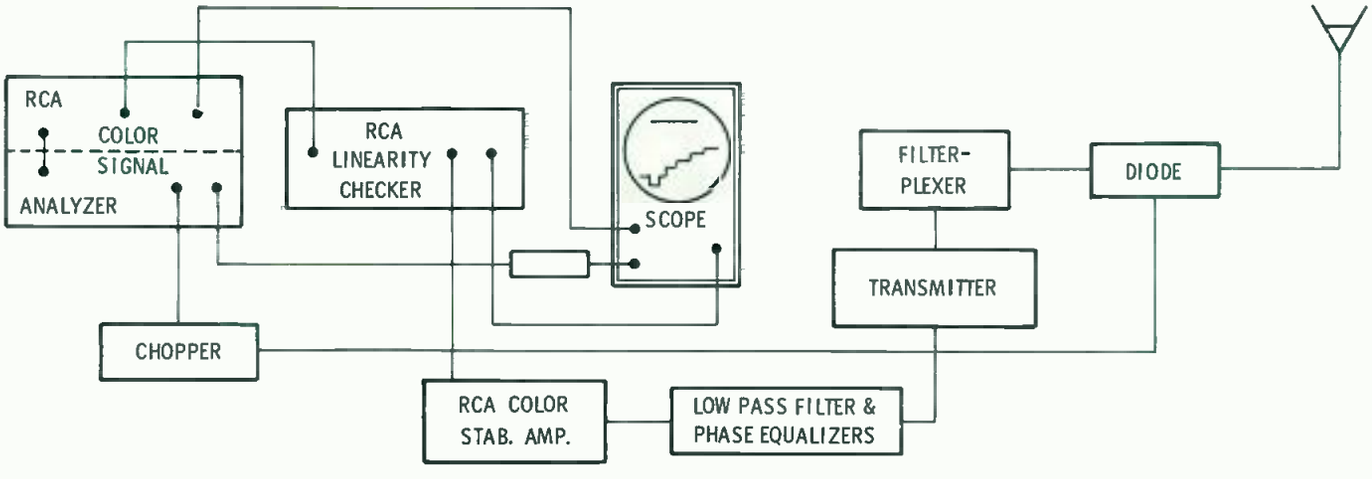

Fig. 4c Block diagram of equipment setup.

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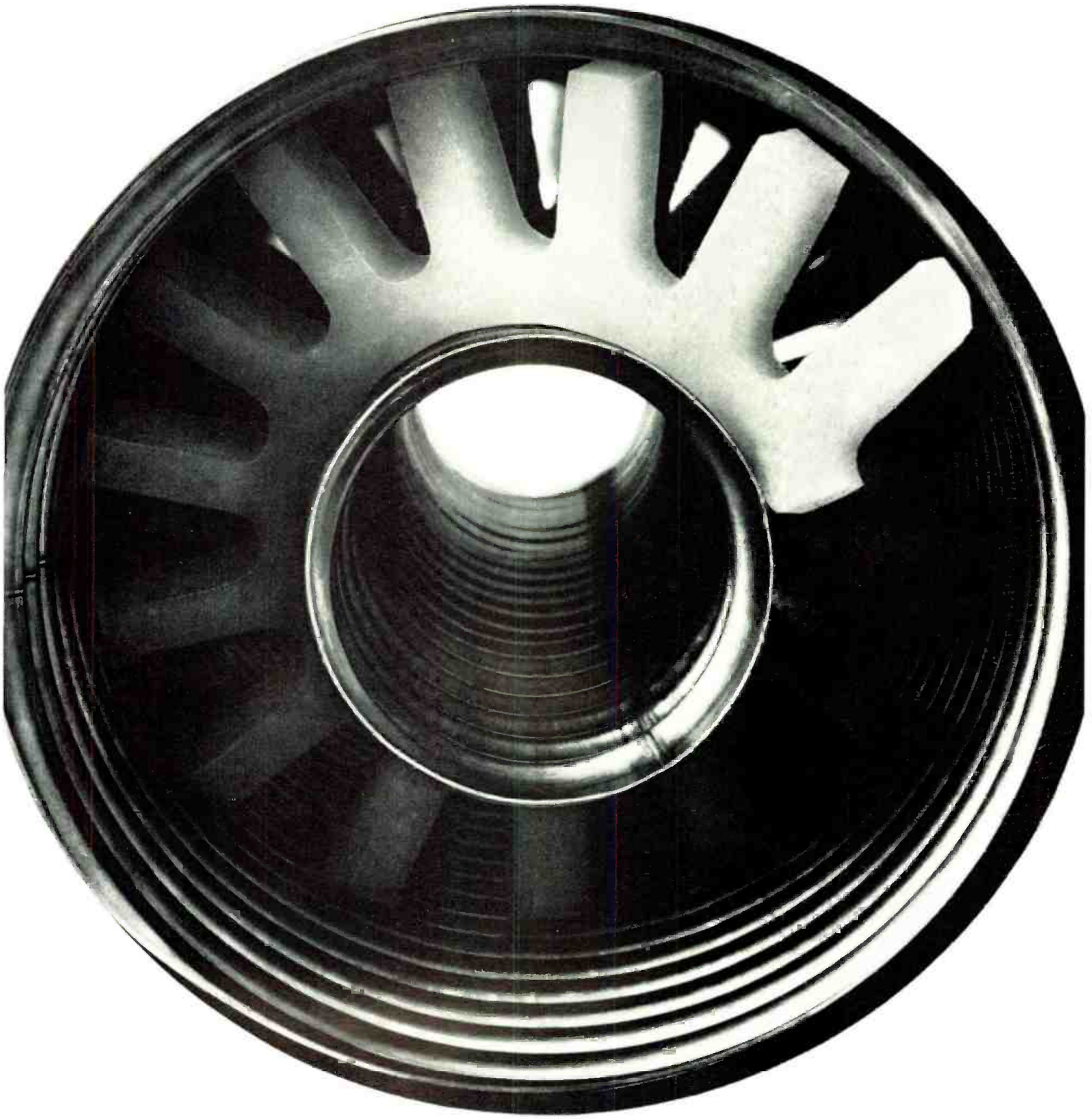

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It requires a very selective field-strength meter to tune in a separate frequency on the sideband close to carrier. Ordinarily, 200kHz is the recommended frequency, but more success will be had with the 1MHz reference, especially on UHF transmitters.

In an effort to help UHF stations, the FCC has relaxed some of the requirements, or rather tolerances, of the correct vestigal bandpass. This relaxation is only for those UHF stations with a transmitter peak power of 1kw or less. However, none of the waivers apply if that station will cause interference because of too much radiation from the lower bandpass. If, because of operating stations or CP's granted such waivers do not apply, then even the small UHF must comply with the standard vestigal bandpass and tolerances.

Envelope Delay

Envelope delay is normally a part of type acceptance measurements made by the transmitter manufacturer. These usually show little change, and as long as approved color equalizers are installed, envelope delay measurements are not made at Proof time. It requires a special instrument to make these measurements.

One can check the operation and adjustment of the color equalizers with less complicated equipment. To do this, the transmitter is operated in mid-characteristic mode and a square wave signal (100kHz) is fed to the color equalizer input. The modulation is recovered after the sideband filters by a demodulator. The equalizers are then adjusted for minimum tilt of the square wave and ringing at the transitions.

AM Noise

With the transmitter still in mid-characteristic mode and without modulation, measure the AM noise figure exactly as was done for the AM noise measurement on the aural side. The directional coupler tap that was used in the previous response measurements is a suitable pickup point. While there are no specifications for AM noise, the transmitter manufacturers' specs usually call for about —45 db. If the noise is hum, this is just barely enough, and the system would be better if a —50db figure could be achieved. A small amount of hum in the picture, if the picture is non-synchronous, can be annoying to the engineer who knows it is there.

Differential Gain (Linearity)

The transmitter should now be restored to normal program mode of operation and clamps restored and power run up to 100 per cent. A stairstep generator with 3.58MHz riding on the steps should be fed into the system at any point ahead of the linearity correction circuits. Since the stairstep generator has horizontal sync, it can be introduced at the video switcher input if desired. Correction then can be made for the system. When correcting in this way, the circuits between should be ones that are normally included in the system without change. Otherwise, any non-linearity in these circuits that is corrected at the transmitter will be overcompensated at the transmitter should any of these circuits be switched out of the system. The safest place is to feed the color equalizers. Any non-linearity in the switcher, etc., should be corrected, not compensated.

Modulate the transmitter to full modulation, using the chopper to indicate correct modulation. The output of the transmitter is detected after the sideband filters either on a diode or a demodulator. One must be certain that the detector itself is linear. Both diodes as well as demodulators can be non-linear.

The author prefers a diode over a demodulator because there is less circuitry involved and the diode can be checked easier. The easiest way to check the diode is to observe the oscilloscope display from the diode. Adjust the coupler to increase the input to the diode. Low levels, and the diode becomes non-linear. Care must be taken not to overload the diode: this would make it non-linear. If one wished to be more certain of the diode's linearity, he could modulate the transmitter with a single frequency at different levels of modulation. The output of the diode is then plotted on a graph and it should show a straight line increase with increased input levels.

To observe the lincarity of the circuit under test, it is better to feed the output from the diode through a high pass filter. This removes the steps and leaves only the 3.58MHz bursts on the same axis. The correction circuits are then adjusted so that the amplitude of each burst from black to white (step levels) are equal in amplitude. The correction circuits will change the system gain, so modulation must be checked often during the measurements and adjustments to keep it correct. No tolerances have been set. A photograph from the oscilloscope will serve as a record of performance. At the same time, feed the pre-distorted signal through the filter and photograph this pattern. This will show the system linearity.

Differential Phase

Without any further adjustments to the transmitter as it is for the linearity measurement after correction, feed the diode output to either a color analyzer or a vectorscope. The phase analyzer requires an external oscilloscope. According to the instructions with which instrument you have in use, null the burst at black or back porch level to the base line. Next, adjust the fixer phase values so that the burst the greatest in amplitude deviation from the base line is nulled to the same level as the original reference null. The instrument will then directly indicate the phase sh ft through the system. Make an oscilloscope photograph of the display. Modern transmitter systems should be able to get the phase shift corrected to within 5 degrees. The Rules do not have limits set on this as yet.

Harmonics and Out of Channel Measurements

Harmonic radiations are normally a part of manufacturers' type acceptance measurements and not normally made at Proof time. Approved harmonic filters should be installed in the transmission line. Unless interference from harmonics is under dispute, measurements are not normally made. Equipment to measure UHF harmonics is very sophisticated.

Out of channel measurements are normally made. The transmitter is modulated to full modulation with

a test pattern and at full power. A field strength meter then tunes in the carrier to set a reference line. The area 3-6MHz below the lower channel edge and 3-6 MHz above the upper channel edge are checked for any readings. These readings should be down at least —60db.

Standard Signal

Modulate the transmitter to full modulation with a test pattern and full power. To demonstrate that the picture or transmitter is transmitting a standard TV signal, photograph the waveform of the signal after the transmitter. Show the horizontal sync and video, plus a chopper line and a scale showing modulation percentages. Next, photograph the waveform monitor showing the vertical sync and picture. The tilt and hum should not be over 5 per cent modulation.

Next, photograph the picture from a monitor which is fed from the same video that was photographed on the waveform monitor.

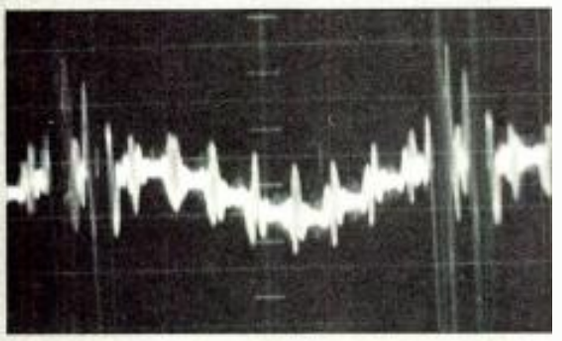


Fig. 5 System phase measurement. The amount of overall system phase indicated here is 1½ degrees.

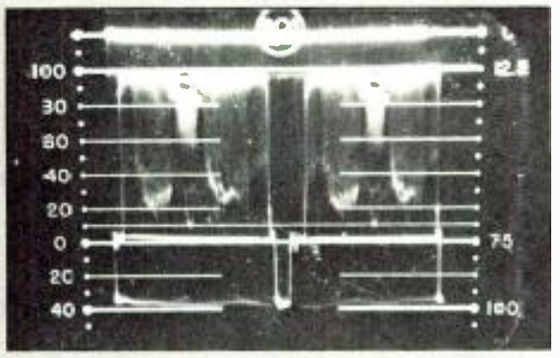


Fig. 6 Photo of waveform monitor showing chopper line and other modulation percentages. This is the horizontal sync display.

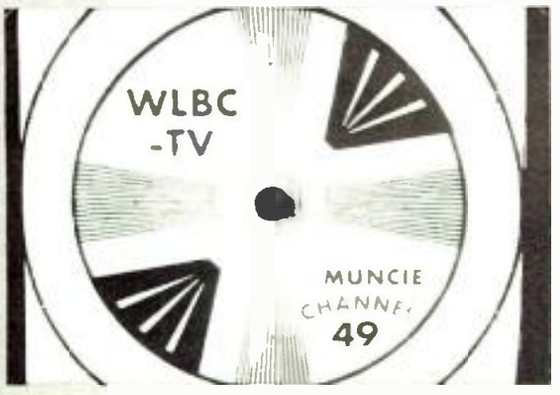


Fig. 7 Photo of test pattern taken off monitor. This is a picture of the waveform with video information displayed in Figure 6.

Other Measurements

Since the dummy load is on the transmitter, the power meters can be calibrated at this time if desired. They must be calibrated at least every 6 months. Check the meter indicated at 80-100-110% power points. These show the tolerances of power maintenance.

The transmission line and antenna may be checked across the channel width for vswr. It requires special equipment for this.

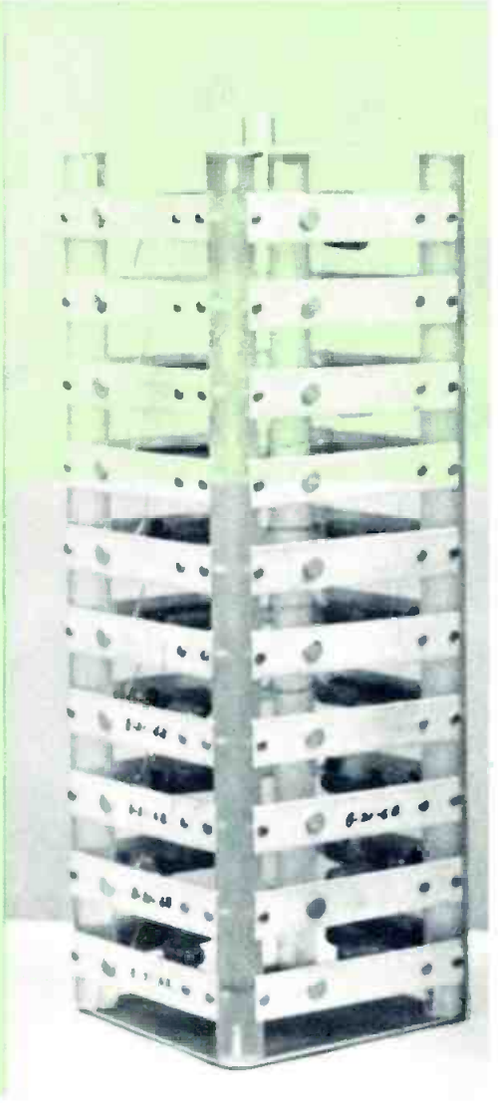
Power shift of the visual should be checked. This is a simple measurement. Set the visual power output for 100 per cent in standard black picture. Then switch up a test pattern to full modulation. The power shift should be under 10 per cent, with a typical figure under 5 per cent. Some transmitter manufacturers specify 7 per cent.

