A HOWARD W. SAMS PUBLICATION

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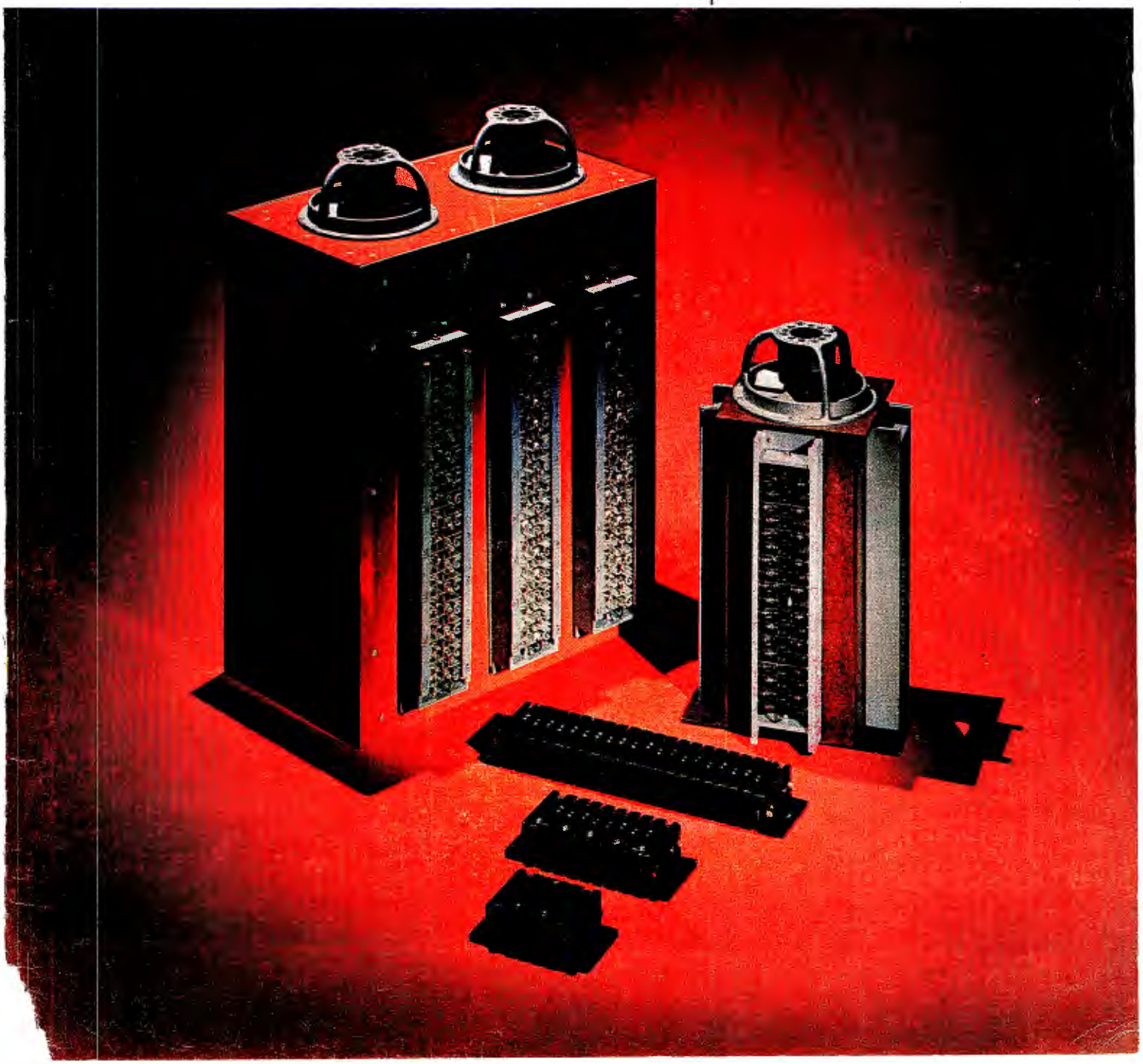
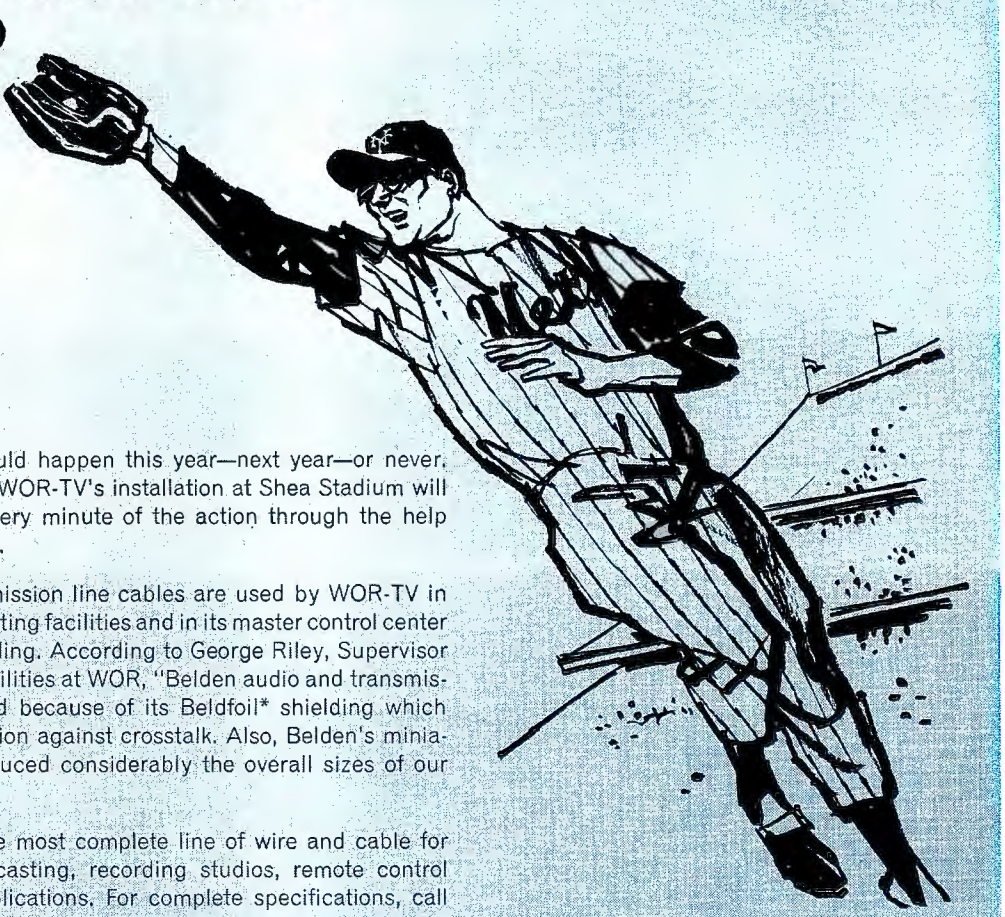
Broadcast Engineering

the technical journal of the broadcast-communications industry



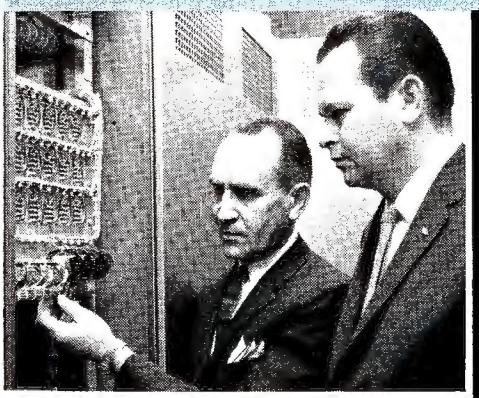
When the "Mets" capture the pennant... Belden will be there



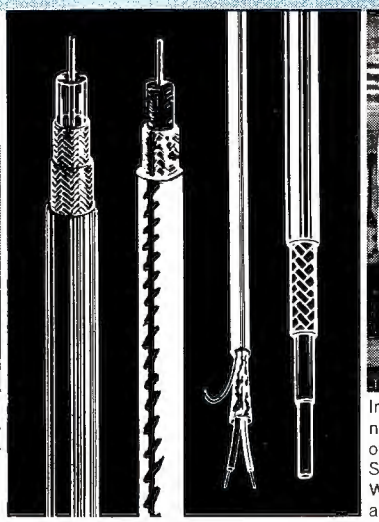
Such a phenomenon could happen this year—next year—or never. But if and when it does, WOR-TV's installation at Shea Stadium will record and broadcast every minute of the action through the help of Belden wire and cable.

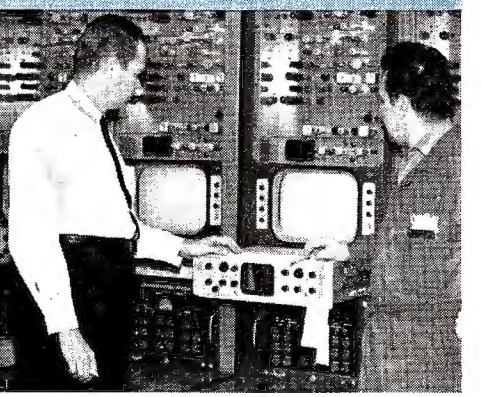
Belden audio and transmission line cables are used by WOR-TV in both its stadium broadcasting facilities and in its master control center in the Empire State Building. According to George Riley, Supervisor of TV Operations and Facilities at WOR, "Belden audio and transmission line cable was used because of its Beldfoil* shielding which provides superior insulation against crosstalk. Also, Belden's miniaturized audio cables reduced considerably the overall sizes of our panels and consoles."

Belden manufactures the most complete line of wire and cable for all TV and radio broadcasting, recording studios, remote control circuits, and similar applications. For complete specifications, call your Belden electronics distributor.



The control center of WOR-AM-FM is wired with Belden 8451 and 8700 miniature broadcast and audio cables. Explaining the complexity of the installation to George Kyros is Orville J. Sather, Director of Engineering for WOR-AM-FM.





In the control room, six monitor screens help the engineers transmit the play-by-play action. Looking over part of this installation are George Kyros, Belden Territory Salesman, and Earl Neely, Maintenance Supervisor of WOR-TV. The monitors are wired with Belden 8451, 8241, and 8281.

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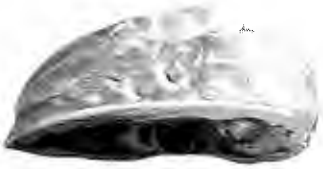

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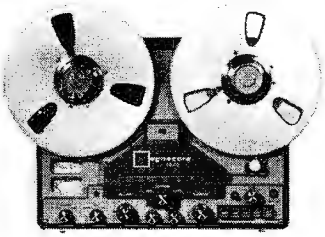

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Volume 6, No. 6 **June, 1964**

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BPA

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LETTERS to the editor

DEAR EDITOR:

Each month I travel over 3000 miles in North Carolina and Virginia working for WTVD and WRAL, whose towers in Raleigh are roughly within a mile of each other. My duties are to determine how the stations can assist technicians and service dealers in providing adequate service throughout the area. As part of the plan, we provide program schedules and bulletins for distribution by the service firms to their customers. We insist the dealers mark the material with their own rubber stamp and inform customers that next month's schedule may be obtained by merely stopping in the store.

We hold service meetings and conduct tours through the studios and control rooms at the stations. Often the service technicians arrive early in the evening and do not leave until sign-off. It is a pleasure to work with these interested people.

Recently a successful service dealer confessed to me that he did not know fully how to use the expensive scope that sat on his bench. I was so grateful for his trust and confidence that I spent the entire evening explaining points he did not understand.

Often we are able to provide assistance in obtaining parts for obsolete sets, data on sets no longer manufactured, information on taxes, and solutions to bookkeeping problems. In addition, I am constantly seeking good technicians for dealers who are unable to find suitable personnel.

Do you know of other stations which provide this service? I certainly would like to exchange notes with anyone engaged in such an activity.

ROBERT G. MISENHEIMER
TV Service Representative,
WRAL and WTVD,
Raleigh, N. C.

An interesting and valuable arrangement. Now how about it, readers; why not let Mr. Misenheimer's letter serve as an invitation to write to B-E regarding your station/service-dealer cooperative programs?—Ed.

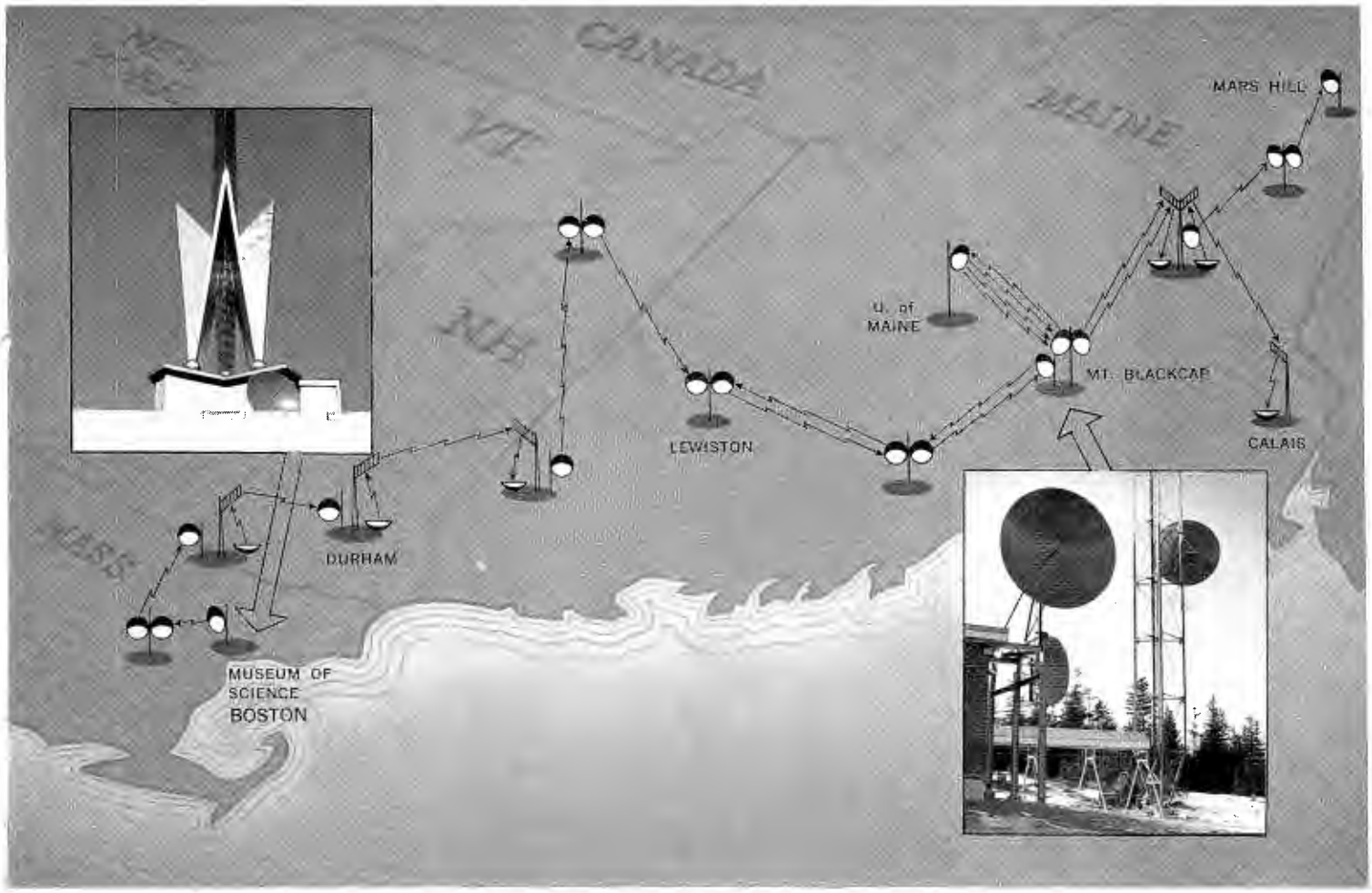
DEAR EDITOR:

As I am employed at a station soon to go directional, I followed with interest E. B. Chick's admirable series on the operation of directional antennas.

In going over the calculations for determining maximum and minimum common-point currents, I noticed an error in the formulas on page 11 of the January issue. Shouldn't the formula for minimum power be 5,000 × .90 rather than 5,000 × .95? I am a few years out of any formal math course, and it had me puzzled for a while.

OSLER J. WOOSMAN
Chief Engineer, WPIK,
Alexandria, Va.

You are correct; the equation should read: 5,000 × 0.90 = 4,500 (minimum power).—Ed.



Nation's first interstate ETV microwave network linked by Raytheon heterodyne repeaters

A 687-mile educational television network operating between Boston, Massachusetts, and Presque Isle, Maine, will soon link four Maine ETV stations and one New Hampshire ETV station with the University of Maine and Boston's Eastern Educational Network. The system — which uses *a complete complement of Raytheon 7 Gc and 13 Gc portable and rack-mounted microwave equipment* — will beam programs from the University of Maine campus and Boston's Museum of Science into classrooms and homes throughout the Pine Tree State.

The contract — awarded to Raytheon Company by the University of Maine for flexibility in being able to supply the best equipment for each location at the lowest price — requires the use of Raytheon portable KTR's, rack-mounted KTR's, and RM-1C heterodyne repeaters across a three-state area.

Let us prove to you why the statement: "as Maine goes, so goes the nation", makes good sense in terms of equipment performance, reliability and low-cost. For the complete story write: *Raytheon Company, Dept. BE-664, CADPO, 1415 Providence Turnpike, Norwood, Massachusetts.*

RM-1C Heterodyne Repeater

Rack-Mounted KTR

Portable KTR

Circle Item 6 on Tech Data Card

RAYTHEON

Some plain talk from Eastman Kodak about:

oxide needles and sound brilliance

What makes good tape good? How we push needles around has a lot to do with it.

As exotic as the many performance parameters of sound tape might be, it all still depends upon gamma oxide particles dispersed throughout a resin binder. Many of the tape's magnetic characteristics depend largely on the size, shape and orientation of these particles. Frequency response, signal-to-noise ratio and general sensitivity are all interrelated, not just to one another, but to how close to optimum these needles of gamma oxide are handled.

Let's see just what's involved.

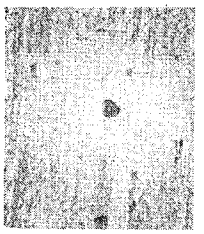
Visualize a basket filled with a few million needles.

They have all been magnetized so they are clinging together in disoriented clumps. The problem? Just take them all apart, lay them along parallel lines so they are all similarly oriented and their magnetic fields all reinforce one another. Oh, one more detail. These needles measure 1 micron by .2 microns; so, of course, they are somewhat delicate. One more point. Don't break any. The lengths are critical. For every broken or disoriented needle, H.F. response and signal-to-noise ratio will be affected. Every time one needle touches another, making electrical contact, sensitivity suffers.

Photographic emulsions are generally considered to be far more critical than sound tape in terms of physical characteristics. But we think that tape made to the gnat's-hair specifications of a photographic film is a better tape. And we proceed on just that basis. We separate the needles in a big-shouldered machine called a ball mill. Visualize a massive stainless steel drum that contains two million ball bearings. As the drum turns, the bearings tumble. Into the drum goes the binder which will act as a suspension for the oxide. Now add the oxide. Now the mill starts turning, and the ball bearings tumble. As they tumble, they actually shear the honey-like suspension separating the individual needles, coating them with suspension so they can't make electrical contact with each other. This process really takes horsepower—and lots of it! It's like the world's biggest taffy-pull. Now comes the critical part. If you stop milling too soon, you'll have clumps of needles. If you mill too long, you'll start breaking up the individual needles.

We never cut milling time. And we can prove it.

Take any well-worn tape. Look at it so that light reflects off the surface. See those glossy spots surrounded by a dull ring? These are nodules—high spots produced by clumping of the oxides. They were caused by too short a milling time.



Nodules show up as polished "high points" on tape surface.

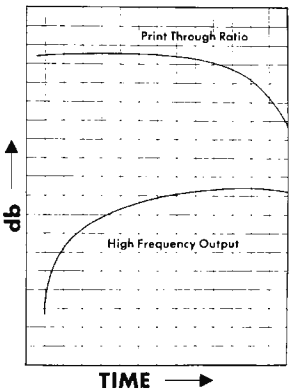
In actual practice they cause accelerated head wear and degrade high-frequency response as well as show up on the tape as noise.

Now check a well-worn Eastman tape

If you can't find a clumping immediately, check the entire roll. There must be one there, someplace. Or must there?

Milling too long is equally bad. Here's why. Best performance is to some extent dependent on the dimensions of the needles. That is the ratio of length to width. If you break the needles into smaller particles by milling too long, you'll get forms that are more cube-like than needle-like.

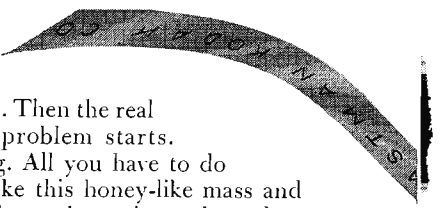
Cubes have pretty awful characteristics in terms of their magnetic parameters. Some of the very first magnetic tapes ever produced had cubes. These cubes do all sorts of other distressing things, such as change the bias requirements of the tape, and elongate the hysteresis curve, cutting sensitivity,



Notice how severely high frequencies suffer when milling time is too short; how print-through is degraded with prolonged milling.

and give pretty awful print-through characteristics.