Packaging

After the measurements comes the paper work. No particular form is required, only that it is reasonable and shows the results of the measurements, the equipment hookup, and the methods used. A logical assembly into a single package would seem appropriate, filing the aural proof and then the visual proof, etc. The engineer should sign and date each page or a title page at the front of a bound Proof. An inexpensive cover or binder will dress the whole package up nicely. Keep the Proof on file at the transmitter, even though the Rules do not require this. As a ready reference during periods of technical problems, it will serve a very useful purpose as a record of what the equipment could do. Once the first Proof is packaged, it can serve as a manual and reference the next time you make a Proof. It will save looking up each requirement in the Rules. ▲

Roll Your Own

High Voltage Silicon Rectifier Stacks



By James F. Ranney*

The superiority of high-voltage silicon rectifier stacks over mercury vapor tubes has been well established, with the result that they are used in most modern transmitters. While older transmitters can be brought up to date in this respect by installing commercially built silicon stacks, sometimes the cost is considered prohibitive.

If this is the case in your station, you can "roll your own" high voltage silicon assemblies at a fraction of the cost of commercial units. This was done at WCKY, where type 857-B rectifier tubes formerly used in both of the station's 50-kilowatt AM radio transmitters were replaced with "do it yourself" silicon stacks.

This article is not intended to be a complete technical treatise on the design and construction of silicon rectifier stacks. Rather, its purpose is to describe how such units were successfully fabricated in a particular case, and thus encourage anyone who has considered such a project. It is felt that any capable technician can design and build units which will successfully replace most types of high and medium power mercury vapor rectifier tubes.

While it is possible to build a silicon substitute for the 857-B tube at less cost than that for the tube, such will probably not be the case for the smaller rectifiers, such as the 8008 and 872-A. However, one would be justified in spending several times the tube cost for its silicon counterpart, due to the extremely long life of the latter, and its operating advantages. Such problems as no warm-up period and arcbacks are eliminated.

At WCKY, stacks were first constructed for the alternate main transmitter, an RCA Type 50-D which employs a 15 KV, 8 ampere high voltage supply. The success of these units encouraged us to fabricate silicon assemblies for the G.E. Type BT-25-A main transmitter, which requires 11 KV at 10 amperes for the high voltage supply.

To date, the silicons in the RCA transmitter have accrued approximately 3500 hours of operation; those in the G.E. transmitter about 16,000. We have had but two diode failures in the G.E. stacks during this time.

At first, the RCA transmitter units were plagued with resistor failures; we apparently were unfortunate in getting a bad run of resistors, but after these were weeded out, the operation was successful.

The faulty resistors triggered a number of diode failures which would otherwise not have occurred. If the shunt resistor opens, the associated diode receives nearly the full voltage which is across the stack, and this is usually fatal. In the G.E. transmitter stack, one of the two failures was an open diode, which is unusual. Silicon diodes usually short when they fail, which is fortunate, since several shorted units in a series stack will not affect operation of the unit as a whole. Shorted diodes can be weeded out periodically by an ohmmeter check, as described later.

*Engineer, WCKY

Fig. 1 A unit from an RCA transmitter compared to a 857-B tube.

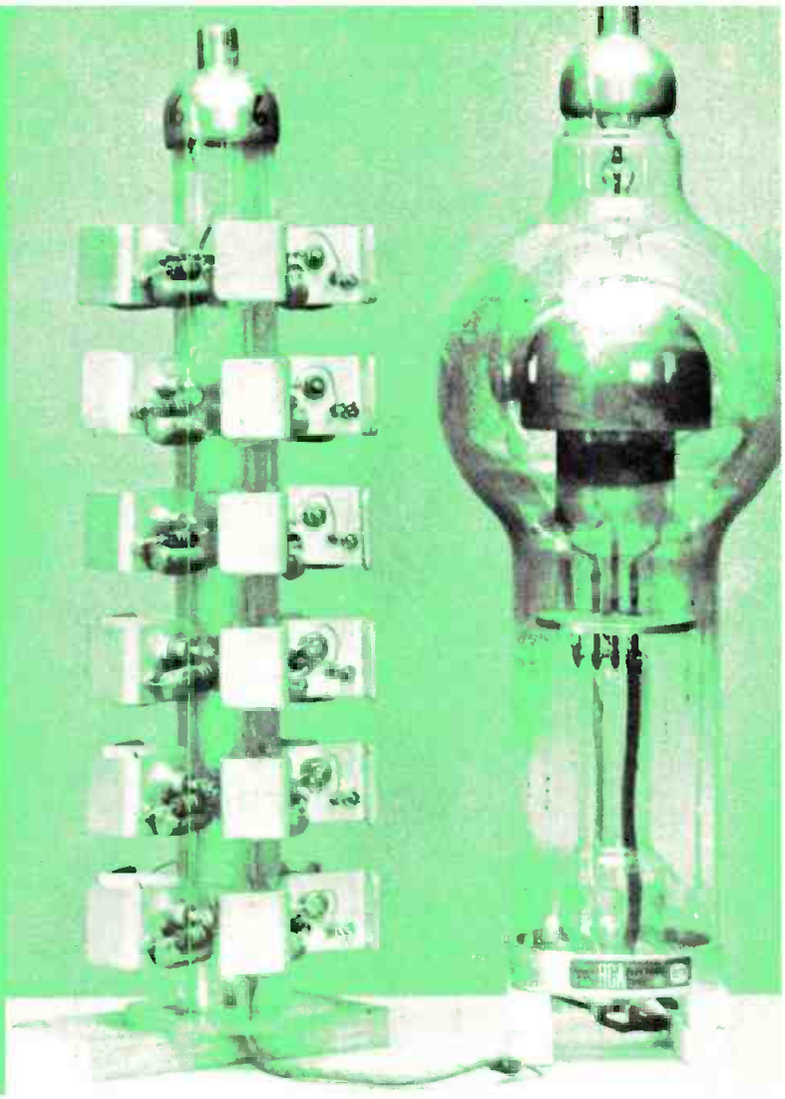


Fig. 2 A GE stack is shown here beside an 857-B.

Construction Steps

Construction of the stacks falls into two general steps: choice of diodes and shunt elements, and physical configuration. Since the latter is determined to some extent by the size of the electrical components, it is logical to begin with the selection of the proper diodes, shunt resistance and capacitance.

Choice of diodes can be made in two ways. Voltage and current ratings of the stack can be made to equal or exceed those of the tube it is to replace, or alternately, in a particular application where the full ratings of the tube are not being utilized, the diode stack can be derated somewhat, with a saving in cost.

In our case, as mentioned, the tube we were replacing was an 857-B which has a maximum rating of 22 KV at 10 amperes. The stacks for the RCA transmitter consist of 40 G.E. Type A-440-M diodes, which are rated 600 volts at 15 amperes. This gives a total stack rating of 24 KV at 15 amperes. The units for the G.E. transmitter consist of 30 Westinghouse 1N126, which are 600-volt 12-ampere diodes, resulting in a rating of 18 KV at 12 amperes. While these units are somewhat de-rated, voltage wise and compared to the 857-B tubes, they are still being operated very conservatively. This is one of the advantages of building your own stacks—they can be tailored to the job. If desired, they can be greatly over-designed, and still cost less than commercial units.

Selecting Resistors And Capacitors

After selecting the diode type, the values of the necessary shunt resistors and capacitors can be determined. These shunt elements are necessary whenever diodes are operated in series.

The resistors equalize the voltage drop across each diode which would otherwise vary from unit to unit due to manufacturing tolerances. Without shunt resistors, one or two of the diodes can "hog" most of the voltage, with the result that the reverse voltage will exceed the dielectric breakdown property of the silicon, causing failures.

The shunt capacitors are needed to absorb the sharp spikes of voltage encountered in normal operation, and also generated during lightning strikes on the power system.

Values of resistance and capacity do not seem to be particularly critical, but do depend on the type of diodes used. Ideally, the shunt resistor should be about one-half the diode reverse resistance. This can be determined by the formula:

$$Rs = \frac{1}{2} \frac{PRV}{RI\ max}$$

where PRV is the peak reverse voltage of the diode, and RI max is the maximum allowable reverse current. Both of these will be specified in the manufacturer's ratings. This value of resistance would be correct where the diode is being operated at its maximum peak reverse voltage, and where the junction temperature is maximum. In most practical applications, this is not the case, so higher values of shunt resistance can be used.

Silicon diodes have a negative temperature coefficient of reverse resistance, so this tends to raise the reverse resistance when they are operating below maximum junction temperature. In most cases, unless diodes are being operated at absolute maximum ratings, which would be inadvisable, the resistance value obtained by dividing the operating PRV by the maximum reverse current should be satisfactory.

Once the resistance value is determined, the wattage rating can be calculated by plugging this and the maximum reverse current into the familiar $P = I^2R$ formula. In most cases, a two watt resistor is more than adequate, and this is what is used in the stacks for the G.E. transmitter. The resistance value in these stacks is 180,000 ohms, incidentally. The resistors in the RCA transmitter units are 50,000 ohms, 20 watts. We used the high wattage mainly because we weren't sure at the time what was necessary to keep heating at a minimum, and decided to be ultra conservative.

Capacitance

The shunt capacitance should be equal to at least 100 times that of the diode junction. In medium power diodes, the junction capacity is in the vicinity of 100 mmfd, so a shunt capacitor of .01 mfd would meet minimum requirements. Voltage rating of the capacitors should be equal to the PRV of the diode. We used 0.1 mfd, 600-volt molded capacitors which have proven satisfactory.

Size Considerations

Once the diodes and shunt components have been selected, there remains the problem of physical size and shape. Some of the factors to be considered are:

1. Overall size should be such that the units can be installed in the space occupied by tubes.
2. The stacks can be made direct replacement "plug-ins", or some other configuration can be used.
3. Design should allow for adequate cooling of the diodes.
4. Spacing between the elements of a stack should be adequate to avoid arcing, even when some of the inevitable dirt is present.
5. Accessibility for cleaning and service.
6. Cost of materials.
7. Ease of assembly.

The only one of the above points which might seem difficult to remember here is that most manufacturers design their silicon diodes to operate under extreme conditions. Westinghouse, for example, rates their diodes assuming operation in a closed container with only the normal movement of air by convection available for cooling. It stands to reason, then, that if the diodes are run conservatively, mounted so as to allow free circulation of air, and provided with a small heat sink, heating should be no problem. Both types of stacks which we constructed bore out this assumption and run very cool.

The rectifier compartment of the G.E. transmitter has cooling air supplied by the main blower, but in the RCA transmitter, the stacks operate in a fenced off portion of the transmitter operating room, with only the natural air circulation usually found in such a location. When the G.E. stacks were first put into operation, we clipped a thermometer to a fin of one of the units, and the temperature rise averaged 20 degrees C. above the ambient compartment temperature. Even in hot summer months, when the incoming air would be as high as 95 degrees F. (35 degrees C.), the diode case temperature would be only 55 degrees C., which is far below the manufacturers maximum of 150 degrees C.

Physical construction of the two types of stacks built for the WCKY transmitters is shown in the photographs. A unit from the RCA transmitter is shown in Figure 1, with an 857-B tube alongside for comparison. The complete set of these units installed in the transmitter rectifier rack is shown in Figure. 4. One of the G.E. transmitter assemblies is shown in Figure 2, while the complete set installed in the transmitter can be seen in Figure 4. Close examination of the photograph of the G.E. stack will reveal that the diodes at the bottom of the assembly are physically larger than those at the top. This is the way they came through from the supplier: all the diodes are type 1N1206. The individual diode/resistor/capacitor units for each type of stack are shown in Figure 3.

The type of construction shown in Figure 2 is recommended over that of Figure 1. It has proven superior, particularly in respect to items 1, 4 and 5.

The square type has been satisfactory in the RCA transmitter, but is too large to be used in the smaller rectifier compartment of the G.E. transmitter. They were somewhat

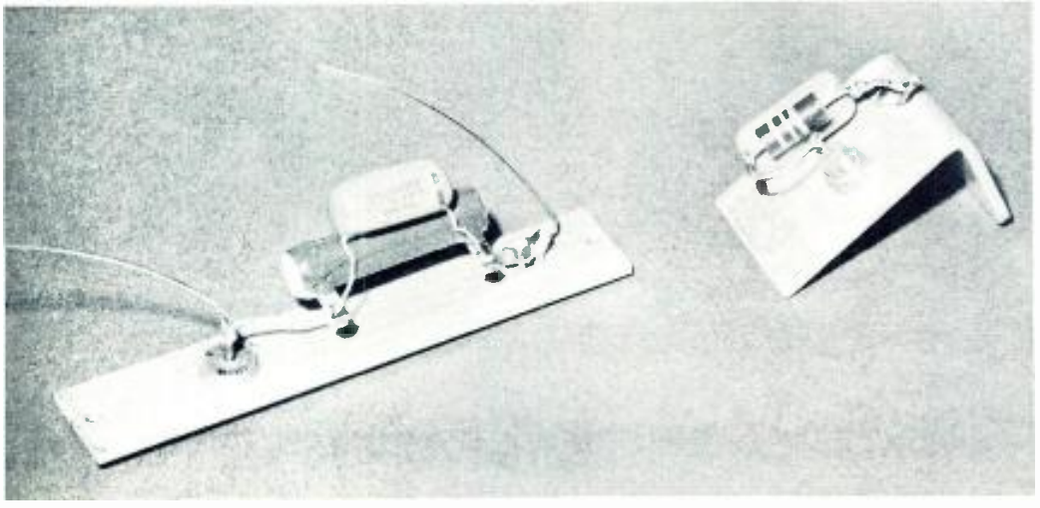


Fig. 3 Individual elements are from RCA (left) and GE (right) stacks.

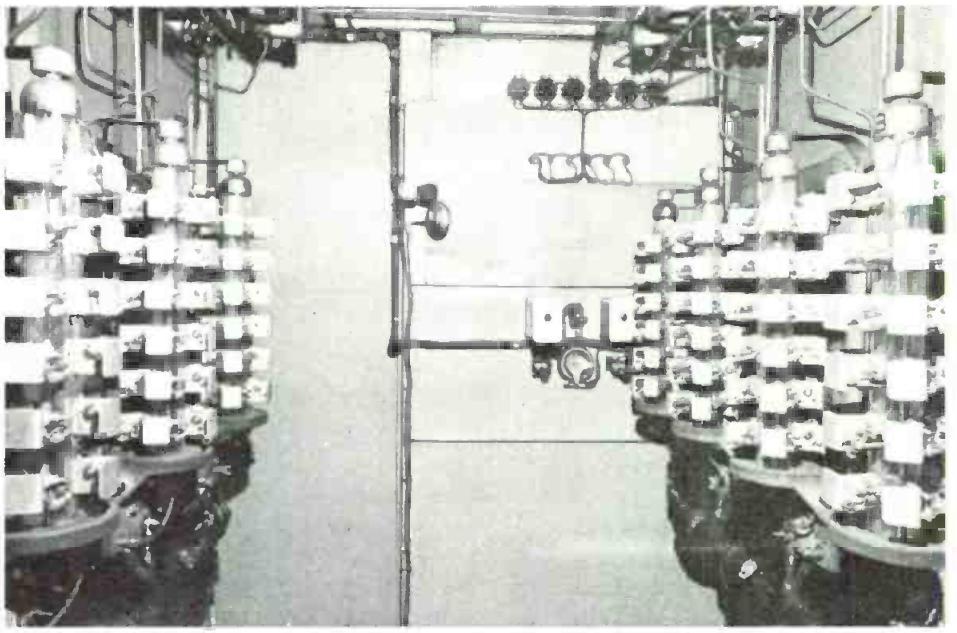


Fig. 4 Stacks in GE transmitter installation.