Once the milling operation is complete, the suspension is filtered to remove any clumps that might have remained. Then the real tough problem starts. Coating. All you have to do is to take this honey-like mass and lay it along a base nice and evenly.



Problem is the needles try to reclump after filtering. To prevent this, we developed our new "R-type" binder. It never reclumps. And it always stays where it's put. No sagging, ever. And this means it can be handled with precision.

At Eastman Kodak, coating is uniform to within a few millionths of an inch. No, that's not a typographical error—we mean it. Six decimal places. This may be a new standard of precision for sound tape. But remember, we've been doing this sort of coating for years on film. While it's not exactly as easy as falling out of bed, it is a technique which we have down cold.

As one Eastman physicist puts it, "making tape is like being married to a redhead. But luckily, we know how to handle her." Next time, let's chat about base and surface characteristics.

CUSTOMIZED AUTOMATION SYSTEM FOR RADIO

by L. C. Sandlin, Chief Engineer, KWHK, Hutchinson, Kansas — Here are some operational modifications of a purchased automation system that conform to one station's needs.

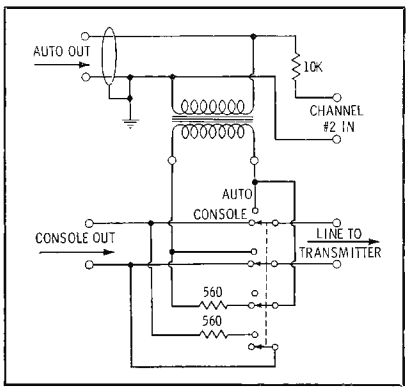


Fig. 1. The automation output switching.

When automation is mentioned to most laymen, their thoughts turn to massive rows of electronic equipment which takes volumes of information and in a very short time disseminates one important answer.

This is not necessarily the case in radio broadcasting. The objective, here, is to pre-record programs, musical selections, and commercial announcements and air them at predetermined times.

In August, 1962, KWHK Radio investigated the possibilities of purchasing an automatic programmer. The equipment arrived at the station during the third week of October. In less than a week we had automation on the air. With the use of dual clocks and individual channel-timer units, we play music, spots, programs, and features at the rate and sequence desired.

Our equipment consists of two reel-to-reel tape players for music, five single cartridge players, and two multiple cartridge machines—each able to play 24 spots without reloading. The multiple machines play spots in the same manner as a single cartridge machine. When the spot is over, the tape is recued, the deck is switched out of the play mode, and the drum is advanced to the next cartridge. This device will not switch to a blank slot, since a switch must be activated by an inserted cartridge for the deck to operate.

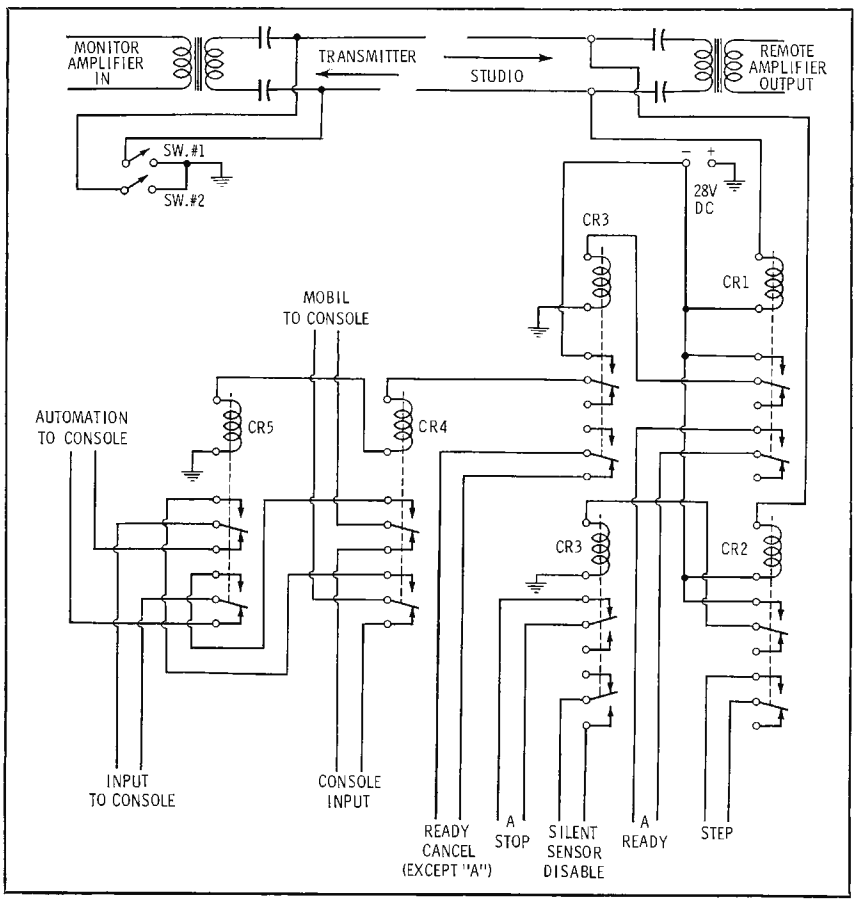


Fig. 2. Circuit for remote operation of automation system and studio monitoring.

Two of the single cartridge players are used for time signals. (A similar time signal device was described by Patrick S. Finnegan, Oct., 1962.) The half-track music units play first in the forward direction, then reverse to play the other track. The top unit starts first, and is followed by the bottom unit when the tape has played in both directions. The upper machine is reloaded to be again activated when the lower tape has played to completion. Both machines provide eight hours of music at 7½ ips without reloading. The switching is controlled by a 20 cps tone which is recorded at the end of each musical selection. On playback, the music passes through a 20 cps filter to trap the tone which is then amplified and rectified into a tripping voltage to start the next transport.

The cartridge players use an auxiliary tone of 3 kc for tripping. When the second spot starts the first stays on the program buss for two seconds, thereby producing a fading effect. A silent sensor controls the sequence should a channel fail to function.

News Circuits

During the first week of automation, we added circuits to interrupt the program for news bulletins and regular newscasts. To do this we ready channel A, set the A stop, and disable the silent sensor. For

bulletins the program is interrupted immediately; for regular newscasts, we start the program as the system switches into the A-stop mode. At the conclusion of the news broadcast all of the channels that have become ready during the program are cancelled and the step switch is pressed to switch the system directly into music.

Production

Our program department expressed a desire to use the control board for production while automation was on the air. A bypass switch (Fig. 1) was installed to feed the automation output directly into the transmitter program line. At the same time a load is placed across the output of the console.

Remote Control

We needed someone in attendance with the automation, and to monitor police receivers for local news. Since our studio is four miles from the transmitter, the use of "Combo" operators is out of the question. With the engineer on duty, this amounted to a two-man operation. KWHK is directional day and night, so remote control for the transmitter was not an immediate solution.

After some experimentation, we found that the automation could be controlled from the transmitter site (Fig. 2). In addition, we can switch the mobile units on the air, monitor the various police receivers, and monitor the receiver section of the two-way base station—all on one telephone pair. To communicate with the mobile unit, we use a "walkie-talkie" at the transmitter coupled into a roof-mounted antenna for improved range.

Two relays, CR1 and CR2 (Fig. 2) are wired through the remote pair to the automation power supply. At the transmitter, each line of the pair is connected to ground through a separate switch. When the switches are closed the relay coil circuits are completed at the studio.

Using the "walkie-talkie" and by monitoring the base station, we know when the mobile newsman is ready to go on the air with a report. Then, we play an opening cartridge and actuate the first switch. This energizes relay CR1. One set of contacts places channel A in the ready mode. Another set closes latching relay CR3, disabling the silent sensor, putting channel A in the stop condition, and cancelling all ready circuits except that for cartridge machine A. (The music tape completes a selection before stopping.) Relay CR3 also fires relays CR4 and CR5 putting the mobile unit into the automation channel.

As the news broadcast ends, we play a closing, and press the second switch which energizes relay CR2. One set of CR2 contacts steps the automation system into the music mode. Another pair resets CR3, making the silent sensor operative, permitting the ready circuits to function, and switching mobile and automation back to their original mode.

To give the automation more versatility and for the insertion of Christmas music (and other special programming), channels C and D and the music channels were modified. The channel C and D ready circuits (Fig. 3) are controlled by spare relay contacts in their respective cartridge players. These are actuated by the auxiliary tone amplified from the spot tape. As the C contacts close CR1 is held energized by means of n/c contacts the channel D relay. This disables channel C and completes the D machine ready circuit. At the same time relay CR3 switches music deck number two to play the Christmas music. When the tape has played through and stopped, music deck number one is reset. Then, cartridge machine D plays and the n/c contacts on its relay open CR1; this readies channel C. At the same time the channel D n/o contacts fire CR2, resetting music deck number two. This flip-flop sequence can be set to normal with switch 1, and the music insertion can be defeated with switch number two.

As a quickie aid to our live announcers the audio from both multiple cartridge units is fed into the control board. By means of two push-buttons, he can play 48 spots without moving from his chair or touching a cartridge.

While still somewhat away from the "true" sense of automation, we at KWHK feel that we have gone a great distance in that direction. The circuits described in this article have helped to improve our operation and produce a better sound for our listeners. ▲

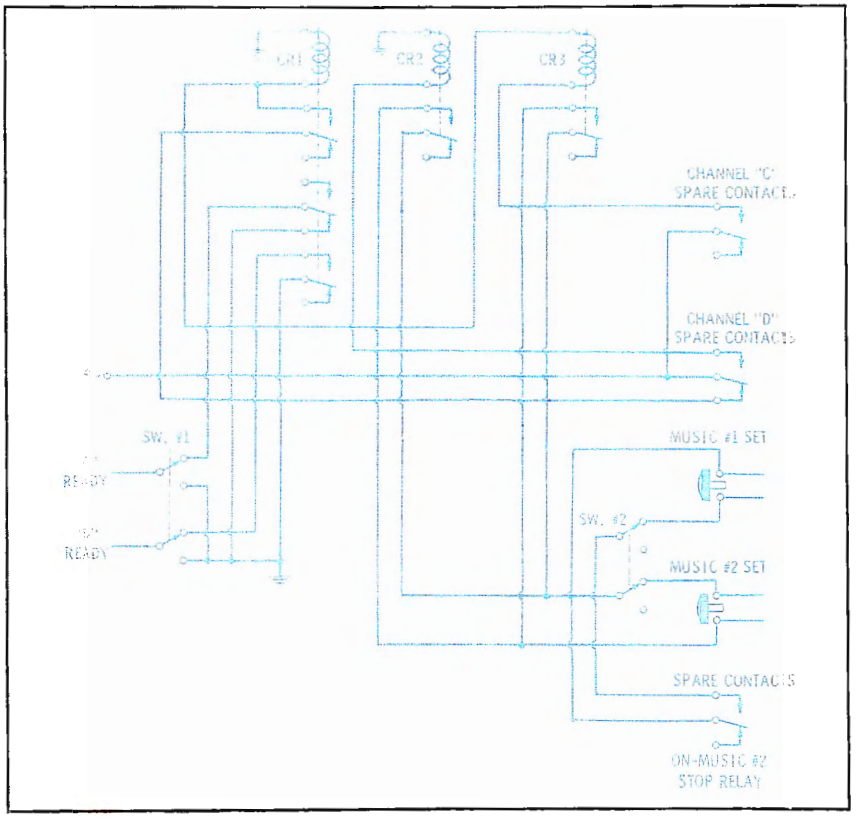


Fig. 3. Special music inserter circuit.

WINTER-TO-SUMMER CONDUCTIVITY EFFECTS

by Robert A. Jones, Consulting Author, Consulting Radio Engineer, La Grange, Ill. — How to distinguish between shifts in antenna radiation and the effect of changes in soil conductivity.

Most engineers living in the Northern United States, and those who have had occasion to perform measurements of directional arrays in this and similar geographic areas, often find large variances in signal strength between monitor-point readings taken during the winter and those taken during the summer at the same locations.

Why does this difference occur? Almost all engineers agree it is due to changes in **soil conductivity.** But that's as far as they agree. Some think the change is caused by temperature, while others believe it is a result of the water content in the ground. And there are still others who contend the change has to do with air temperature and snow depth.

This article is intended to help the chief operator distinguish between a change in conductivity and a variation in actual antenna radiation. I will not try to settle the argument as to what causes conductivity to change, but will indicate steps to take if and when it does.

Table 1. WIMS 265° Radial.

Distance in miles	Proof June	Reproof January	Ratio
0.2	800 mv/m	850 mv/m	1.06
0.4	360	400	1.11
0.6	212	225	1.07
0.8	155	180	1.16
1.0	108	130	1.20
1.2	82	110	1.34
1.4	68	95	1.40
1.6	53	70	1.32
1.8	44	64	1.45
2.0	37	50	1.35
2.5	26	40	1.53
3.0	19	30	1.58
3.5	14	23	1.65
4.0	11	19	1.73
4.5	8	15	1.88
5.0	7	12.5	1.78
5.5	6.1	11	1.80
6.0	5.0	9.1	1.82

High Conductivity

I had a good representative case at WIMS in Michigan City, Ind., a few years ago. Their 5000-watt directional antenna was tuned and proved in June of the year. One of the monitor points is at a bearing of 265° True, only two miles from the transmitter site. During the rest of that summer and into the fall the weekly readings at this point were quite steady, never exceeding the FCC limit of 40 mv/m. The typical reading was 37 mv/m. As October came and went and November began the weekly readings approached the limit. By December we found the signal strength was constantly exceeding the limit. It was first assumed that a change in radiation had occurred. However, a careful check of all phase readings, base currents, and current ratios indicated that no shift in the actual directional pattern had occurred. By readjusting the phasor controls we could bring the field intensity at the 265° monitor point within limits, but in so doing the phase and current readings were caused to deviate substantially from licensed values. This proved that the antenna pattern had not shifted.

By January it was impossible to keep the field strength at the 265° monitor point within limits; at times it measured as high as 50 mv/m or 25% above the FCC limit. Obviously something had to be done. In order to analyze what was wrong, I remeasured the first six miles along this bearing at the same locations we had used in June. The readings and the ratio of winter to summer values are tabulated in Table 1.

From the data it is apparent that the readings at each location had increased in value. By plotting the ratios on semi-log paper, as shown in Fig. 1, it became evident that a change in soil conductivity was the cause. In this case the soil actually measured higher in January. As a result the field intensity measured at our 265° monitor point increased. It was not a case of the directional antenna pattern shifting.

In Fig. 2 you will note as the

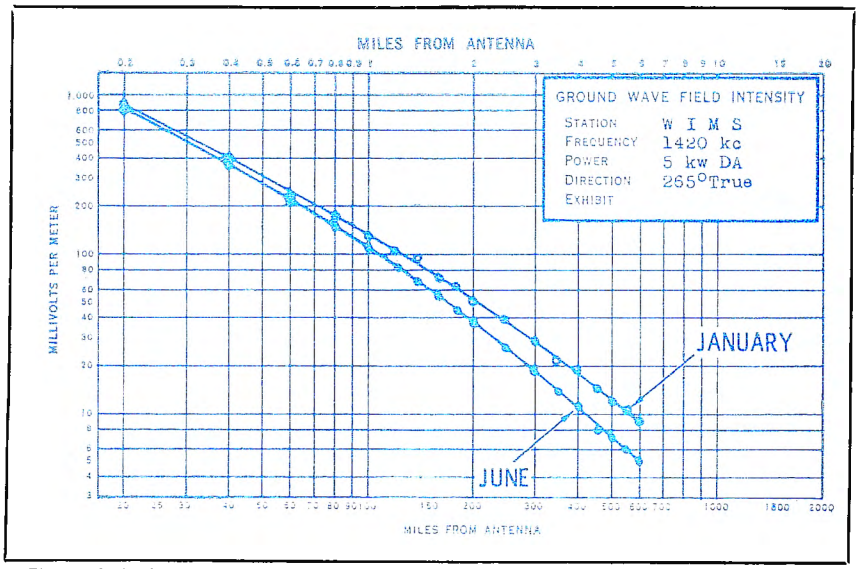


Fig. 1. WIMS field intensity readings versus distance for June and January proofs.

distance increases, the slope of the ratio curve increases also. If the curve slopes downward, a drop in soil conductivity is indicated. Fig. 3 illustrates several examples of what can happen. As you can see, the close-in readings most accurately indicate whether a soil change or a change in radiation has occurred. This points to a good guide to keep in mind when establishing monitor points. Choose them as close as possible to the transmitter site, taking local roads and other geographical features into consideration. Monitor points close to the antenna array are least affected by changes in soil conductivity and will more accurately reflect changes in radiation. After all, this is the reason we have monitor points.

Low Conductivity

I encountered just the opposite of the WIMS problem last year at station WFRL in Freeport, Ill. There we tuned and proved a 5000-watt directional antenna in December. One of our three monitor points was on the 245° radial. In order to find a good obstruction-free location, we selected a point west of the city at a distance of about 3.5 miles from the station.

When summer began intensity was holding steady at monitor points 1 and 2, but the reading at 3 decreased. At the same time, we could detect no significant change in any of the phase-angle readings, or base-current values. These factors led us to believe the pattern had not changed. Why, then, was the third reading going down? By August intensity at point 3 was only half of what it had been in December. A series of readings at the bearings of points 1 and 2 proved that no changes in radiation or soil conductivity had occurred in those directions.

Checking further, we found an interesting condition at 245°. Table 2 shows a tabulation of readings along this radial comparing the original December proof with the August measurements. To our surprise we found practically no change in readings from December to August between the antenna site and the Pecatonica River. But, on the other side of the river we detected bigger and bigger differences between the two sets of readings

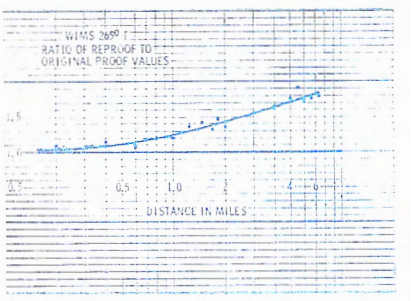


Fig. 2. Curve showing ratio of reproof on WIMS 265°T radial to original readings.

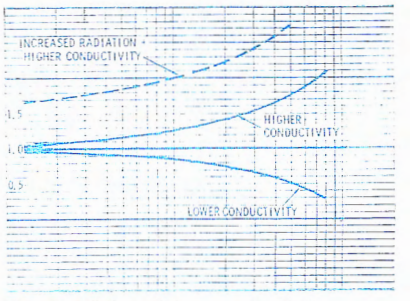


Fig. 3. High and low conductivity curves.

(Fig. 4). The general relationship of the WFRL site to the City and the river is shown in Fig. 5.

Obviously the river is a geological barrier which offers less attenuation during the winter than it does during the summer. The most significant difference in the river during the winter is the higher water level. This and the freezing conditions apparently create a conductivity break. This situation also accounts for the seasonal effect on the 245° radial and the constancy of the other two monitor points east of the river.

The obvious solution to our problem at WFRL was to establish a new monitor point east of the river. The chosen location could not be affected by conductivity breaks and would allow a more accurate indication of changes in radiation.

General Procedure

As a general rule, the first step to take when all the monitor-point readings shift at once, or as in the case of WFRL where only one point changed, is to remeasure as many points within the first ten miles from the site as you can. Most important are those within the first two miles, since the readings at these locations tell most accurately whether antenna radiation has changed or a variation in soil conductivity has occurred. Then, if the cause is still not evident, plot the ratios on semi-log paper and analyze the graph for a change in conductivity. If you discover variations in both conductivity and radiation correct the tower radiation error first.

In the event conductivity has shifted downward and your monitor-point reading is well below the limit, as was the case at WFRL, you have nothing to fear from the FCC inspector. However, when faced with high readings such as those we encountered at WIMS you can be in trouble if the inspector shows up. I would suggest the following solution: Rerun a complete radial out to 15 or 20 miles. Then analyze the data to prove that the unattenuated radiation specified in your construction permit has not been exceeded. File this new radial and an appropriate tabulation of data with the FCC; be sure to in-

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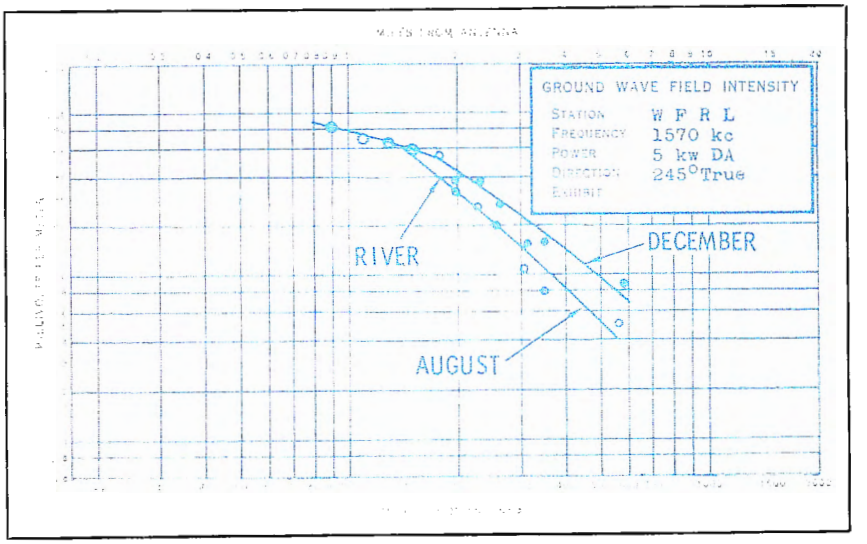

Fig. 4. WFRL field-intensity readings.