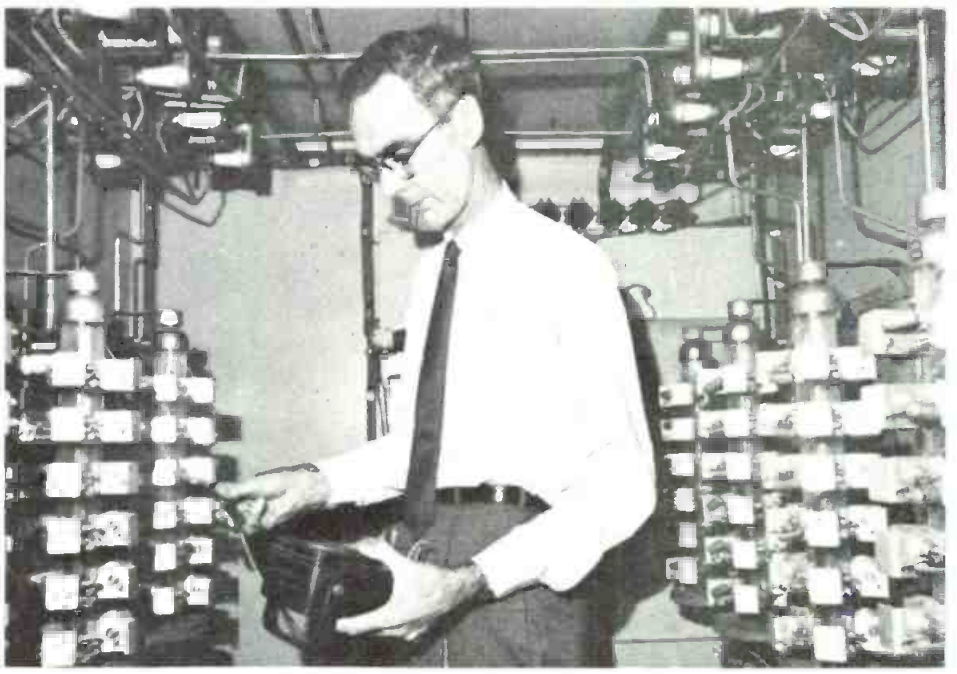


Fig. 5 Checking diodes on the stacks.

less expensive to build, mainly due to the use of the "press in" type diodes, which are considerably cheaper than the more familiar stud type. However, they were somewhat more difficult to build, and more difficult to clean since the components are mounted inside the assembly.

As seen in the photographs, the diodes and shunt elements are mounted on a heat sink consisting of a piece of ⅛ inch aluminum, 5½ inches long by 1 inch wide. These are supported on four polystyrene rods, 1 inch pieces of 1/16 inch aluminum. The elements are in series around the circumference at each level, and the ends of the various levels are connected at one corner. As mentioned previously, the G.E. type A-440-M diodes used are of the press fit type, which are more time consuming to mount than the stud type. The mounting hole must be very accurately drilled; if it is too large, the connection to the diode will be too loose for good electrical and heat conduction. If it is too small, the pressure necessary to force the diode in place can cause internal stresses which degrade the reverse resistance. The pressing operation can be done on a drill press, using a piece of hard wood with a hole in it large enough to clear the diode anode connection.

In the other type of mounting of Fig. 2, the elements are mounted on a piece of ⅛ inch aluminum, 1½ by 3⅜ inches. The outer 1¼ inch is bent a little over 90 degrees to reduce the overall diameter of the assembly. The main support is an 18 inch piece of cast acrylic, 2 inches in diameter. Using a table saw at slow speed to avoid melting the plastic, five ⅛ inch saw cuts were made along its length at 72 degree intervals. The aluminum heat sinks are inserted in these saw cuts at 1 inch intervals, and secured with epoxy cement. As in the other type stack, the elements are in series around the circumference at each level, and, in effect, the string of diodes spirals down the length of the assembly. The top cap of a discarded 857-B tube is cemented to the top for the anode connection.

In assembling strings of diodes of any type, it is advisable to check the forward and reverse resistance before mounting. This will eliminate any defective units, or any with reversed junctions. This can be done with an ohmmeter, or better still with a "megger". We used a megger which applies 500 volts to the unit under test, and quickly shows up defective or marginal units.

For routine checks, the homemade two pronged ohmmeter probe shown in use in Fig. 5 is handy for rapidly running down the stacks. Good diodes will read the value of the shunt resistor; shorted diodes and capacitors and open resistors are quickly detected. As mentioned before, even if several diodes short during operation, there is no noticeable effect on the overall operation of the string. For this reason, occasional checks of this type should be made to discover if any diodes have expired. When we first installed the stacks, this check was made at weekly intervals, but now testing at 60 day intervals is considered sufficient. With only two failures in 16,000 hours of operation, even this interval is probably shorter than necessary.

The author wishes to acknowledge the invaluable aid gained in the conversion from the "High Voltage Silicon Rectifier Designers Handbook" published by the semiconductor division of Westinghouse Electric Corporation. This comprehensive manual is highly recommended to anyone considering the construction of silicon stacks. ▲

Building A Simple EAN Receiver

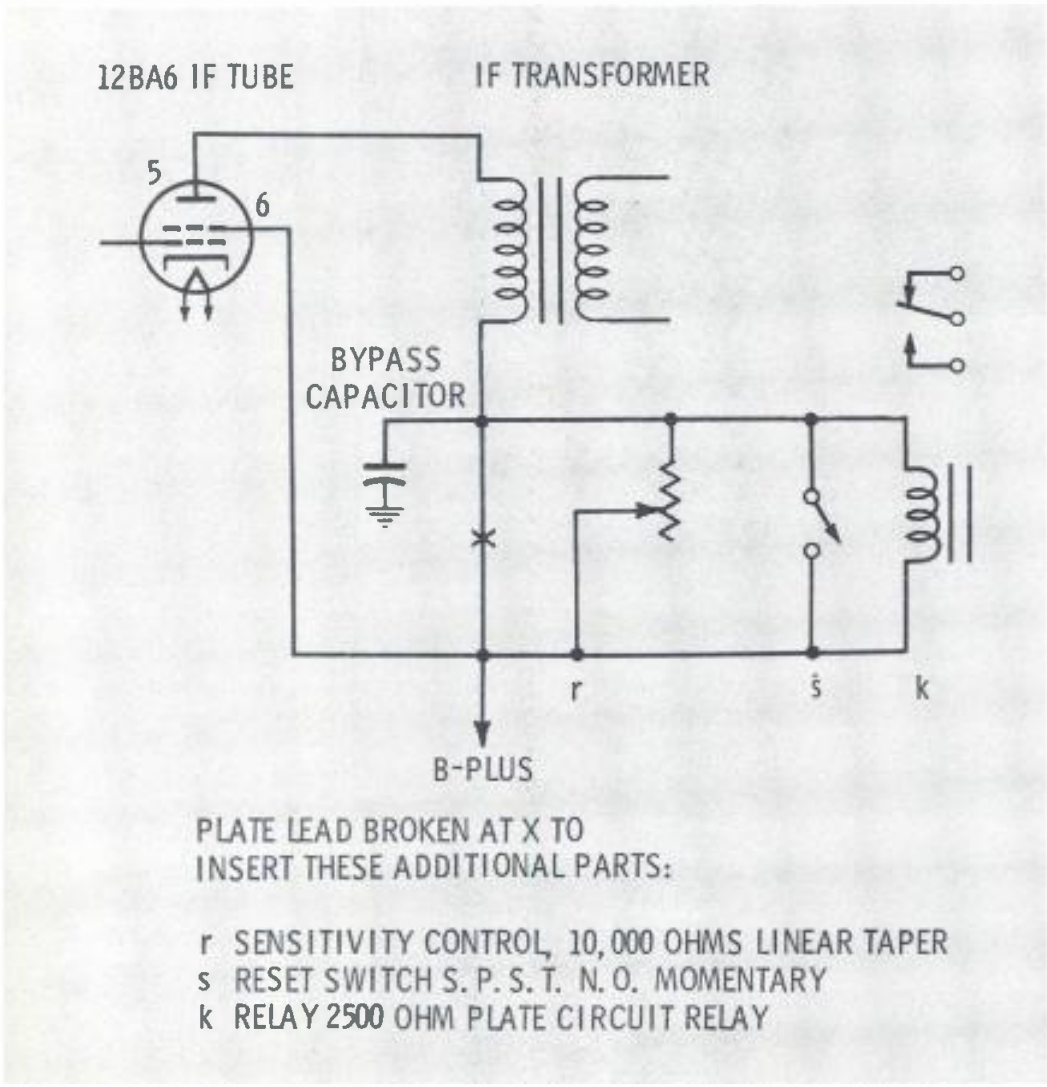
By Ronald Pesha*

■ This article describes modifications to common 5-tube radios for use as Emergency Action Notification receivers. Unlike some more complex modifications, the changes described here require no external circuitry nor additional tubes or transistors. The three new parts required — a relay, control and a switch—fit even the most crowded radio cabinet.

*Engineer, Lawrence, Kansas

The circuit depends on variation in plate current in the radio's IF stage, caused by application of AVC voltage. A relay inserted in the IF stage's plate lead pulls in when plate current rises, caused by the loss of AVC when the monitored station's carrier ceases.

The schematic details a portion of the IF stage in a typical AC-DC radio. A 2500 ohm plate circuit relay with S.P.D.T. contacts inserted in series with the plate lead on the B plus side of the IF transformer. Move the screen lead if it attaches to a terminal on the IF transformer, but retain the bypass capacitor.



Shunt the relay coil with a 10,000 ohm control, mounted on the back of the radio. This sensitivity control adjusts the total current through the relay, thus controlling its pull-in point. In use, adjust the control so the relay remains open while a station is in tune, but pulls in as soon as the receiver is detuned. If the control offers insufficient range, it may be necessary to tighten or loosen the relay spring.

When the relay pulls in because of loss of carrier, it stays in because enough holding current flows even when the carrier returns. Therefore, a suitably located reset switch shorts the relay coil, causing the relay to open and return to standby condition.

Connect the relay contacts to turn on the receiver's speaker or switch on an external alarm device as desired. Remember that the relay **closes** when the carrier of the monitored station goes off.

This modification has certain faults. As the relay pulls in when the carrier goes off rather than releasing, it does not offer "fail-safe" operation. And like any AVC operated device, the monitored station must provide a reasonably strong, fade-free signal. However, the simplicity and low cost of the modification suggests its use in small stations or as an auxiliary EAN receiver where more elaborate carrier-and-tone operated receivers are in use. The modified receiver also makes a good off-the-air alarm for AM stations.

I have installed these modified radios as EAN receivers at several different stations. All proved highly reliable, requiring only an occasional tube replacement. ▲

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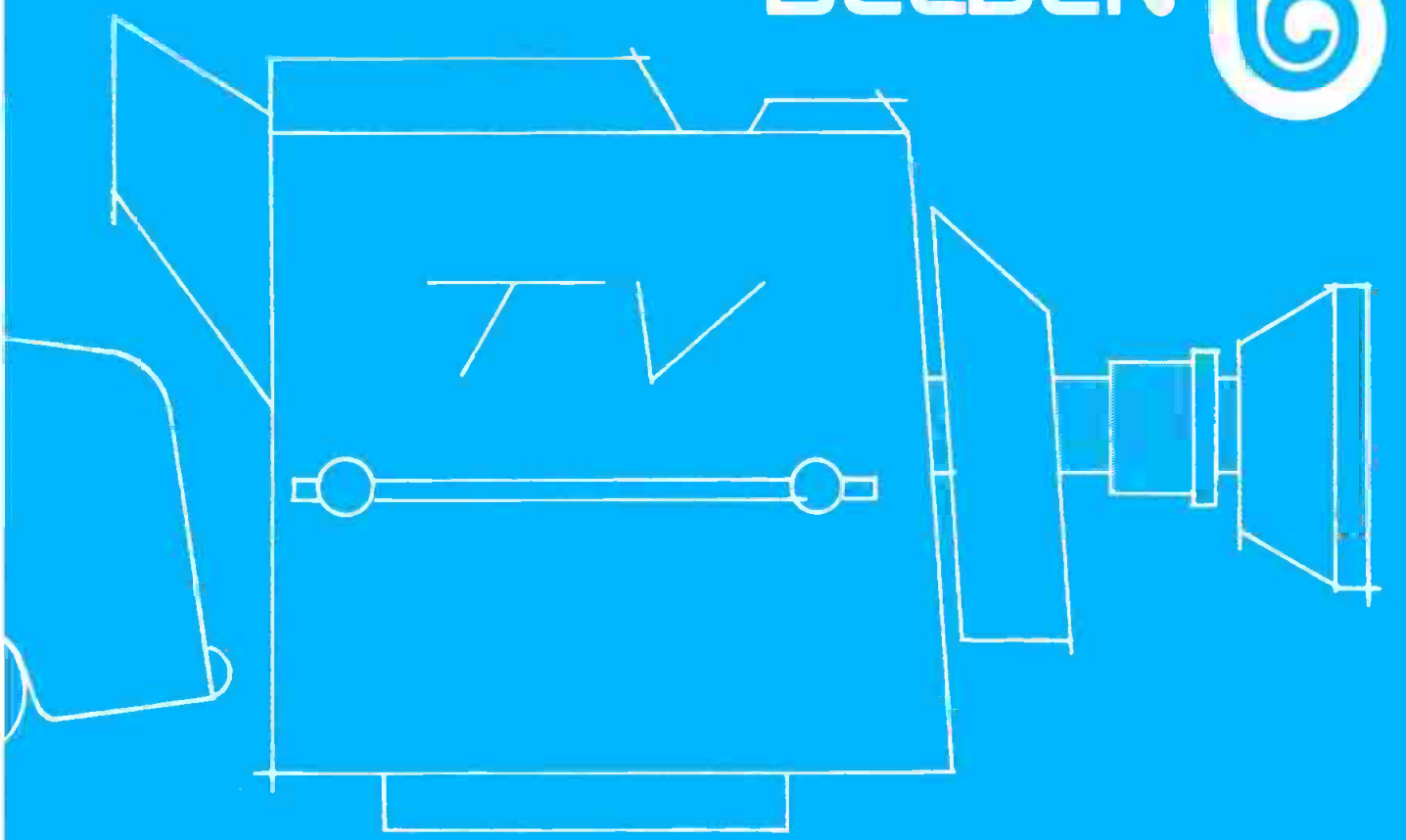

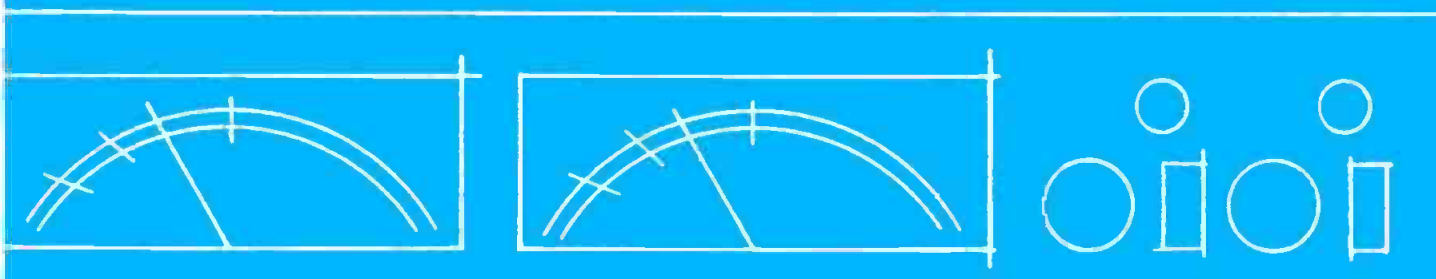

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G-4-8

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Using FET's and IC's

Gain Control Revisited

By Walter Jung*

■ A requirement of many systems today is an electronic gain control element. By using such an element, an audio level can be controlled or programmed as either a function of voltage or current. The use of such an element allows adjustment of levels, automatic level control

*MTI, Maryland

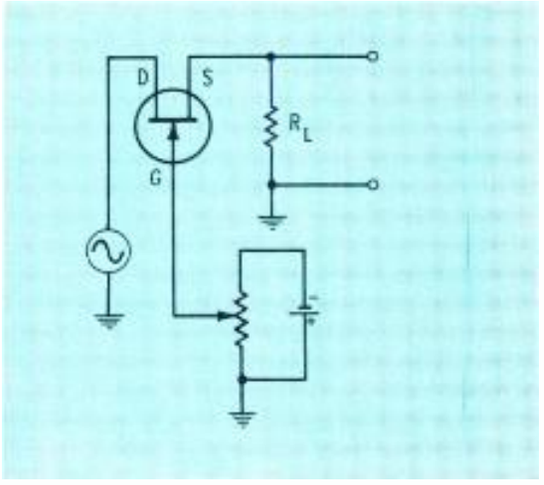

Fig. 1 A basic "L" attenuator

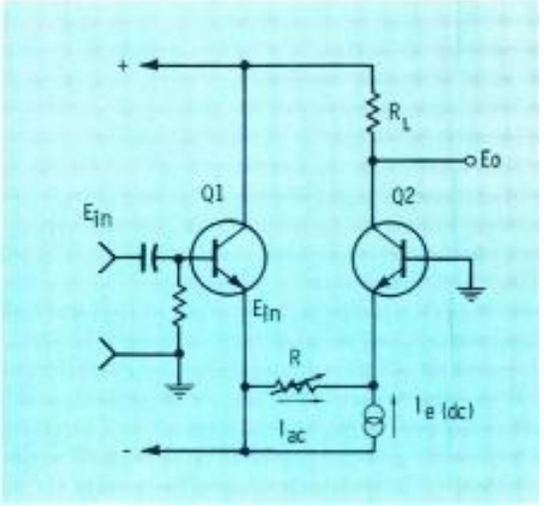

Fig. 2 Schematic of a gain controlled amplifier.