MATCHING AND ISOLATING PADS

by Joseph H. Dessen, Audio Design Engineer, Blackwood Terrace, N. J. — Part 2. Application of the design formulas to the various networks introduced last month.

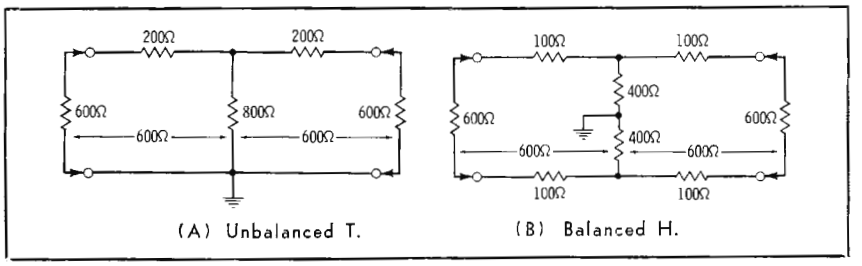

Fig. 1. Corresponding six-decibel loss symmetrical networks for 600-ohm systems.

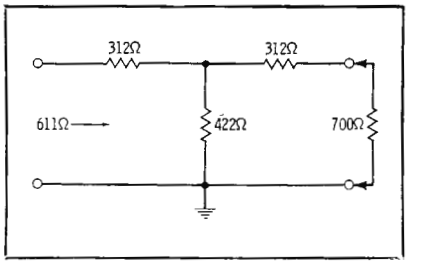

Fig. 3. Ten-decibel T pad, 700-ohm load.

In part 1 of this article (May, '64), resistive networks for attenuation and impedance matching in audio systems were introduced. Several applications were pointed out, and circuit configurations with typical design formulas were shown. This month, in part 2, we shall use these design equations and employ hyperbolic functions.

Symmetrical Pads

Let us discuss the use of design equations for symmetrical-T pads (shown in Figs. 2A and 2B of part 1). We will design three pads for 600 ohms. The first will have a loss of 6 db, the second 10 db, and the third 20 db. In each case the impedance properties of the network will be determined.

Resistance pads are not usually designed for losses greater than 40 db because of the leakage effects at the higher frequencies. Additional attenuation may be obtained by cascading two or more networks.

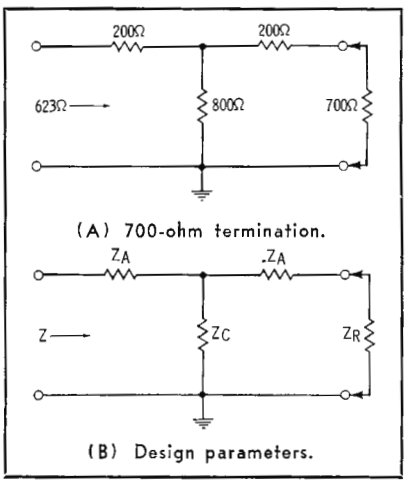

Fig. 2. Unbalanced-T pad configuration.

Six Decibel Loss

Table 1 gives the values of K in terms of decibels. For the first pad mentioned above, K is 1.995, or approximately 2, for a loss of 6 db (see Fig. 2A of part 1). Thus:

$$ZA = 600 \times \frac{2-1}{2+1} = 200 \text{ ohms}$$

and,

$$ZC = 600 \times \frac{2 \times 2}{4-1} = 800 \text{ ohms}$$

Design equations in terms of hyperbolic functions for the same network were shown in Fig. 2B of part 1. Referring to Table 2 we see that 6 db is 0.6907 nepers (for simplicity of notation we shall use the symbol, N), tanh N/2 is approximately 0.3323, and sinh N is 0.747. Therefore:

$$ZA = Z_{11} \tanh N/2$$
$$= 600 \times 0.3323 = 199.3, \text{ or } 200 \text{ ohms}$$

The T pad circuit is shown in Fig. 1A; while in Fig. 1B is the balanced version, or H pad. Both networks present a 6-db loss in a 600-ohm system.

To obtain a balanced pad from an unbalanced pad, we merely split the resistance in the upper series arms and insert half in each lower arm. Completing the job, we produce a center ground by dividing the 800-ohm resistance into two 400-ohm resistances, as shown in Fig. 1B.

Now let's determine the impedance stabilizing, or isolating, properties of the 6-db pad. The same network is shown again in Fig. 2A, but this time with a 700-ohm termination resistance instead of 600 ohms. The change in input impedance would then be a good indication of the isolation, and is:

$$Z = ZA + \frac{ZC(ZA + ZR)}{ZA + ZC + ZR}$$

$$= 200 + \frac{800(200 + 700)}{200 + 800 + 700} = 623 \text{ ohms}$$

where Z, ZA, ZC, and ZR are shown in Fig. 2B.

It is apparent from the above calculations that terminating the pad with 700 ohms instead of 600 ohms has increased the input impedance from 600 to 623 ohms. This means a difference in input impedance of only 23 ohms for a change of 100 ohms in termination impedance.

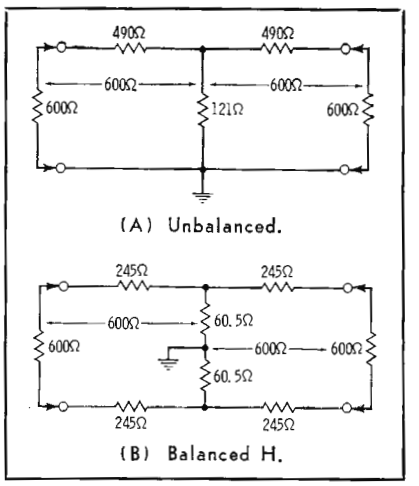

Fig. 4. Twenty-decibel symmetrical pads.

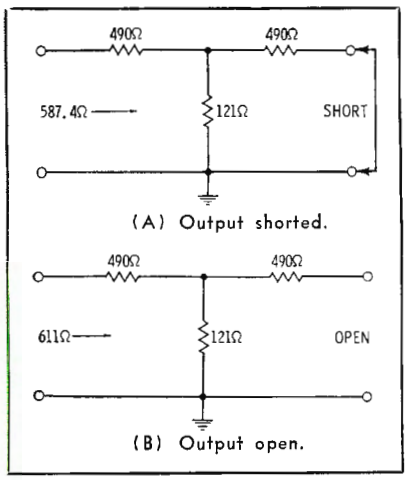

Fig. 5. A twenty-decibel loss network.

Ten Decibel Loss

The second pad mentioned earlier was to have a loss of 10 db. From Table 1 we find K is 3.162 and apply the formulas:

$$ZA = 600 \times \frac{3.162 - 1}{3.162 + 1} = 312 \text{ ohms}$$

and,

$$ZC = 600 \times \frac{6.32}{9} = 422 \text{ ohms}$$

To derive the same network in hyperbolic form, we find from Table 2 that 10 db is approximately 1.512 nepers. Applying this value in the same equation as used in the first example:

$$ZA = 600 \times 0.5195 = 312 \text{ ohms}$$

and,

$$ZC = \frac{600}{1.423} = 422 \text{ ohms}$$

As before, to determine the isolating properties of the network a termination other than 600 ohms is substituted in the formula. The unbalanced T pad terminated in 700 ohms instead of 600 ohms is shown in Fig. 3. The input impedance is:

$$Z = 312 + \frac{422(312 + 700)}{312 + 422 + 700}$$
$$= \text{approx. } 611 \text{ ohms}$$

Table 1. Values of K in Terms of db's.

db	$K = \frac{I_1}{I_2}$	db	$K = \frac{I_1}{I_2}$
0.5	1.059	8.0	2.512
1.0	1.122	9.0	2.818
2.0	1.259	10.0	3.162
3.0	1.413	15.0	5.623
4.0	1.585	20.0	10.000
5.0	1.778	25.0	17.780
6.0	1.995	30.0	31.620
7.0	2.239	35.0	56.230
		40.0	100.00

Note the 10-db pad shows better impedance stability than the 6-db pad did. The former had a impedance change of 11 ohms as compared to the 23 ohms of the 6-db circuit, with the same 700-ohm termination for each.

Twenty Decibel Loss

Now let's proceed to the third network which is to be designed for a loss of 20 db. In this case K in Table 1 is 10. From the design equations:

$$ZA = 600 \times \frac{9}{11} = 490 \text{ ohms}$$

and,

$$ZC = 600 \times \frac{20}{99} = 121 \text{ ohms}$$

Once again, referring to Table 2 we find that 20 db is equal to 2.3025 nepers, tanh N/2 is 0.8181, and sinh N is 4.95. Then:

$$ZA = 600 \times 0.8181 = 490 \text{ ohms}$$

and,

$$ZC = \frac{600}{4.95} = 121 \text{ ohms}$$

The two completed pads are shown in Fig. 4.

To compare characteristics with the other pads, we shall once again calculate the input impedance change that results from a variation in termination. With 700 ohms

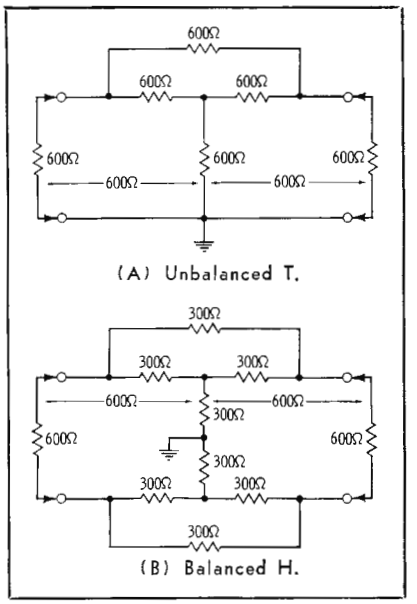

Fig. 6. Two six-decibel bridged networks.

across the output end of the 20-db pad, the input impedance is found by:

$$Z = 490 + \frac{121(490 + 700)}{121 + 490 + 700}$$
$$= 599.8 \text{ ohms}$$

The change of input impedance in this case is only 0.2 ohms for a variation of 100 ohms in the terminating load. Therefore, it is evident that as the attenuation pre-

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Table 2. Relation of Decibels to N, Sinh N, Cosh N, Tanh N, and Tanh N/2.

db	N	Sinh N	Cosh N	Tanh N	Tanh N/2
0.5	0.05756	0.5759	1.00166	0.5750	0.02877
1.0	0.11513	0.1153	1.0066	0.11463	0.05750
2.0	0.23026	0.2323	1.026	0.22627	0.11463
3.0	0.34539	0.3523	1.0602	0.33228	0.17100
4.0	0.46052	0.4769	1.1079	0.43051	0.22627
5.0	0.57565	0.6079	1.1703	0.5195	0.28013
6.0	0.69078	0.7470	1.2482	0.59848	0.33228
7.0	0.80591	0.8960	1.3427	0.66732	0.38246
8.0	0.92103	1.0568	1.4550	0.72639	0.43051
9.0	1.03616	1.2317	1.5865	0.77637	0.47622
10.0	1.15129	1.4230	1.7392	0.81818	0.51950
15.0	1.72694	2.722	2.9006	0.93869	0.69804
20.0	2.30259	4.9500	5.0500	0.98020	0.81818
30.0	3.45388	15.795	15.827	0.99800	0.93869
40.0	4.60517	49.995	50.005	0.99980	0.98020

PROCEDURES AND EQUIPMENT IN MICROWAVE MAINTENANCE

by Donald Kirk, Microwave Equipment engineer, Philadelphia, Pa.
— A description of typical klystron tubes and microwave maintenance equipment

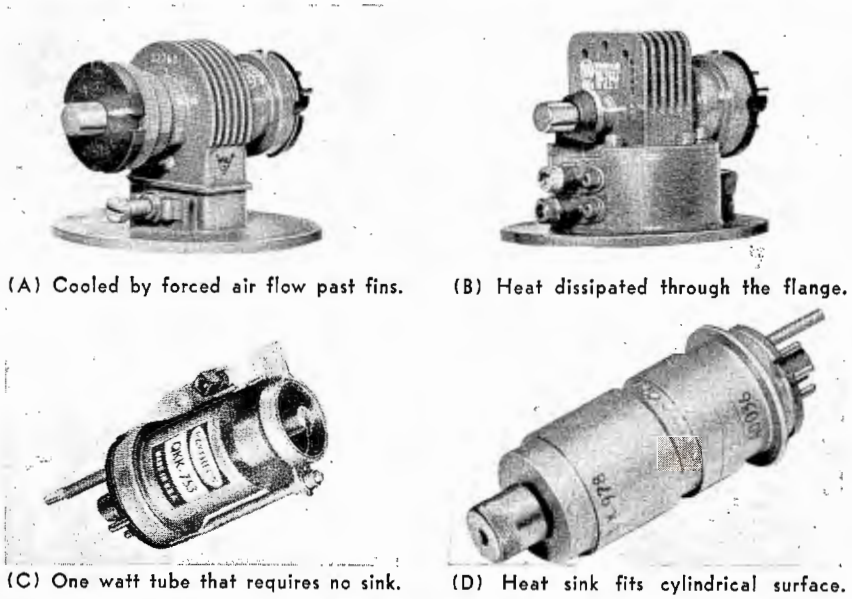
With the television broadcasting industry making increasing use of microwave systems for relaying video and audio signals, station engineers are often called upon to maintain the equipment employed. Two broad areas of maintenance activity are involved: routine maintenance to assure proper equipment operation and actual trouble-shooting and repair of transmitters and receivers.

Most of the actual hardware in microwave equipment — such as video amplifiers, broadband IF amplifiers, discriminators, and regulated power supplies—is basically very similar to that found in television broadcast equipment. Procedures and equipment used in the maintenance of such devices are familiar to most broadcast engineers.

There are some parts of a microwave system, however, which may be new to the broadcast engineer. These include the transmitter parts used in generating the actual high-frequency carrier and the receiver parts which establish the RF band-pass and convert the received microwave signal frequency to a lower intermediate frequency. This article describes typical klystron tubes used in these parts and some of the equipment employed in testing microwave systems.

Klystrons

In practically all STL-type microwave systems, the signal radiated by the transmitter is generated in a reflex klystron. Examples of various mechanical configurations of klystrons are shown in Figs. 1 and 2. In these tubes, an electron beam with an energy of 300 to 1000 volts is passed through a microwave cavity and then reflected back through the cavity by an electrode called a repeller. The interaction of the electron beam with the cavity generates the high-frequency signal. The signal is then carried from the tube, through whatever filtering is necessary, to the antenna. The frequency of the klystron can be varied by changing the mechanical tuning of the microwave cavity or by changing the repeller voltage. The latter method is used to produce frequency modulation of the klystron in a transmitter and to exercise automatic frequency control of the klystron when it is used as a local oscillator in a receiver.



(A) Cooled by forced air flow past fins.

(B) Heat dissipated through the flange.

(C) One watt tube that requires no sink.

(D) Heat sink fits cylindrical surface.

Fig. 1. Some typical klystron tubes positioned to show their cooling surfaces, or heat sinks.

Precautions During Maintenance

When an engineer is called upon to replace a klystron, there are a number of precautions which he should observe. First, he should always be aware of the high voltage associated with klystrons. In some cases, the metal shells of the klystrons are actually connected directly to high-voltage supplies. In many designs this is avoided, but repeller and beam voltages at the base of the klystron are lethal.

Another general operating precaution has to do with the repeller leads which come out as a separate pin (Figs. 1A, B, and C, for example). Most klystrons can be quickly damaged by operation with a repeller voltage that is positive with respect to the metal shell. For this reason, a klystron beam should never be turned on unless the repeller supply is connected and is supplying the correct voltage.

Heat Dissipation

Since the physical size of a cavity is one of the things which determine the klystron operating frequency, the expansion or contraction of the klystron due to temperature changes is very important. All klystrons are provided with some means of dissipating heat and controlling temperature, and the maintenance engineer should take these into account when installing a new klystron.

Fig. 1A shows a typical klystron that is cooled by blowing air over the radiating fins. The klystron in Fig. 1B dissipates most of its heat through the waveguide flange. The

massive structure of the cavity on the lower side of the tube is specially made to be a good heat conductor. Fig. 1C shows a 0.1-watt klystron which requires no additional heat sink; however, this klystron is often operated in some sort of enclosure to provide frequency stabilization. The klystron of Fig. 1D is shown without its heat sinks. Note the two cylindrical surfaces that are slightly larger than the rest of the tube; in actual operation, these surfaces would be clamped in an external heat sink. The klystrons shown in Figs. 2A, C, and D are cooled both by air flow and by heat conduction to the waveguide on which they are mounted. The klystron in Fig. 2B is physically massive and is made to be cooled by conduction into the waveguide alone.

Installation of Klystrons

When a klystron whose cooling depends on conduction to the waveguide or a heat sink is replaced by a maintenance man, he must be careful that the klystron and heat-sink flanges are perfectly flat and free from any particles that would keep them separated. A heat-conducting grease (such as the silicone used on transistor heat sinks) may also be applied, but it should be kept well away from the waveguide openings, and only a very small amount should be used.

In installing any of the klystrons that mount directly on the waveguide, care should be taken to keep foreign matter out of the waveguide cavity because almost anything in this cavity will cause improper operation of the klystron. With klystrons such as the one shown in Fig. 2C, additional care should be taken not to damage the mica window in the waveguide flange. This is part of the vacuum-tight structure of the tube, and if it is scratched the tube may be ruined. In installing klystrons such as those shown in Fig. 1C or D, the little output probe that comes out as one of the pins on the octal base must not be bent.

When a new klystron is installed, two adjustments must be correct in order for the klystron to produce output power. First, the mechanical tuning of the microwave cavity must be correct; and second, the repeller voltage must be in the proper range.

Mechanical Tuning

With most of the klystrons shown, a good way to start is by making the mechanical tuning adjustment of the klystron the same as that on the tube removed from the equipment. This can be done on all the units shown except those in Figs. 1D and 2C. In Fig. 1A, the mechanical adjustment is the screw just behind the waveguide flange. There is another small Allen-head setscrew very close to the tube; this is a coupling adjustment and should not be moved. In Fig. 1B the tuning adjustment is the setscrew farthest from the flange. The setscrew near the flange is a coupling adjustment; this is set to midrange at the factory. The tuning procedure for a particular microwave transmitter may call for optimizing this adjustment after the tube is in oscillation and putting out power, but it should not be turned until the tube is in operation. In Fig. 1C the mechanical tuning of the klystron is accomplished by rotating the small square stud which moves the tuning bows on the lower side of the tube together or apart. This mechanism stretches or contracts the whole tube to achieve tuning. The klystron in Fig. 1D and the one in Fig. 2C tune in a similar fashion, but the actual mechanism that stretches or contracts the tube is inside and cannot be seen. The screw on the end of the tube actuates the tuning mechanism. In the

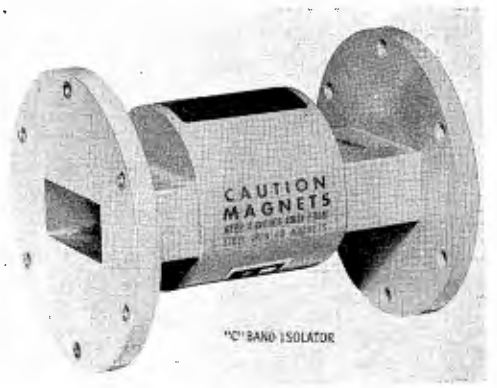


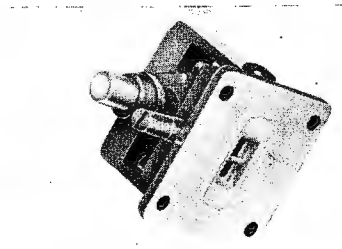
Fig. 3. One C-band ferrite isolator unit.

klystron shown in Fig. 2A, the large setscrew near the repeller cap is used for mechanical tuning. The small probe across the waveguide output of the tube is a factory-set coupling adjustment.

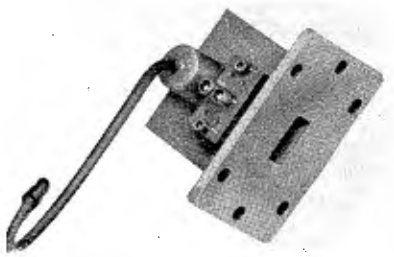
Adjustment of Repeller Voltage

After the klystron has been mechanically tuned as closely as possible to the setting of the one removed from the equipment, it should be installed and its various operating voltages should be measured. In both microwave transmitters and receivers, some meter indication of whether or not the klystron is working must be provided. In a transmitter, this is usually in the form of an output-power monitor; in a receiver, operation of the klystron is usually checked by measuring current in the mixer crystal.