(AGC), modulation of the signal envelope, and switching between multiple inputs electronically.

Examination of the desirable characteristics of this element will set up some guidelines for optimum performance. Major factors must naturally include range, control, and economy of construction and operation.

Obviously, dynamic range is important. The range of control capability should be as large as possible. A good working figure might be 60 dB. However, high signal levels should not overload or suffer distortion. The signal to be transmitted should not be altered by any significant distortion products at any usable operating level. Also, frequency response and linearity should remain unaffected by gain adjustment.

Another consideration should be output isolation. Variation of gain should not be transmitted to the signal output terminal as a transient, change in operating point or other noise or distortion. Of course, it is desirable that the control element not introduce any additional side effects of its own. An example of this effect would be lamp-photocell combinations. They have a natural response in the millisecond range which must be considered in any practical design.

And to be practical, economy must be a consideration. The circuit should be easily reproduced with readily available components of moderate cost. This is a point where design often runs down-hill and out of sight.

In order to offer flexibility, the element should be expandable to at least two more control channels, such as in a multiple input mixer. And another possibility would be digital control of drive to provide a switching function. For possible video application (for maximum flexibility), it should be capable of wide bandwidth.

A minimum amount of control power should be required to activate the control. The magnitude of the control swing should be compatible with transistor supplies. And, finally, it should be capable of bridging input (high impedance) and line impedance output (500-600 ohms). Insertion gain should be easily predictable in a minimum gain condition.

Robert Hirschfeld has made an interesting comparison of various gain control techniques, and offers a good insight into a novel approach for certain applications. (National Semiconductor Application Note AN-11). This article will not attempt to compare various AGC elements, except to conclude that very few offer optimum transients, high level distortion and/or poor signal handling capability, restricted dynamic range, and of course, economy (or lack of). The control mechanism to be described here, while not new in itself, is used in such a way that it takes advantage of its attributes and allows reasonable performance by utilizing a simple technique.

Gain Control

The mechanism of gain control is illustrated in Figure 2. The input signal E_{in} is buffered in a low impedance level by Q_1. Since the input impedance of grounded base element Q_2 is very low (<10 ohms), the resultant load impedance looking out of Q_1's emitter will be essentially R (assuming R large compared to 10 ohms). Therefore, voltage variations at Q_1's emitter are translated into current variations (Iac) in R which in turn modulate the static emitter current of Q_2, Ie. As a result, Q_2's collector current will consist of a DC term (Ie) and

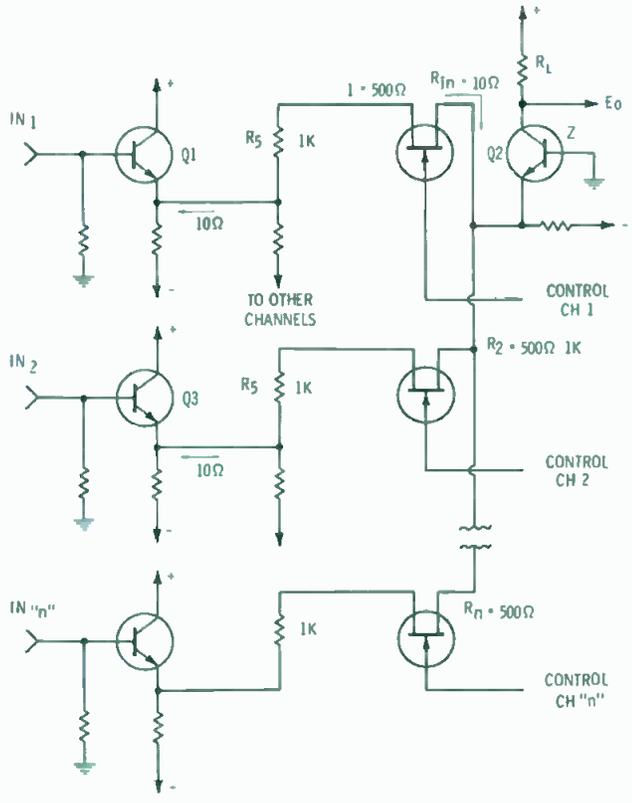

Fig. 3 Multiple input mixer.

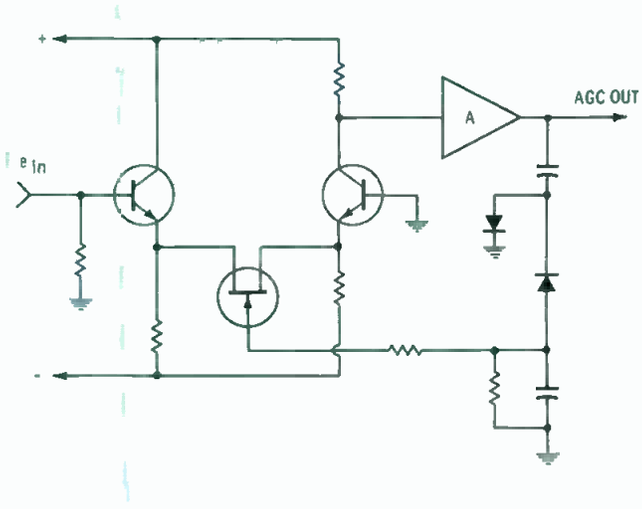

Fig. 4 A range compressor, another AGC device.

an AC term (Iac). Since the Iac is controllable by variation of the value of R, a gain controlled amplifier results.

Examination of the circuit configuration reveals characteristics which are some of the desirable attributes listed previously.

It is well known that the field effect transistor's channel resistance can be easily controlled by varying the gate to source bias voltage. The net result is a voltage-variable resistor. Since the drain-source element of a field effect transistor is a resistance modulated by gate bias, there will be no offset, or DC voltage, across the device and AC voltages are easily attenuated. See Figure 1.

Attenuation

To obtain high ratios of attenuation with this L pad attenuator, the ratio of R_{ds} to R_L must of necessity be very high. For a given value of channel resistance (a particular device) a maximum attenuation will be achieved by minimizing R_L. Logical extension of this thinking concludes that R_L should be zero or close to it. Just such a load is provided by a virtual ground (such as a forward biased diode). By making this diode a transistor base emitter junction, useful transmission of the signal can occur to the collector circuit.

Dynamic range of attenuation will be essentially the ratio of R_{ds} (on) (around 100-500 ohms) to the R_{ds} at maximum bias voltage. For a plastic economy FET such as the 2N5459 (MPF105), a range of 40dB can be achieved wtih a 12V gate bias. A 1K resistor is added in series with the FET to allow a predictable R_{ds} (on).

The 40db attenuation range is given with a 100 mv P-P maximum input. Higher level signals can be handled, but distortion begins to rise because of variation in the channel resistance with dynamic signal voltage. As a switching device, isolations of 60dB or better are achieved.

As mentioned already, distortion is limited by dynamic swing across the FET channel resistance. With P-P AC swing held below 100 mv, distortion levels can be held to a minimum. However, since distortion is at a maximum at high bias voltages, (high attenuation) this will not be a problem where just signal isolation is required. At normal operating levels (minimum bias) distortion is a minimum.

Isolation

In considering output isolation, the inherent DC symmetry of the configuration places both emitters at the same DC potential (assuming matched base-emitter drops, as in a monolithic IC) and resistance changes in the FET do not effect the DC current in Q_2. As a result, variations in gain are not transmitted as a DC transient to the output.

The circuit introduces no extraneous side effects. Response time is limited only by the speed of the external circuitry, and high speed control signals will result in a modulator characteristic. There is no hysteresis or lag characteristic of other types of attenuators.

The circuit is inherently economical and in its simplest form can be built with 2 transistors, a FET and the associated passive components. An integrated circuit version is quite feasible and also economical.

This element lends itself to multiple input expansion. Any number of control elements may be summed at Q_2's emitter with no interaction between channels and virtually zero crosstalk. Attenuation between adjacent "on" channels is low because of two attenuations. From Q_1 to Q_3,

Continued . . .

for instance, $\frac{R_5 + R_1}{R_6 Q_2}$ is the first, then $\frac{R_2 + R_5}{R_6 Q_3}$. Since these ratios are the same or

$$\frac{1000 + 500}{10} = \frac{1500}{10} = \frac{150}{1}$$

the total path is

$$\frac{150}{1} \times \frac{150}{1} = \frac{22500}{1}$$

or roughly 86dB. Since this is the worst case of adjacent arm attenuation (both channels on), cross talk should not be a problem. The control channels shown are not limited to linear control; switching in a digital fashion from full-on to full-off results in a squelch amplifier. As for bandwidth, there is certainly no limitation on frequency response for audio applications. Useful upper limit extends well into the video range due to low R-C time constants.

The objective of low control power is easily accomplished by the high impedance FET gate circuit, essentially a back-biased diode. Also, the emitter follower input allows bridging of lines with no problem because of its inherently high impedance. The load resistor (R_L of Figure 2) can be made 500 or 600 ohms, standard line impedances. Since Q_2 is a constant current source, an external load of the same value will drop the voltage output 6db, satisfying the source impedance criterion.

After discussing various features of this attenuator, an illustration of some applications would be in order. Use as an AGC device or range compressor is shown in Figure 4.

The attenuator circuit proper is followed by an additional gain stage to increase AGC sensitivity and provide drive for the detector diodes. As output increases, more DC voltage is developed by the diodes and fed back to the FET which attenuates the signal, tending to maintain a constant level.

The previously mentioned squelch amplifier is illustrated in Figure 5 with a driver circuit which is compatible with standard digital logic levels. A plus signal at Q_3's emitter turns the amplifier "on," and a ground level signal shuts the amplifier off.

A practical example of the attenuator is shown in Figure 6 using a readily available economical IC and FET. This particular IC lends itself to the configuration quite well as use is made of 4 out of 5 transistors. Q_1 and Q_2 serve as constant current emitter feed for Q_3 and Q_4.

Some performance data on the IC-FET circuit is given in Figure 6.

If this whets your appetite for further information, try the references listed. One should conclude that there are more considerations, but in this article we intended only to uncover AGC basics, to set up parameters, and to provide a jumping off place for further investigation. ▲

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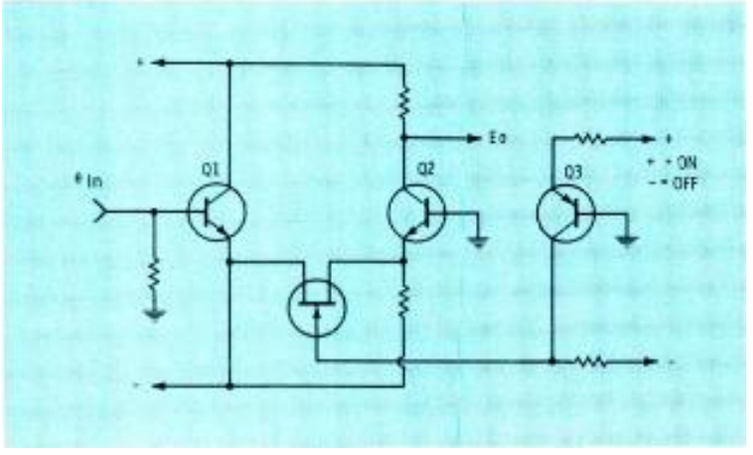

Fig. 5 Squelch amplifier.

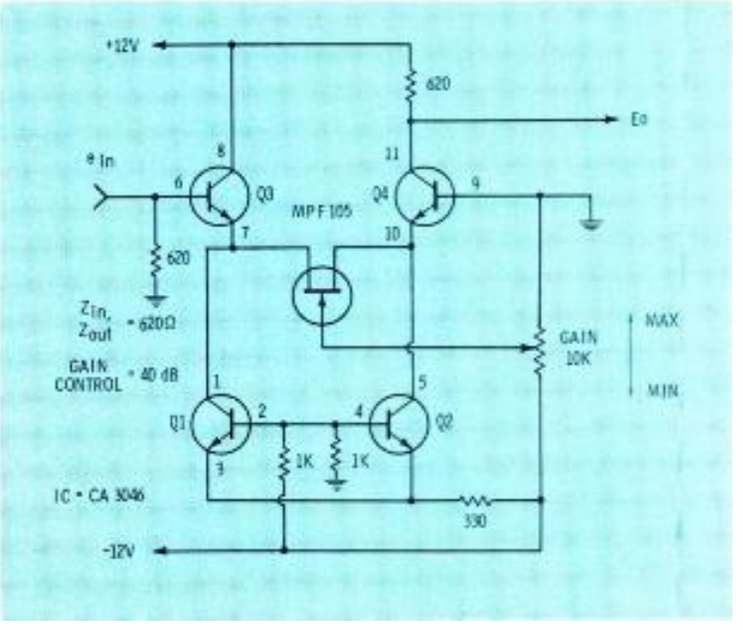

Fig. 6 Practical example of an attenuator.