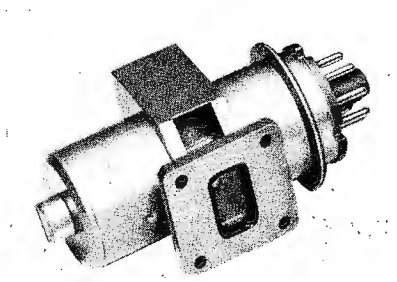
With the klystron installed and warmed up, the maintenance engineer turns the repeller-voltage ad-



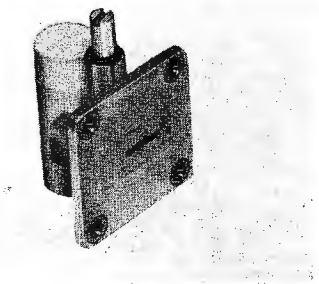
(A) Tuned by setscrew near repeller cap.



(B) Hex head socket screws permit tuning.



(C) Screw at end adjusts internal system.



(D) Tuned by slug below repeller cap.

Fig. 2. Other klystrons positioned to show mounting surfaces and tuning adjustments.

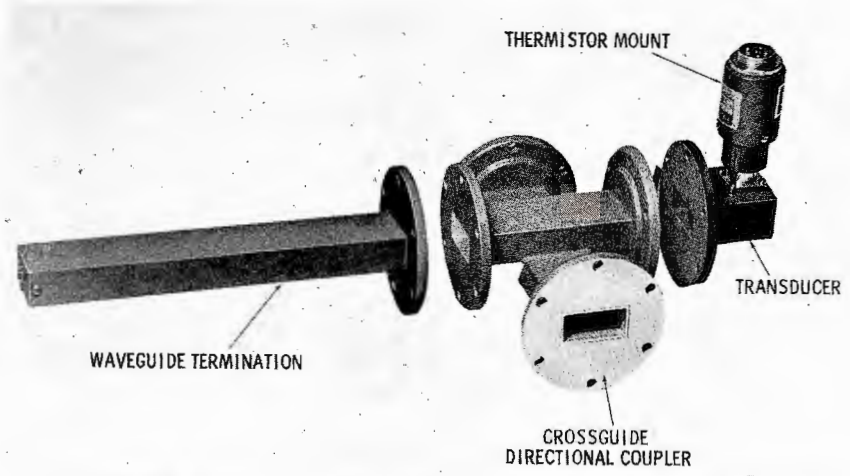


Fig. 4. Equipment used for measuring the power output of microwave transmitters.

justment of either a transmitter or receiver through its range, looking for evidence of klystron power output. If none is observed, he then mechanically tunes the klystron slightly in one direction or the other and again sweeps the repeller voltage through its range. This is continued, first on one side of the preset mechanical tuning and then on the other, until evidence of power output is obtained. In some equipment, it is possible to get the klystron to operate on two different repeller-voltage settings. In most cases, the one which gives greatest power output is the desired mode.

In equipment which provides good automatic frequency control, final adjustment of the klystron is quite simple. The automatic frequency control is first turned on to hold the klystron on the proper frequency, and then the mechanical tuning adjustment is carefully turned for maximum klystron output. The repeller voltage is then adjusted so the AFC-amplifier control voltage is returned to zero. The final adjustment and peaking of the klystron should not be done until the equipment has had time to warm up completely. If there is any danger of AFC lock-out, the klystron should be turned off and on a few times to assure that it will return to proper operation after a power outage.

Ferrite Isolators

One of the microwave devices with which a broadcast engineer might not normally be familiar is a ferrite isolator, such as the one shown in Fig. 3. This device has a slab of ferrite material inside the waveguide and a permanent polarizing magnet on the outside of the waveguide. It has the interesting property that microwave signals can pass very freely in one direction (attenuation .5 to 1 db) but microwave signals traveling in the other direction are highly attenuated (40 db or more). All good microwave transmitters of current design use such devices to prevent "pulling" of the klystron frequency by signals reflected from mismatch points in the waveguide run or the antenna system. Very little maintenance is required on these devices, but in performing maintenance on the other portions of the microwave transmitter the engineer should be careful to avoid jarring the magnet.

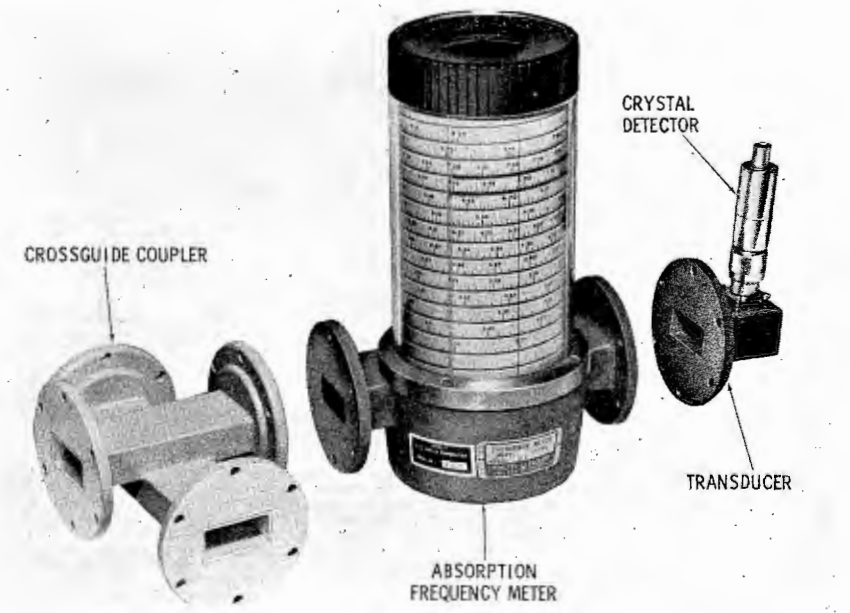


Fig. 5. Equipment for measuring freq. and klystron mode in microwave transmitters.

Test Equipment

Test equipment for measuring microwave-transmitter output power is shown in Fig. 4. The crossguide directional coupler can be inserted directly in the waveguide run between a microwave transmitter and its antenna. A small portion of the energy passing through this device is coupled into the crossguide. In many installations it is found convenient to put the crossguide coupler into the antenna run permanently as a test point. When a measurement of transmitter power is to be made, the transducer and the thermistor mount are attached to the output flange of the coupler. A waveguide termination may be used on the other terminal of the coupler. A conventional RF wattmeter would be connected to the thermistor to indicate actual RF power. Crossguide couplers can be obtained in a variety of coupling attentuation ranges. For many purposes, a 30 db coupler is convenient, and where this is used each milliwatt of power read by the thermistor indicates 1 watt of power output from the transmitter.

When it is desired to observe the frequency or the shape of the klystron mode in checking a microwave transmitter, the test equipment shown in Fig. 5 may be used. Here the crossguide coupler is the same as shown in Fig. 4, but instead of the thermistor a transducer and a crystal detector are connected to the coupler through an absorption frequency meter. The output of the crystal detector can be connected

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A TRANSISTORIZED CAMERA AMPLIFIER

by James French, Consulting Author, KRMA TV, Denver, Colo.— Description of transistorized video preamp and solid state bias supply for updating cameras.

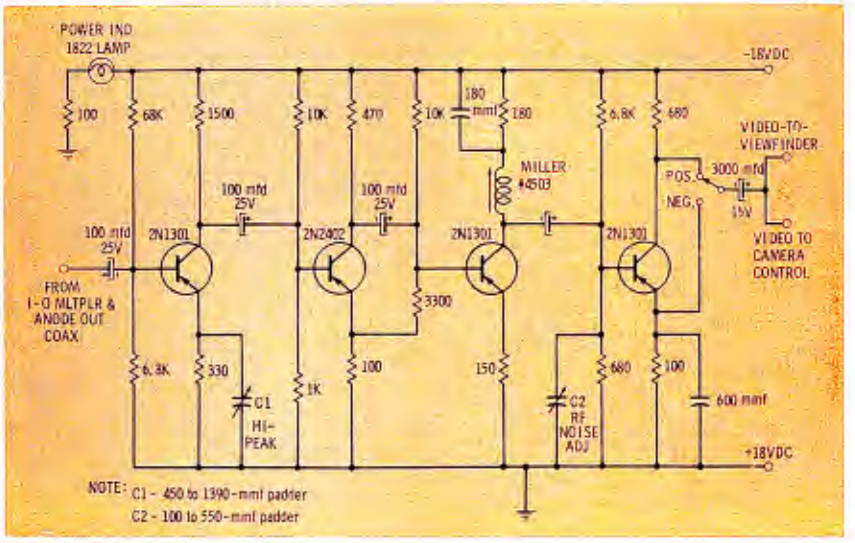

Fig. 1. Circuit of four-transistor video preamp-amplifier for image-orthicon cameras.

The modifications described here can be employed to improve many studio I-O cameras. Results are reliability, simplicity, and freedom from preamplifier microphonics.

Two circuits will be described. One is a transistorized preamplifier; the other is a bias supply for the deflection and viewfinder sections. Both units were designed for G-E cameras but could easily be adapted to other types.

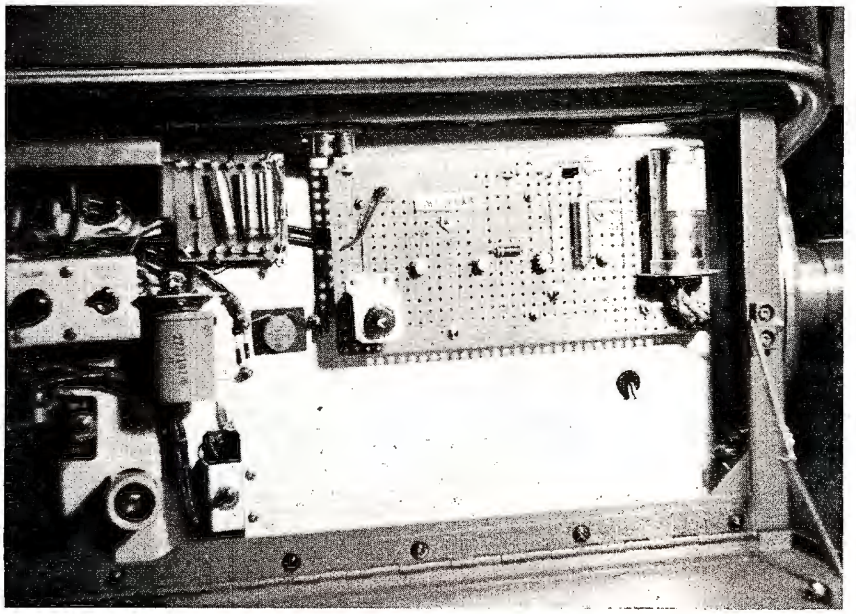

Fig. 2. Camera preamp mounted on panel.