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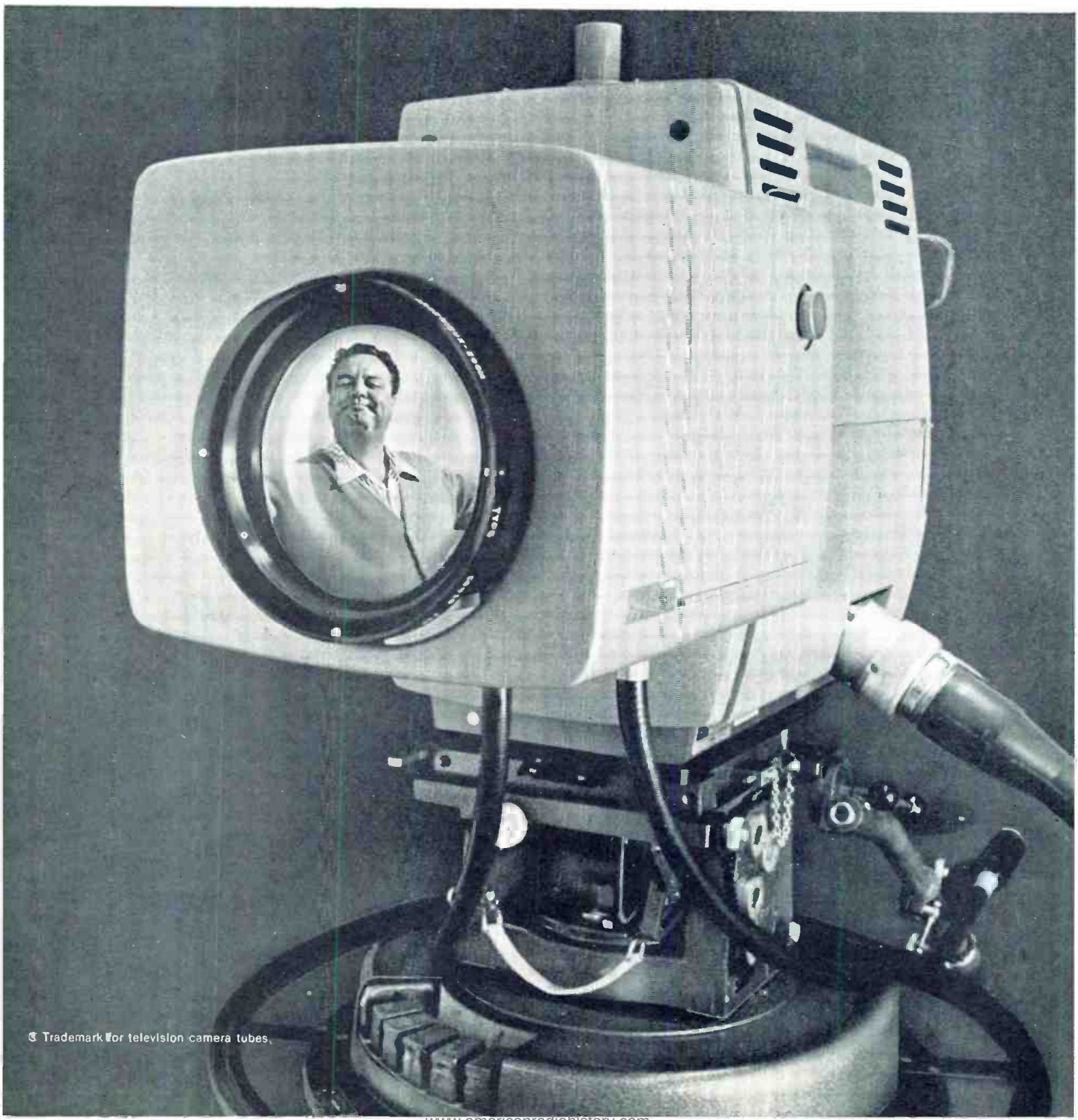

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ENGINEER'S EXCHANGE

Dear Editor:

Recently I was called upon to help a station here in the area which was off the air. Upon investigation it was determined that the audio driver transformer was shorted from the primary to one of the secondary windings. This, of course, dumped B on the grid of the modulator tube involved and resulted in a fiery red plate until the overloads took over.

The transformer was dismantled to see if any temporary repairs could be made. However, repairs were impossible.

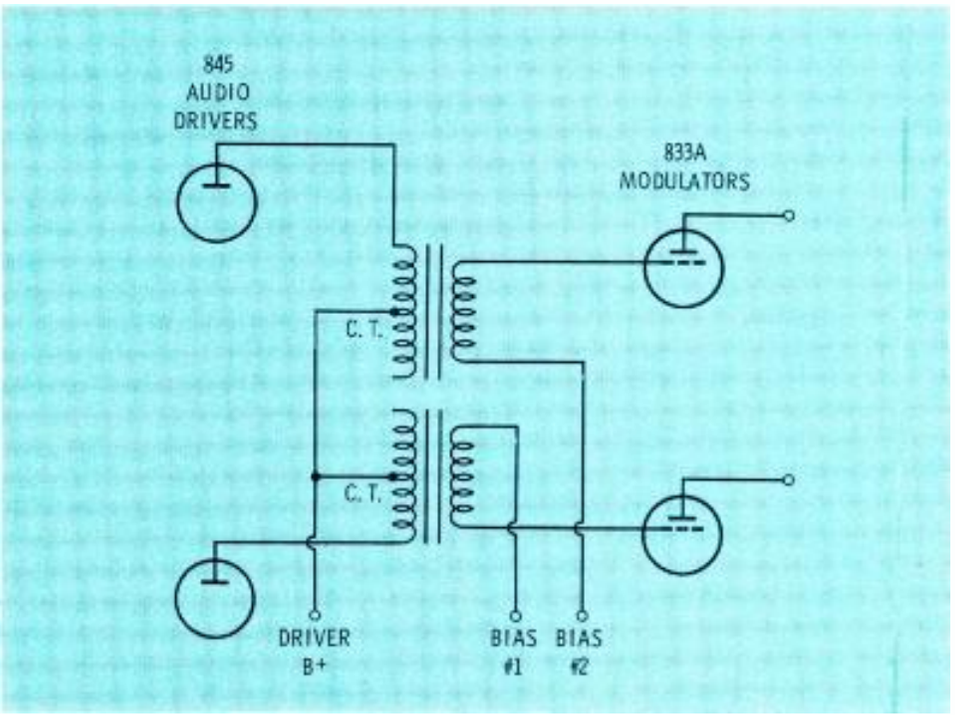
At this point we began casting about for some type of substitute, and recalled that TV power transformers have been used in "Ham" transmitters as modulation transformers. One of the engineers at the station was also employed at a TV repair shop, so a quick run was made to the shop to see what was available. We were very lucky. A pair of identical transformers was found.

With 110 volts on the primary windings, we measured about 650 volts on the secondaries. This was roughly a 1 to 6 step-up ratio. What was needed was a 3 to 1 ratio and a reasonable approximation of this was obtained by reversing the transformers and using only half of each secondary winding. The transformers were installed on a board to reduce the possibility of voltage breakdown. The original 110 volt primary windings were connected to feed the modulator grids. The center taps of the HV windings were tied together and hooked to the B— feed for the audio driver stage and one HV lead from each transformer was hooked to a driver plate. The remaining HV and filament leads were taped and tied out of the way.

This substitute worked surprisingly well and allowed the station to remain on the air until a replacement could be located, shipped and installed. The Bass response was reduced noticeably due to the saturation of the transformer cores by the DC current flow to the drivers.

If it is found that the rig won't modulate, reverse one of the windings feeding the modulators, and that should clear up the problem. While not a permanent cure, this scheme can well save a station an extended period of off-the-air time while locating and having a replacement shipped in.

E. J. Alexander
Chief Engineer
KMPL AM-FM
Sikeston, Mo.

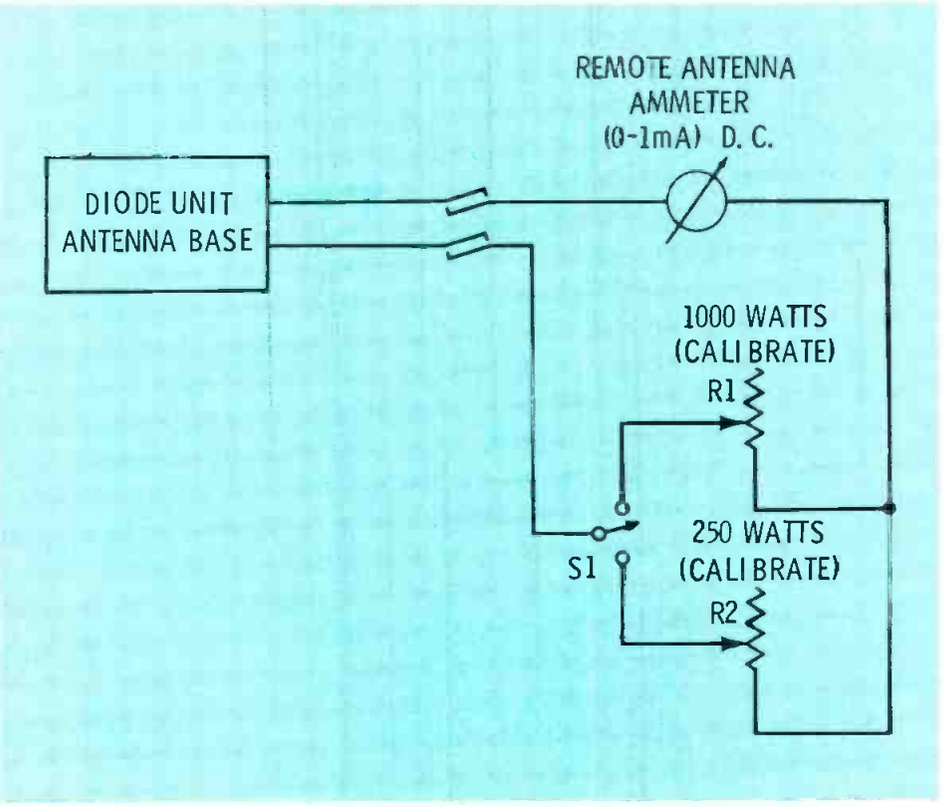


Dear Editor:

We were faced with a problem in which our remote antenna ammeter diode unit was not linear for both 1000 daytime and 250 watts nighttime powers. Therefore, you could not accurately adjust the remote antenna current meter for both powers during the weekly calibration checks. I installed the enclosed circuit which enabled me to accurately calibrate the remote meter for both powers. This diagram is simplified since I required additional switching because of an alternate main transmitter.

I thank you for your time and trust that this will be helpful to your fine magazine.

Dennis J. Snyder
Chief Engineer
South Burlington, Vermont



1. S1 can be a spare section of the transmitter's power change switch or relay.
1. R1 and R2 are both 5000 ohm carbon pots.

3. The Diode Unit in the antenna house was adjusted for full output and all calibration adjustments are made by the separate calibration pots on the transmitter cabinet.

EDUCATIONAL BROADCASTING

NAEB Publishes ETV Summary

In a study released by the National Association of Educational Broadcasters, it was disclosed that of 185 educational television stations surveyed, only 15 are equipped for complete color programming. The study, the first of its kind made by the NAEB, found that 22 stations are equipped for live color, 48 for color film, 45 for color slides, 35 for color tape and 80 for network color. Of the 185 stations, 90, or 51%, have no color facilities.

The report, "A Summary of ETV Station Information," also includes the results of: (1) a survey to determine the number of ETV stations which operate below the maximum visual power authorized by the FCC for their frequencies: and (2) a comparison of ETV and commercial station antenna heights.

A summary of statistics shows that of the 185 stations surveyed, 47 per cent of ETV antennas are significantly lower, (100 ft.) than commercial antennas in the same area. Eighty-two per cent of all ETV stations are operating below maximum authorized visual power for their frequencies.

The study, undertaken to determine deficiencies in ETV station facilities, will provide important data for projecting future requirements for expansion of facilities and financial assistance to ETV stations.

The report is available through the Office of Research and Development, NAEB, 1346 Connecticut Ave., Washington, D.C.

FCC Grants Waiver For Intercity Relay

The Commission has granted a request from South Dakota State University for waiver of Section 74.631 (e) of the Rules and has okayed applications for a six-hop, two-way TV intercity relay system between Brookings, South Dakota, and Appleton, Minn.

The three-hop northeast-bound TV relay system from Brookings to Appleton will transmit program material from educational station KESD-TV, Brookings, to a different licensee KWCM-TV, Appleton, which is not commonly owned. This service is contrary to the Section as it now stands, which provides that all program material transmitted over a TV intercity relay station shall be used by or intended for use by a TV broadcast station owned by or under common control of the TV relay station's licensee. Program material used by the licensee may be used by other TV broadcasting stations with the permission of the licensee of the TV auxiliary facility.

South Dakota State requested waiver of the rule in order for the construction permit and license to be issued in the University's name—the University being the owner of the associated intercity relay equipment.

Harley Asks Funds For ETV Expansion

William G. Harley, president of the National Association of Educational Broadcasters, testified before the Subcommittee on Labor, Health, Education and Welfare of the House Appropriations Committee, Monday, May 19.

He urged a $15 million appropriation for fiscal 1970 for Title I of the Public Broadcasting Act for educational television and radio facilities. His statement said: ". . . a $15 million appropriation would, based on past experience with this program, permit the activation of perhaps as many as 31 educational television stations, and the expansion or improvement of 18 more, and the activation or expansion of 24 radio stations . . . A $4 million appropriation would fund proportionately less activity, and would have proportionately less effect in putting local pledges to work, and might bring all new activity to a halt."

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FCC Seeks Comments On Scramble

A proposal to permit noncommercial education television stations to present scrambled programming during part of their broadcast day has been advanced by the Commission in a Notice of Proposed Rule Making (RM-1365). The action would be by amendment to Sections 73.621 and 73.682 of the Rules.

The Commission proposal followed a petition of November 1, 1968, filed by Community Television of Southern California, licensee of noncommercial educational station KCET, Channel 28, Los Angeles, California. Community Television asked that the rules be amended to allow noncommercial ETV stations to transmit limited amounts of encoded or scrambled television programs for instructing doctors, nurses, and law enforcement personnel. Community has transmitted such programs under experimental authority during the past four years.

Comments were received from many hospitals and institutions in the Los Angeles area, and from the Office of the District Attorney of Los Angeles County. All of those commenting agreed with the petitioner that the subject matter of such programs is not suitable for viewing by the general public and that use of ETV stations with scrambled signals would be far more economical than use of film, video tape, or Instructional Television Fixed Stations (ITFS).

The Commission said that Community's argument that there is a clear need for such programs has merit, especially in view of growing congestion in the ITFS frequencies in large metropolitan areas; however, the Commission pointed out that broadcast bands were set aside for broadcasting to the public, to anyone with a receiver, and that uses such as this are of a more limited nature, and are really a point-to-point service.

The Commission said comments on the Notice should be directed to the following questions, though not necessarily limited to them: Is it in the public interest to divert broadcast frequencies to a service of a private nature such as this? What should be the limits of the amount of time or percentage of operating time an ETV station may devote to scrambled programs of this sort? Should they be limited to or excluded from particular times of day? Should there be limitations on what ETV stations are eligible to engage in scrambled operations? Should it be permitted only by stations in markets having two or more ETV stations, or limited to only one station in a market?

It was also stated that the Commission is by no means convinced that curtailment of general ETV broadcasting to accommodate these uses is warranted, and is concerned lest the uses proposed here be an opening wedge for more widespread demands. Comments on this point were invited.

FCC Adopts New Rules To Authorize Response Stations

New rules to permit exchange of communications between teachers and students using Instructional Television Fixed Stations (ITFS) have been adopted by the FCC. At the same time, the Commission also initiated a rule-making proceeding to consider non-voice use of the facilities including teaching aids of various kinds.

The new rules authorize ITFS licensees to operate response stations in association with instructional TV stations so that questions and answers and classroom discussion may be carried on. They also permit use of voice communications when necessary for the technical operation of the system. The ITFS response station may be operated only by the ITFS licensee at an authorized receiving location, but any licensee may operate more than one response station. Response stations communicating with a single instructional station must operate on the same frequency determined by the channel assigned to the instructional television fixed station. Operation on other ITFS response channels is not permitted. Either AM or FM may be used for the response stations and no individual call signs will be assigned since it's felt that the stations can be readily identified from the nature of the material being transmitted.

The Commission initiated a rule-making proceeding in Docket 18346 on October 4, 1968, in response to a request from Leland Stanford Junior College. Numerous responses were received from educational, legal and technical sources, all in favor of the proposed rule. Some of the responses suggested, in addition, that such teaching aids as push button scoring and computer assisted instruction be included to take advantage of the most advanced teaching techniques. The Commission said, however, that since it wanted to act expeditiously in providing the voice channels, and since it felt that more specific information should be provided for the non-voice uses, it was authorizing the voice response service and issuing a Further Notice of Proposed Rule Making to solicit comments on other forms of exchange between instructors and students.

In answer to requests for opening licensing in the response channels to others in addition to ITFS licensees, to permit such uses as data retrieval and library reference service, the Commission said it preferred to wait until the ITFS response service had become established in voice or other student response areas before adding other uses "or creating a new service to operate on these frequencies."

Send Your News of Non-Commercial Stations and Organizations to Broadcast Engineering

Japan And England Lead In Public Broadcast Investments

Citing the commitments by the Governments of Japan and Great Britain in the field of public broadcasting, FCC Chairman Rosel H. Hyde told the Subcommittee on Commerce that the FCC "wholeheartedly endorses" legislation to appropriate $20 million for the Corporation for Public Broadcasting for the fiscal year 1970 and to extend for five years authority for grants for construction of educational television and radio broadcasting facilities.

Chairman Hyde said that the Japanese have a financial commitment to public broadcasting that would be equal to $1.7 billion a year in the United States. He noted that the British have made an equivalent effort and said that the United States has lagged behind these countries. Commanding the efforts of the Committee and its Chairman to remedy the situation, Chairman Hyde said that the bill before the Committee was "necessary to continue the progress in making noncommercial broadcasting a truly vital service to the American people," and he stressed the added diversity that public broadcasting would bring.

Stating that the FCC has, since its inception, been devoted to the principles of diversity and competition in broadcasting, Chairman Hyde said that "the American people are richer today—culturally as well as economically—because of the FCC's efforts to increase the diversity of sources of available information and entertainment."

"The present legislation is essential to continue our progress," Chairman Hyde said, noting that "Channels are available and the desire of states, local communities and educators to fill the clear needs is strong. Money, as is so often the case, is the missing ingredient. Many more operating stations will be needed for educational television to reach its full potential, and many states are planning state-wide educational television networks which will need increased funds. S. 1242 is designed to meet these needs."

NAB And NCTA Begin Work On Harmony Document

President Vincent T. Wasilewski of the National Association of Broadcasters announced today that representatives of the broadcasting and community antenna television industries have hammered out an agreement which, if adopted, would "allow CATV and broadcasting to complement one another and to exist in harmony."

He said in an address before the Federal Communications Bar Association here that the document "covers the major historic points of contention between broadcasters and CATV operators."

Wasilewski said the document has been submitted to important government leaders as a "reasonable" basis for ending "two decades of squabbling" over the respective communications roles of CATV and free broadcasting.

The executive committees of both NAB and the National Cable Television Association, he continued, have decided the agreement deserves "broader consideration" and "the Boards of Directors of NCTA and NAB must, acting in behalf of their respective members throughout the nation, determine whether such a document is workable and consistent with the interest of their members."

Some of the points in the agreement, he said, must be incorporated in the Communications Act, FCC rules and regulations, and the Copyright Law.

Here in summary is a broad outline of the agreement as reported by Wasilewski:

- CATV systems would be liable as determined by Congress for payment of copyright fees on television programs they retransmit to their subscribers.
- CATV systems would be permitted to carry three network affiliated stations, plus three independent commercial stations. Where television station signals must be imported to provide such service, a CATV system would have to pick up the nearest stations first.
- CATV systems would protect copyright material in two ways. Stations in the top 50 television markets would be protected on all non-network programs for the extent of their contracts. In all other markets, stations would be protected only for the first showing of a syndicated program. Protection means that a CATV system would not be allowed to import a competing signal which would duplicate such programming.
- All CATV systems serving subscribers as of the date of the passage of new copyright legislation could continue to carry signals they carry presently without providing the agreed-upon "exclusivity" protection.
- The present carriage and non-duplication rules require a CATV system to carry a local station's signal without degradation and afford same day non-duplication protection on network programming to local stations.
- CATV systems may originate sponsored programs on a single channel.
- Interconnection of CATV systems to distribute mass appeal programming would not be permitted.

Wasilewski said representatives of both NAB and the NCTA consider the agreement to be "a package" and the "deletion or significant alteration of a major point, or the addition of other points, could well disturb the balance and render the document unacceptable to broadcasters or cable operators." However, NAB said some refinements in language may be necessary.

Wasilewski said both sides feel the document "represents a major forward step of accommodation on the part of NAB and NCTA" but recognized that "we have a long hard road ahead before a theoretical document becomes an operating fact."

If the proposed arrangement can be carried out, he said, it would permit CATV and broadcasting "to complement one another and to exist in harmony" and both broadcasters and CATV could "then serve the public better."

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There are several additional features of the DPR which are described in our DPR brochure. (We'll send you a brochure on the DOC also, in case you are interested.) Drop us a line. Better still, call our DPR Information Phone at (805) 482-1911 ext. 216 and request the brochures.

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DIRECT CURRENT FROM D. C.

By Howard T. Head

Aural Proof Of Performance Requirements Under Study

Commission and industry engineers are paying an increasing amount of attention to various aspects of the engineering problems represented in conducting aural proofs of performance. One troublesome aspect is the performance of compression and limiting amplifiers almost universally employed by all AM, FM and television stations. The problem in connection with compression and limiting amplifiers is that no satisfactory method has been devised for simulating under proof of performance conditions the characteristics of these amplifiers when they are handling normal program material.

The Commission's Technical Standards specify that proofs of performance be conducted ''without compression,'' but differing interpretations of this requirement can lead to substantial differences in both distortion and noise measurement results.

Among the solutions to the problem which have been given consideration are (1) simply patching around the compression and limiting amplifiers, (2) leaving the amplifiers in the circuit by disabling the AGC rectifier, and (3) substituting a fixed bias for that normally produced by the AGC rectifier. All of these methods have their advantages, but none produce conditions truly representative of actual operation.

Perhaps you have your own solution to the problem and, if so, Broadcast Engineering would like to hear from you. Send your ideas to 1014 Wyandotte, Kansas City, Mo., 64105. We will digest the replies and pass along any helpful suggestions which are received concerning this and other audio proof of performance problems.

Color Uniformity Studies Continue

The Joint Committee on Inter-Society Coordination (JCIC) is making-progress in studies of color variations during the transmission of color television programs (See Oct., 1968 Bulletin and June, 1969 page 49.) These studies are revealing that color variations are far more serious than had been believed and also are showing that all of the steps along the color program chain are responsible to some degree for variations.

One of the more serious problems arises from the fact that there has been no coordination among the various elements, with makers of studio equipment, transmitters, and receivers feeling under little constraint to design their portions of the system to tolerances which would produce a workable whole. Consequently, JCIC is finding many instances where individual components of the system are indulging in exclusive tolerances which, when combined with variations in other components, produce color variations.

One receiver manufacturer has developed an automatic color control which corrects, insofar as possible, for changes in amplitude and phase at the color subcarrier frequency. The viewer selects flesh tones, sets the controls, and the automatic circuitry maintains phases and amplitudes to produce a pleasing effect.

Time And Date Now Required On AM Field Strength Readings

The Commission has amended the Standard Broadcast Technical Standards so as to require that all reports of field strength measurements indicate dates and times when measurements are made. The new rules are effective immediately.

This action is another step in the long-range study by the Commission's engineers on variations in AM field strengths which are often unexplained Variations may be seasonal, and in most instances are associated with cold weather. Variations in groundwave often have been observed over such a short period of time that interpreting AM proof measurements is difficult. The apparent indications are that long and short-term changes are at work.

In addition to seasonal fluctuations, there are well-known effects of skywave propagation which are present just after sunrise and just prior to sunset. This effect may affect the magnitude of fields, especially when groundwave field at a measuring location is relatively weak and skywave field is relatively strong.

Short Circuits

The Commission is expanding its program of research and computer studies in its planning activities; the latest project is the construction of a mathematical model of the entire television industry . . . The Commission is expected to act shortly to authorize frequency-shift keying (FSK) in lieu of amplitude modulation as a means of translator identification . . . The Broadcast Industry has endorsed the Commission's proposals to improve the relative ease of UHF television receiver tuning . . . The Commission is expected to act soon in the matter of adopting new Technical Standards governing non-commercial educational broadcast stations; meanwhile, an FM application in Iowa which proposed an ERP of more than the 100 kw permitted for commercial Class C stations has been turned down . . . ''Talk-Back'' stations for use with ITFS operation have been authorized.

Howard T. Head

Commission Rejects Petition To End Four-Network Operation

The ABC four-network radio service "serves the public interest and should be permitted to continue," subject to suggested corrective measures, the Commission has concluded in response to a complaint by the Mutual Broadcasting System. Among these measures are a limitation of affiliations in a single market, vigilance against duplication in any market and regular reports to the Commission on coverage. Mutual's petition for termination of the four-network operation was denied.

Denied as moot was an MBS petition asking the Commission to rescind the waiver granted ABC December 28, 1967. This waived Section 73.137 (prohibiting operation of more than one network by one organization) of the FCC Rules to permit limited simultaneous broadcasting in the same market in connection with delayed broadcast of the "Breakfast Club" program. This program is no longer on the air.

In its 1967 action on the four-network proposal, the Commission found overriding public interest considerations to warrant exemption from Section 73.137 for non-simultaneous networks. "We still find the exemption to be sound," the Commission said in its latest order.

Answering an MBS assertion that ABC dominance in markets where it has three or four affiliates is anti competitive, the Commission said. "We find that in the larger radio markets, where there are many radio stations, the affiliation of 3 AM and one FM stations with the four ABC (non-simultaneous) networks is not, per se, contrary to the public interest. However, we are concerned with the situation in the smaller radio markets, where the ABC networks affiliate with all, or nearly all, of the local stations. All four ABC networks place heavy emphasis on news and commentary, the minimum being 70%.

"Since the news and commentary programs for all ABC networks originate from one company, we cannot find it in the public interest to have all, or nearly all, of the stations in a market affiliated with commonly owned networks. There should be a limitation on the number of affiliates permissible for one network owner in the smaller markets. Until we have an opportunity for further study of this question, we are requesting that ABC limit its AM affiliations and disaffiliate when necessary in markets with more than one AM station to no more than one affiliate in 2-station, 3-station or 4-station markets and no more than two affiliates in a 5-station market."

MBS charged that ABC is violating Section 73-137 because affiliates have been broadcasting programs simultaneously in some markets, particularly where an affiliate delays a program. The Commission said, "We will require ABC to tighten its controls and eliminate even minor infractions of the rule and we hereby request that ABC file annual reports of its surveillance and the results thereof of enforcement of 'Delayed Broadcast' provisions in its Affiliation Agreements . . ." ABC also was directed to file quarterly reports showing radio markets covered and the percentage of national coverage obtained for each network.

In connection with an MBS fear that ABC expansion may force it out of business, the Commission reviewed network financial information. "It is apparent," the Commission said, "that radio networking as a business has been generally unprofitable, compared to other elements of broadcasting. ABC has the poorest financial record of all the radio networks, operating at a loss of roughly $2 million per year between 1956 and 1967 and showing a substantially higher loss in 1968, its first year of expanded operation."

The Commission expressed great concern, however, with the possible anti-competitive aspects of the multi-network operation and expects to review this question when one or more of the ABC networks reaches 75-80% national coverage.

SCANNING THE CATV SCOPE

CATV System Operator Seeks Relief In FCC Interpretations

The City of Trenton, New Jersey, and CATV system operator TelePrompTer Corp., have petitioned the New Jersey U.S. District Court to enjoin the FCC from "impeding or interfering with the operation" of a proposed planned cable TV system for that city.

The petition for a ruling on the complaint charges that the FCC, by failing to act as soon as possible, and on account of its Interim Procedures, unlawfully violated the right to freedom of speech.

A petition was submitted by Trenton which had granted a CATV system franchise to the TelePrompTer Corporation. At the present time the city has no TV stations in operation. In response to this action, a Section 74.1109 petition to the FCC was submitted by a Philadelphia TV broadcast station. The city of Trenton, New Jersey is located 13 miles from the Philadelphia city limits and 30 miles from New York's city limits. The major factor is that due to the vast physical area of New York City, the 30 mile limit is of importance because Trenton is actually 52 miles from New York's TV transmitter antennas located atop the Empire State Building.

Although the hearing was pending for the waiver of the Rules, the FCC issued the Notice of Rulemaking and Interim Procedures which, in effect, kept the CATV system from carrying New York TV signals.

FCC CATV Decision Is Judged Unconstitutional

The Bucks County Cable TV, Inc., of Fairless Hills, Pennsylvania, had petitioned the U.S. Court of Appeals for the Third Circuit for review of the Commission's CATV proposed Notice of Rulemaking and Interim Procedures.

The petition also requested review of the automatic stay provisions of Section 74.1105 (c) of the FCC Rules as applied to Bucks County CATV Service, and the Commission action of January 22, 1969 authorizing the Bucks County Cable TV to operate in Falls Township, Bucks County, Pennsylvania, with local Philadelphia and Wilmington, Delaware TV signals, and setting up a hearing on requests for importation of distant signals from New York City.

In response to this petition, a judge of the Philadelphia U.S. District Court has labeled the FCC ruling unconstitutional as it applies to the Bucks County Cable TV in Falls Township. Judge R. Body said that Commission Rule providing for an automatic stay was unconstitutional as it applied to the Bucks County Cable TV. He said in failing to rule on the matter as soon as possible, the Commission thus denied the system its right to due process of law. He granted the system's request for an injunction against prosecution for failure to comply with the automatic stay when preparing for operation to Philadelphia UHF stations, urged the Commission to prohibit the proposed services to Bucks County Cable TV on the grounds it would affect them barring the automatic stay. The Commission had not ruled on the petitions when the new cable antenna rules were issued by the FCC last December.

California First Class Operator's License Suspended

The Radiotelephone First Class Operator's license of Robert Allen Veatch, San Bernardino, California, has been suspended for six months by the FCC for transmission on October 27, 1968 of an obscene "stag" film from KPLM-TV, Palm Springs, California, to CATV systems in the Coachella Valley. The motion piction film contained obscene and indecent meaning in violation of Section 13.67 of the Commission's Rules.

Veatch's license was suspended under the authority contained in Sections 303 (M) (1) (A) and (D) of the Communications Act. On December 2, 1968 he pleaded guilty before the U.S. District Court for the Central District of California and was fined $500.00 under Section 502 of the Communications Act.

Dawn Patrol Cable TV System

Tri-Cities Cable TV, which serves the communities of Petersburg, Colonial Heights and Ettrick, Virginia, recently began originating all-night, every-night programming. Using its public service channel, Tri-Cities' augmented schedule now runs from 12 midnight until 12 noon every day, plus 4 P.M. to 6:15 P.M., Mondays through Fridays.

A large number of cable customers in the area are shift employees of industrial plants. Aside from shift employees there are invalids and insomniacs for whom commercial television provides little during the long night hours.

Multi-Million Dollar CATV System Turnkey

Theodore Baum, President of Vikoa Construction Corp., has announced that the firm has received a contract to deliver a complete operating system on a turnkey CATV basis to the San Jose Cable TV, Inc., for the San Jose, California, CATV system at a total purchase price of $15,000,000.

Construction and installation of the system was scheduled to begin in April 1969 and should be completed within a minimum of four years of construction time. The system will have provisions for 48 channels and will cover more than 2,000 miles of dual plant facilities. This proposed system will be the largest CATV facility in the country.

CATV As Pacesetter For Educational System

As a requisite for the installation and operation of an educational CATV system, the Bucks County Cable TV., Inc., of Fairless Hills, Pennsylvania, has requested permission of the Falls Township Pennsbury School Board to install a CATV system to the Pennsbury Schools in the municipality.

It was the first time CATV has been used in the district and it will serve as a pilot project to familiarize the school directors with the technique. This program was transmitted from the BCCTV headquarters in Fairless Hills to the Fallsington School Administration Building. The franchise with Falls Township requires one connection at each of the 11 Pennsbury Schools in the municipality and 7 schools outside Falls Township.

After a feasible study, the school board has been approached to use CATV as an educational facility on a four county basis. The school board will investigate the entire CATV proposal and will take action in the very near future.

Quasi Laser Link System For CATV

The Quasi Laser System developed by the Chromally American Corporation and Laser Link Corporation was demonstrated for the Federal Communications Commission on October 24, 1968. According to the company, the Quasi Laser Link System provides innovations in television transmission techniques and expands the scope of television's horizons to provide from 20 to 40 additional channels of service at low cost to both urban and rural communities of the United States.

This new dimension in broadcast transmission was created to meet the burgeoning needs of community antenna requirements. In some cities where all cable must be used under

the street, this system is an economical alternative.

According to the developer of the system, the programming can be originated from any point using only a camera, microphone and a device that translates the picture and sound into the Quasi-Laser impulses for the instantaneous trip into every home and apartment house. It is understood that the Quasi-Laser Link System can be operated on any assigned carrier frequency within the band of 10 GHz to 10,000 GHz. The current state of technology at present is such that maximum economics are associated with the lower frequencies closest to 10 GHz.

NAB Objects To CATV Origination Of Advertising

The National Association of Broadcasters position relating to CATV origination of advertising was outlined in a filing before the Federal Communications Commission by Douglas A. Anello, NAB General Counsel, and John B. Summers, Assistant General Counsel.

The filing pointed out that if CATV is permitted to originate advertising it would be engaged in direct competition for the advertising dollar with the very station whose signals it is using as a basis for its operation, adding that this would defy the most elemental standards of fairness. NAB said that the origination of advertising by the CATV system will result in an eventual decline in both the amount and quality of free radio and television broadcasting and will lead to a system of CATV-PAY-TV. The Association also objected to any limitation of cross-ownership of CATV systems and broadcast facilities.

FCC CATV Task Force Actions

The CATV task force on April 14th dismissed as moot points the requests of the following CATV system operators:

Jackson County Cable TV, Inc., Pascagoula, Mississippi—Dismissed as moot Section 74.1105 notification filed June 13, 1968.

Roywood Corporation, Mobile, Alabama—Dismissed as moot "Objection to notification and petition for declaratory ruling" filed July 15, 1968.

WKRG-TV, Inc., Mobile, Alabama—Dismissed as moot "Opposition to proposed importation of distant signals and request for hearing" filed July 15, 1968.

Waivers Applied To Section 74.1107

Cable TV of Sylacauga, Inc., operator of a CATV system in Sylacauga, Alabama, has been granted a waiver of the hearing provisions of Section 74.1107 of the rules by the Commission and has been authorized to carry the distant television signals of stations in Alabama and Georgia.

Cable TV will carry the distant signals of WSFA-TV (NBC, Channel 12); WCOV-TV (CBS, Channel 20), and WKAB-TV (ABC, Channel 32), Montgomery, Alabama; WJRJ-TV (Independent, Channel 17), WSB-TV (NBC, Channel 2), and WAGA-TV (CBS, Channel 5), Atlanta, Georgia; and WCFG-TV (CP, Channel 68), Birmingham, Alabama, when it becomes operative. Cable TV now carries signals of Birmingham Stations WAPI-TV (NBC-CBS, Channel 13), WBRC-TV (ABC-CBS, Channel 6), WBMG (AB, CBS, NBC. Channel 42), and WBIQ (educational, Channel 10).

A request for interim authority and waiver of distant signal requirements has been granted by the Commission to Northwest Illinois TV Cable Co.. Inc., Galesburg, Illinois, to carry the distant signals of non-network stations WGN, WCIU and WFLD, all Chicago, Illinois; KSST, Davenport, Iowa, and KPLR, St. Louis, Missouri and educational station WTTW, Chicago, on its proposed new system.

Triangle Cable Company, located at Oakdale, California, in the Sacramento-Stockton TV market (22nd among the top 100) has been authorized by the Commission to begin operation of its proposed CATV system at Oakdale, carrying the signals of television station KNTV, San Jose, but not of Station KSBW-TV, Salinas. Under notice of Section 74.1105 Triangle Cable Co., listed its intention of carrying the local California signals of KLOC-TV (Independent), Modesto, KCRA-TV (NBC), KXTV (CBS), KVIE (Educational), and KXTL (Independent), Sacramento; KOVR (ABC), Stockton; KVTV (ABC), San Jose, and KSBW-TV (CBS-NBC), Salinas.

Oakdale is within the predicted Grade A contours of KXTV, KOVE and KOCC-TV, and within the predicted Grade B contours of the remaining stations.

A petition was filed by Great Western Broadcasting Corporation, licensee of TV Station KXTV, Sacramento, asking relief under Section 74.1109 of the Rules against Triangle's carriage of the signals of KNTV and KSBW-TV. Authorization has been granted to carry signals from KSBW-TV and denied in other respects.

The request by petition, of Tomah State Wide TV, Incorporated operator of a Tomah, Wisconsin, CATV system, for waiver of the non-duplication requirements of Section 74.1103 (e) of the Rules, or for a declaratory ruling, has been denied by the Commission, and Tomah has been directed to afford program exclusively to television Station WKBT, La Crosse, Wisconsin. The Commission has also denied a petition by WKBH Television, Inc., licensee of WKBT, asking that Tomah show cause why it should not be ordered to cease operation until it complies with the notification provisions of Section 74.1105 of the Rules.

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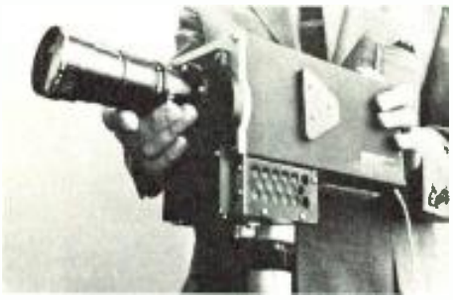


(60)

A color television camera that weighs less than 15 pounds and a "mini" monitor—a TV set with a screen smaller than a credit card—was built by **Westinghouse Electric Corporation** for Apollo 10 astronauts to take with them on their mission to the moon.

The camera is about 17 inches long including a variable focus "zoom" lens. It is designed to be carried aboard the three-man Apollo 10 command module and is the first color TV camera designed for use aboard a manned spacecraft. The use of a zoom lens and a TV monitor aboard a manned spacecraft are also space "firsts."

The lens has a variable focal length ranging from 12.5 millimeters to 75 millimeters and will provide a diagonal field of view variable from 54 degrees to nine degrees respectively There is a range of aperture stops from f2.2 to f22 for operation in the expected mission light levels and a focus range of 20 inches to infinity.

(61)

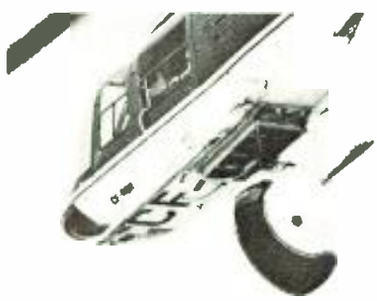
The first **Ampex** HS-200 high band color disc recording system designed for the production of color commercials and other television programs has been demonstrated by the video division of Reeves Broadcasting Corporation, New York City.

An outgrowth of color disc technology pioneered by Ampex, the computer-controlled system records and plays back frame-by-frame color pictures and permits an operator almost immediate access to any recorded frame from a push-button editing console. Like the original high band color disc recorder, the Ampex HS-100, the system plays back recorded material at normal, fast and slow speeds, down to stop-action, in both forward and reverse modes.

Thirty seconds of program material may be recorded on the HS-200 system for immediate or repeated playback on highly polished plated metal discs. Additional flexibility is possible by recording every other frame, every third frame, or any sequence of frames to increase the time span of recorded material. For instance, by recording every other frame, 60 seconds of action can be recorded without disrupting the flow of action.

The computer-controlled editing capability of the disc system gives the operator instant access to all recorded frames, as each frame is automatically addressed for positive identification and swift retrieval. The system's programmer enables the operator to assemble recorded material in any order, insert program material from other sources and add special effects.

Because the system is fully locked to station sync, program material from color television cameras, videotape recorders and film chains may be incorporated in to a finished commercial. When used with a videotape recorder, the HS-200 system may be programmed to insert cuts, wipes, dissolves and other special effects into a completed tape. Color cartoons and other animated programs can be recorded on discs and transferred to tape.



(62)

A new photography technique originally intended for airborne surveillance work, is now ready for

television and motion picture producers.

The technique employs a new device called the Wesscam stabilized camera mount developed by Canadian Westinghouse in Hamilton, Ontario, Canada. With the Wesscam stabilizer the director can use a helicopter, boat, auto or any other form of mobile base to place his camera anywhere in the three-dimensional space surrounding his subject, and ask for any form of camera movement with the assurance that the resulting pictures will be as clear and vibration-free as though taken from a sturdy, ground-based tripod.

The system consists basically of a gyro-stabilized platform contained in a ball-shaped housing mounted outside a moving vehicle. The platform inside the "ball" supports the camera which is operated via remote control by the cameraman riding safely inside the vehicle.

The camera's reflex viewfinder is integrated with a closed circuit television system that relays a picture of the shooting area to a video monitor inside the vehicle to show the cameraman what he is filming. Due to the gyro-stabilization, the camera remains stationary and vibration-free. It can pan through 360 degrees or tilt to a maximum of 90 degrees.

(63)

Videometrics, Inc., Plainview, New York, has introduced a new video test signal generator directed primarily at the CATV, ETV and microwave markets. The Model 309A produces a composite test signal comprising a color burst, modulated 5-step stairstep, 20T pulse and Sine Squared (T) Window.

This one test signal provides for the measurement of system gain, linearity, differential phase and gain, luminance/chrominance gain and delay ratios, as well as short time, line time and field time waveform distortions (frequency response). It is available in portable case or rack-mount configuration.

(64)

A new AC voltmeter plug-in, the DP 130, has been introduced by **The Hickok Electrical Instrument Company.** The new plug-in, when used with any Main Frame of Hickok's DMS 3200 Digital Measuring System, provides digital display of AC voltage measurements over a wide range of level and frequency.

AC measurements down to 10 microvolts and as great as 1000 volts are possible with the DP 130, and with an accuracy specification of ±0.1% of reading ±1 digit. Although accuracy in this order of magnitude is rather commonplace in DC digital measurements, it is most

unusual to find it in AC measuring devices.

The plug-in may be used for measurements over a frequency range of 22 Hz to 1.0 MHz. Accuracy of 0.1% is maintained over the range of 22 Hz to 100 kHz and with but a slight reduction up to 1 MHz. The unit is designed to provide RMS readings when measuring sine wave AC signals: however, it will accept and display accurate indications of the RMS value of square and triangular waveform inputs as well, if specified correction factors are applied to such measurements. The DP 130 is designed and constructed to assure the stipulated accuracies so that certification is available from independent calibration laboratories which are approved by the National Bureau of Standards.

Loading errors are minimized by the exceptionally high input impedance of 1000 megohms shunted by approximately 25 picofarads on all ranges. Long term stability is assured by ultra-stable voltage dividers and a precision temperature compensated zener diode reference. Its basic design uses a unique dual slope, self-zeroing integration technique. Input circuitry is protected from damage by excessively high voltage and a built-in filter, selected by a front panel switch, provides additional noise rejection during low frequency measurements.

(65)

A new low-cost, lightweight helical scan video tape recorder designed for color has been introduced into **Bell & Howell's** line of closed circuit television systems.

The recorder, which utilizes one-inch tape, is available in two versions, both with color capability. The model 2000 can be converted to color with the addition of one plug-in circuit board. Further, as the machines are otherwise identical, color programs taped on the monochrome unit contain all color information and can be played back in full NTSC-type color with any Bell & Howell color machine.

Simplified controls, standard stop motion and tape timer (in minutes and seconds) make the new recorders ideal for use by non-technical people. Both VTR's have a playing time of one hour with 2,150 feet of tape, significantly less tape than many other machines. Fast forward and rewind time is less than four minutes.

(66)

A new sync generator designed to produce a 2:1 interlace synchronized

signal when used with CCTV cameras and other equipment with provision for external sync, has been announced by the **GBC Closed Circuit TV Corp.**

With the GBC SG-1, the CCTV operator can switch from one camera to the other, maintaining a constantly uniform picture on the monitor without tearing of the picture. Used with video tape recorders, the SG-1 provides the necessary stability to produce "stop action" and "slow motion."

The SG-1 employs solid-state circuitry throughout. Advanced IC's are used to stabilize the synchronized waveform to assure a clear, strong picture. The compact and light-weight SG-1 provides horizontal and vertical drive outputs. Threaded output terminals from the case provide positive contact with the camera cables. The terminals accept type "F" cable connectors.

(67)

Production of the new 6000 series high-resolution, closed-circuit television system has been announced by **Cohu Electronics, Inc.**

Designed primarily for applications which demand a high picture detail, the basic system consists of a Model 6100 television camera and 6800 camera control unit.

The solid-state 6100 camera is available in 8 MHz, 16 MHz, or 32 MHz video bandwidths and can provide vertical center picture resolution up to 825 lines with its 1-inch separate mesh vidicon tube. With a horizontal scan rate up to 1225 lines, the camera is capable of generating a television picture that exceeds the clarity seen on a typical home receiver.

Picture fidelity is the result of a low-noise hybrid preamplifier and a wide range automatic sensitivity circuit. The camera measures approximately 15½ inches in length, 7½ inches in width, 5 inches in height, and features transistor and integrated circuit design. Its circuitry is mounted on accessible plug-in cards contained in a high-strength, cast aluminum-alloy housing.

The camera control may be stationed as far as 2000 feet away from the camera and is housed in a dual-compartment rack-mount enclosure which occupies only 5½ inches of vertical rack space. The enclosure will accept either dual camera controls, or a single camera control and control panel.

(68)

Comrex has announced the availability of their latest innovation, the model 7029 Studio Wireless Microphone System.

The new unit operates in the 152 to 174 MHz frequency range. Both transmitter and receiver are crystal controlled, and the transmitter power output is 250 milliwatts.

Comrex also currently is ready with their model 1036 10 watt monitor amplifier. This unit operates directly with input levels of —36 dBm to +40 dBm, and no external pads are required. Completely self-contained, no external power supply is needed and the unit is short circuit protected.

(69)

A new Colorgard meter for setting the white display of color monitors or receivers to the same color temperature (chromaticity) has been developed by **Gardner Laboratory** and will be marketed by **Television Equipment Associates.**

The instrument is not calibrated in color temperature values but in arbitrary RGB values. This enables the operator to correct for any change deviation in the phosphor make-up of the same or different kinescopes. This capability is of particular interest to TV networks and stations where color monitors and kinescopes would be non-uniform with respect to monitor model, kinescope phosphor and kinescope age.

The basic unit is self-contained and may be used alone. Its dimensions are 13½′ x 3½″ x 7″ and weight 8½ pounds. A sensing probe, which stores in the back of the instrument, attaches to the face of the kinescope with a suction cup. Three silicon photodetectors view red, blue or green light from the kinescope through specially selected narrow-band interference filters. The probe may be positioned on the kine to look at one single NTSC color bar or one step of a gray scale.

Three null-type meters on the front of the instrument show a simultaneous indication of the correctness of the ratio of red-to-blue-to-green phosphor emissions.

PEOPLE IN THE NEWS

The American Women in Radio and Television, Inc., has presented **Dr. Peter C. Goldmark,** president of CBS Laboratories, its International Silver Satellite Award for outstanding contributions to the field of communications.

The award was made by **Mary Dorr,** president, at the AWRT national convention in Houston, May 3.

Dr Goldmark, who set the wheels in motion for the long-playing record, color television and, more recently, the Electronic Video Recording (EVR), holds more than 150 patents for inventions relating to communications technology. He developed the long-playing record 20 years ago, and is responsible for the first successful color television broadcast system. His field-sequential system beamed America's first color coverage of the moon to worldwide television audiences from aboard Apollo 10 during its orbital moon flight.

The Hungarian-born physicist spearheaded the development of electronic video recording which makes it possible for the first time to play prerecorded programs over ordinary television sets.

The International Satellite Award is given for outstanding accomplishments in or contributions to the field of broadcast communications through artistic, scientific, sociological, cultural or humanitarian efforts, Miss Dorr said. It was given for the first time last year to Bob Hope for his humanitarian contributions to American servicemen during World War II, and the Korean and Vietnam Wars.

"Dr. Goldmark, who is renowned for his scientific achievements, has been singly responsible for the cultural and entertainment enrichment of millions of people," Miss Dorr said.

Harold P. Westman, nationally known technical editor and expert in electronics standards, retired recently after 24 years of service with International Telephone and Telegraph Corporation.

Westman's interest in electronics dates from his early years. As a youth he held both commercial and amateur licenses as a radio operator and he acquired experience in telegraph communications, vacuum tube manufacture, and telephone-exchange installation.

He served from 1926 to 1929 on the editorial staff of QST, the amateur radio operators' journal, published by the American Radio Relay League, becoming technical editor in 1928. In 1929, he joined the headquarters staff of the Institute of Radio Engineers, now the Institute of Electrical and Electronics Engineers. After serving briefly as assistant secretary, he became national secretary of the IRE in 1930.

For 40 years, he has contributed to engineering literature as an author and editor. He is a Fellow of the Standards Engineers Society and a Senior Member of the Institute of Electrical and Electronics Engineers.

Richard E. Hill has been appointed television consultant to a newly formed broadcast equipment group of Electronic Engineering Company of California (EECO). According to **John S. Baumann,** broadcast equipment manager, Hill will be involved in the promotion of EECO's "ON TIME" video tape editing and control equipment, as well as development of new products for the broadcast industry.

Hill has been involved in various technical areas of radio and television for twenty-five years, the last fifteen years with the Columbia Broadcasting System, Television City, Los Angeles.

Aaron D. Allen has been promoted to chief engineer with WATU-TV, channel 26, Augusta, Ga. He was formerly a member of the engineering staff. He succeeds **J. W. Byars** who has resigned to take a position with The Ampex Corp. in Little Rock, Ark.

Richard L. Geismar has been elected president and a director of Reeves Broadcasting Corporation, it was announced recently by **Hazard E. Reeves,** chairman of the board.

Geismar will assume full operating responsibility for Reeves and its subsidiary companies.

Robert M. Reed, Director of the Hawaii Educational Television Network, Director of Educational Television Broadcasting, and Associate Professor of Education, both the University of Hawaii, Honolulu, has been named Director of the Educational Television Stations Program Service in Bloomington, Indiana. He will assume his new duties August 15. He succeeds David H. Leonard, now Director of the Pennsylvania Public Television Network.

Sonderling Broadcasting Corporation has appointed **Alan Henry** to the position of executive vice-president and chief operating officer, it was announced recently by **Egmont Sonderling,** president.

In the newly formed position, Henry will have overall responsibility for the day-to-day activities of the diversified communications company and will report directly to the president.

Election of **Albert E. Cookson** as a senior vice-president of International Telephone and Telegraph Corporation was announced recently by **Harold S. Geneen,** ITT chairman and president.

Cookson, who has served as vice-president and general technical director of the Corporation since June, 1968, has been at ITT's New York headquarters since February, 1965.

Cookson holds a bachelor's degree in electrical engineering from Northeastern University and a master's degree in electrical engineering from M.I.T.

He is a member of the Tau Beta Pi and Sigma Xi engineering and scientific honorary societies and a Fellow of the Institute of Electrical and Electronics Engineers.

Alfred L. Ladage, formerly an electronics engineer for NBC International Ltd. in Saudia Arabia and director of engineering at XYZ Television in Grand Junction, Colo. has joined the staff at College of the Desert in Palm Desert, California as technical supervisor of Audiovisual and Broadcast Services.

TECHNICAL DATA

73. **ALLEN AVIONICS, INC.** — Precision delay lines, L-C filters and passive laboratory instruments are detailed in a new 12-page brochure P12. A wide variety of custom-built and stocked delay lines and filters are covered with descriptions, specifications and charts. Also included is the newly introduced Spiradel miniature fixed delay line.

74. **AMERICAN ELECTRONIC LABORATORIES, INC.**—Literature is now available on the VHFA-20 communications amplifier. A 1,000 watt broadband amplifier, the unit has only one tube and is tunable over the range of 20-76 MHz. The amplifier allows frequency change in less than two minutes and can be used for Class A_1, A_3, and F_1 modulation.

75. **AMPEX CORP.**—A brochure describing Ampex broadcast television switching and control systems is available. The custom-built systems may be either computer or manually controlled, and are designed for use by television stations, networks and teleproduction houses. Bulletin V240. Also, a brochure describing the VR-660C portable color videotape recorder for closed circuit television production and monochrome broadcaster use is available. The recorder is designed for color recording and editing in education, industry, business, military, medical and CATV applications.

76. **APPLIED RESEARCH INC.** —The latest developments in a line of telemetry components and modules are described in a new catalog. The publication, "L and S Band Telemetry Components," lists specifications of a wide range of units including amplifiers, multicouplers, filters, converters and multipliers.

77. **BELL AND HOWELL**—New literature is ready on Bell and Howell's color closed-circuit television film chain. The brochure explains the operation of the film chain system and describes basic features of the camera, projector, pedestals and multiplexer. Brochure No. 26730.

78. **DIALIGHT**—A new catalog sheet, designated as S-181, offers data highlighting features of all six Dialight Readout series. Described are incandescent and neon readout modules for 6V AC-DC; 10V AC-DC; 14-16V and 24-28V AC-DC; 150-160V DC and 110-125V AC circuits. Specifications are given for numeric readouts having ¾" and 1-1/32" high characters and auxiliary caption modules.

79. **DIELECTRIC COMMUNICATIONS** — A new 72-page application manual is now available from this division of Sola Basic Industries. The manual provides detailed design data for selecting coaxial components such as rigid transmission line and accessories for RF sub-systems operating in frequency ranges up to 7000 MHa at up to several megawatts peak power. Diagrams, graphs and product photos are included in this manual. No. 70-1.

Also available from Dielectric is a 58-page application manual, 70-2, which contains their complete line of WR-650 through WR-2300 large waveguide and Waveguide components.

80. **ELECTRONIC INDUSTRIES ASSOCIATION**—A new Recommended Standard and three Joint Electron Device Engineering Council publications are available from the EIA Engineering department: RS-361, Feed-Through Radio Interference Capacitors Paper, Film and Paper/Film Dielectric;

JEDEC Publication No. 69, proposing preferred lead arrangement for quadruple-triode junction field-effect transistors using flat pack JEDEC outlines TO-84 through TO-88; JEDEC Publication No. 70, "Recommended Practice on X-Radiation Detection and Measurements for Microwave Tubes;" and JEDEC Publication No. 72, "Recommended Practices for Conversion of U.S. to Metric Dimensions for Color and Monochrome Cathode Ray Tubes and Their Component Parts."

81. **ERIE TECHNOLOGICAL PRODUCTS, INC.** — A new distributor catalog, 32 pages, covering all electronic components stocked by the company, has been published. Illustrated with photos, diagrams and charts.
82. **GATES RADIO CO.** — Two technical papers of current interest to broadcasters and particularly engineers are available. W.J. Kabrick, engineer coordinator for audio at Gates, describes the new generation of audio control devices in a booklet called, "Audio Signal Processing by Means of AM/FM Limiters and AGC Amplifiers." The second paper is titled, "Susceptibility of the Open-Delta Connection to Third Harmonic and Transient Disturbances," was compiled by Daniel R. Dening, RF systems designer engineer.
83. **GENISCO TECHNOLOGY CORP.** — Operating characteristics of a new, inverse high pass filter are described in a data sheet available from the Components Division. Dimensional drawings of two configurations of the model HP 322 are provided. Also included is a schematic of a typical application circuit and a chart showing typical frequency response curve in decibels over the range from 10 Hz to 1.0 MHz.
84. **HARVARD INDUSTRIES, INC.** — Frequency Engineering Laboratories, division of HI, Inc. has available an application note 691 which describes in detail how the HP8614A signal generator can be used in conjunction with an FEL 130A stabilizer to generate signals with stability and purity normally associated with synthesizers.
85. **HEWLETT-PACKARD** — A new 3-page application note from the company describes the alignment of A2A local television video loop equalizers and the equipment necessary for doing the job. Application Note 114 discusses the characteristics of coaxial cable losses and kinds of equalization needed to compensate video signals for cable losses.
86. **JERROLD**—A new literature piece is ready describing transmitting equipment for instructional television fixed service (ITFS) systems.
87. **KALART**—Large Screen TV Projector brochure illustrates and describes the Kalart Tele-Beam large screen TV projector. Used in educational TV and Instructional TV systems in education, medicine, industry, entertainment, and multimedia A-V systems, Tele-Beam receivers and projects closed circuit television inputs from TV cameras, video tape recorders, or "off-the-air" broadcasts.
88. **MOTOROLA INC.**—Motorola S1315A Frequency Calibrator is the title of a new brochure on the company's instrument. The 4-page brochure describes this new solid-state device which, for calibration purposes, generates a spectrum of precise frequencies from 100 kHz to 500 MHz covering mobile and aircraft bands.
89. **NATIONAL BUREAU OF STANDARDS** — Periodicals available are "Technical News Bulletin," Vol. 53, No. 4, April 1969, and "Journal of Research of the National Bureau of Standards," issued as Sections A, B, and C. Section A is entitled Physics and Chemistry"; Section B "Mathematical Sciences"; and Section C "Engineering and Instrumentation". Several other non-periodicals are available also.
90. **NATIONAL SEMICONDUCTOR CORP.** — An operation amplifiers specification guide is available, providing basic specifications on the line of military and commercial integrated circuit op amps.

91. **POMONA ELECTRONICS, CO.** — The company has announced publication of the 1969 general catalog of electronic test accessories. The new catalog is 52 pages and contains 375 products, 78 of which are new to the line this year. The catalog provides complete engineering information on all items.

92. **RCA** — "Solid-State Ballasting of Mercury-ARC Lamps," application note AN-3616 is available. Also published are "AC Voltage Regulators Using Thyristors," application note AN-3886, and "UHF Power Generation Using RF Power Transistors," application note AN-3755.

93. **SPRAGUE ELECTRIC**—Thin-film hybrid microcircuits for D-to-A applications are featured in a new technical paper, TP 69-1. The paper gives characteristics and applications of standard thin film hybrid microcircuits for these applications as well as date on tantalum nitride and nickel chromium resistor networks on silicon substrate used in the converters.

94. **THOMAS & BETTS CO.**—A new 4-page illustrated bulletin (500.3) has just been published, describing the newly designed Connecto-Blok solderless disconnect system for high density wiring.

188. **TURNER CO.**—A 20-page catalog describing the Turner line of microphones, including several recently developed models, is now available from the company, a subsidiary of Conrac Corp. Included in the catalog are professional cardioid dynamic, mobile and transistorized mobile, base station, paging public address and tape recording microphones. Catalog number 2520.

95. **UNITRODE**—New is a 4-page data sheet, T160, on the company's new line of miniature high-current controlled-avalanche aluminum-case rectifier assemblies called the MAGNUM Series.

189. **VIKING INDUSTRIES, INC.**—A new, updated 12-page, two-color catalog is ready. It provides design, performance and assembly data in easy-to-read form on Viking's Snaplock (standard) and snap-Elock (environmental) miniature circular connectors which feature #20 contacts in high density patterns.

96. **WARNECKE ELECTRON TUBES, INC.**—A comprehensive description, complete with electrical and mechanical specifications and range of characteristics for equipment designs of a new, miniature M-type Carcinotron RW-700 with a typical output of 100 watts nominal over frequency range of 15 to 18 GHz, is provided in a 4-page data sheet.

97. **WESTINGHOUSE** — The new 20-page semiconductor condensed catalog describes the industry's widest variety of power semiconductor devices ranging Also, a brochure describing high-speed directional relays is ready. Complete application information is given.

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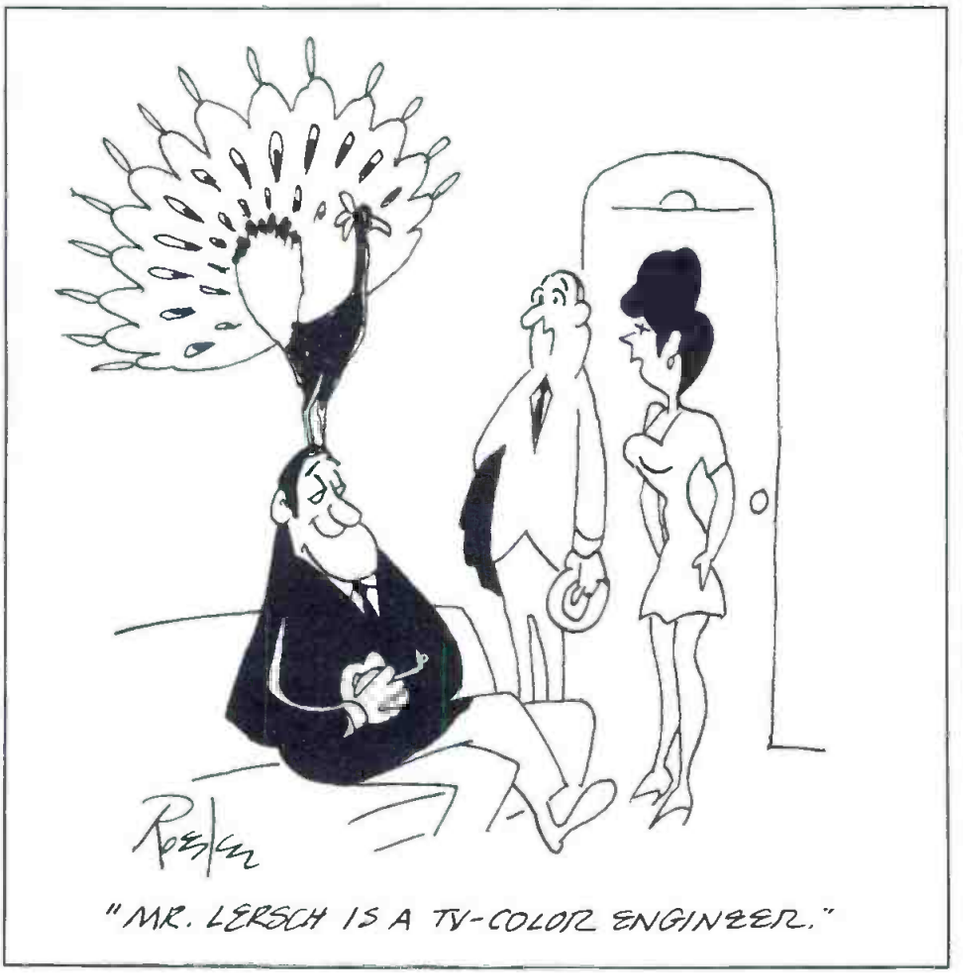

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