Preamp

The preamp, consisting of a four-transistor circuit (Fig. 1), increases the signal from the I-O tube for use at viewfinder and camera control unit. Only three controls require adjustment after construction: a polarity switch, a high peaker, and an RF noise capacitor. The output of the preamp is split to drive the viewfinder and the camera control.

The transistorized preamplifier is built on phenolic pegboard and mounted where the original tube preamp was located (Fig. 2). It is attached to the panel by five threaded studs. The original preamp chassis also contains a bias supply and tally relay. This chassis is cut and only the portion with tally relay is left in the camera. The bias supply is removed and replaced with the unit described later.

The output from the I-O anode multiplier is coupled to the preamp through a .015-mfd 1600-volt capacitor and then shunted to ground with a 4700-ohm resistor (Fig. 3); this network was used in the original circuit. The NE-2 lamp was added as a protective device for the preamp.

The preamp uses three 2N1301 transistors and one 2N2402 transistor, and requires —18 volts DC, regulated, at 100 ma. Power is applied to the preamp through the camera cable. (An ideal supply for these preamps can be found in the May 1963, issue, on page 30.) The preamp also includes an 1822 pilot lamp to indicate the presence of power.

Alignment of the preamp involves the following steps: Back the peaking coil out 12 turns (exposing 12 threads). This sets the proper curve for compensation. Then adjust the hi-peaker, with picture sig-

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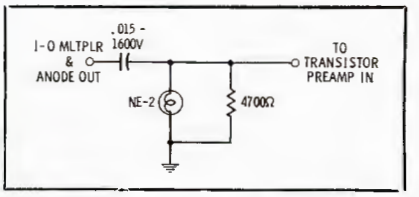


Fig. 3. Coupling circuit for I-O output.

nal, for minimum trailing black and whites. Next adjust the RF noise capacitor, starting at minimum capacity, until picture noise just disappears; then increase the capacitance one quarter-turn more. With some tubes this control can be left at minimum capacitance. The sweep curve through the preamplifier should now be approximately that shown in Fig. 4. Rolloff on the high frequency end will vary with the hi-peaker setting.

When properly adjusted, the preamp will resolve 600 lines easily. We have operated three of these units over two years and have enjoyed 100% reliability and no problems. The freedom from microphonics is a real improvement.

Bias Supply

The circuit in Fig. 5 is the bias supply which eliminates the original two-tube bias circuit for the deflection and viewfinder circuits. The voltage across the bias winding of the power transformer is first rectified by the 1N3194 diode, then filtered. The zener diode regulates the bias-voltage output. Supply requirements will vary according to the type of camera; this unit may not be needed in some cases. ▲

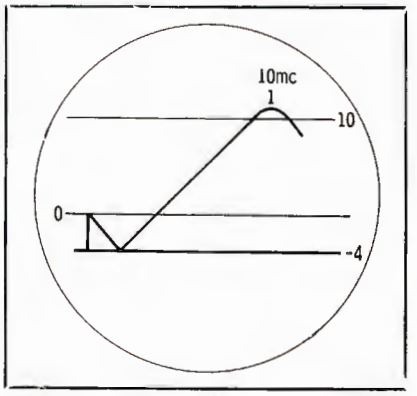


Fig. 4. Swept curve through preamplifier.

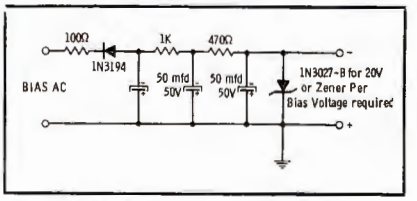


Fig. 5. Semiconductor diode bias supply.

June, 1964

We interrupt this magazine to bring you ...

Late Bulletin from Washington

by Howard T. Head

AM Freeze To Be Lifted

The Commission's staff has been hard at work studying various technical proposals for a lifting of the "freeze" on acceptance of applications for new standard-broadcast (AM) stations. Chairman Henry has announced his intention of ending the freeze in June, and the staff is making every effort to meet this deadline.

When the freeze was imposed some two years ago, the Commission proposed new engineering rules to be employed in allocating any new AM stations. Present indications are that these or similar rules, which will greatly restrict the availability of new AM grants, will be adopted. The Commission's new procedures are almost certain to emphasize service to areas which now receive little or no broadcast service.

FM Harmonic Interference

The increase in pace of new FM station construction (there are now almost 1200 FM stations on the air in the United States) is giving rise to an increasing number of complaints of interference caused by FM signals to the reception of television stations. The problem arises because the FM band (88 mc - 108 mc), and the upper VHF television band (channels 7-13, 174 mc - 216 mc) are in almost exact second harmonic relationship. In some instances, FM stations have been found to actually radiate sufficient second harmonic energy to interfere with television reception on the high VHF channels. More commonly, however, the interference is caused by the FM signal overloading the input stage of the television receiver, generating harmonics in the process. The problem is especially serious in fringe areas where television signals are weak and the use of booster amplifiers is common.

At one time, the Commission endeavored to avoid FM assignments in areas where harmonic relationships to television service might cause trouble. When the new FM Table of Assignments was adopted, however, the new channel allocations ignored possible harmonic interference, with the resulting rash of complaints. In one large midwestern city, interference was so severe that complaints shut down a new FM station which had been on the air for less than 24 hours. Fortunately, a substitute channel was quickly found for the FM station. The Commission is looking into ways of solving the problem, but only on the basis of individual situations. There are no prospects at present for a general FM or television re-allocation to eliminate or minimize the existing conflicts.

Monitors for FM Stereo

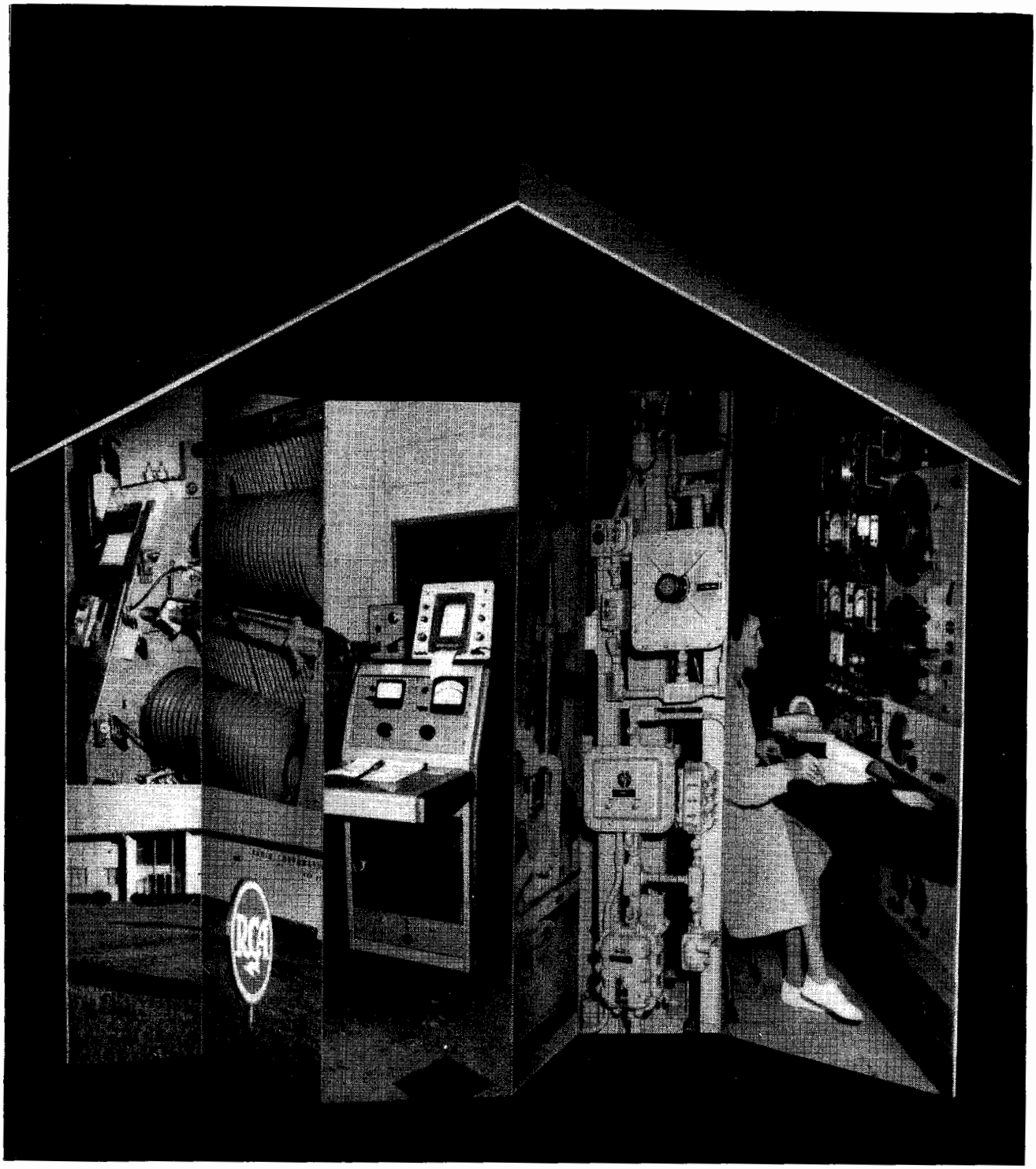
The Commission has invited comments on proposed new rules which would require FM stations transmitting stereo, multiplex, or both, to employ type-approved frequency and modulation monitors to assure that the stereo or multiplex operation complies in all respects with FM Technical Standards. The proposed rules, which would become effective January 1, 1965, would require performance exceeding that now provided by any monitors presently on the market. Hopes are that the Commission's proposal may be relaxed somewhat when the final rules are adopted. Leading manufacturers believe that little if any performance upgrading of existing monitors will be required.

TV and Land-Mobile Sharing

The Commission has proposed a comprehensive study of technical measures that might be undertaken to make additional channels available for both base and mobile stations in the land mobile services. This category embraces fire, police, industrial, taxicab, and many other services employing mobile transmitters.

This study is to include an investigation of the feasibility of sharing the VHF television spectrum (54 mc - 88 mc, 174 mc - 216 mc) with the land mobile services. The Commission has already released some studies which show serious problems of interference from the land mobile services to television reception. However, further investigations are to be made, looking into such matters as technical limitations which might be imposed, time and geographical sharing, possible ionospheric interference in the 54 mc - 88 mc band, and restriction of operation to mobile units only, with base stations being excluded from the television bands.

Howard T. Head...in Washington



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SOLID-STATE CHOPPER FOR MODULATION CHECKS

by Robert L. Zuelsdorf, Assistant Supervisor of Engineering, WKOW-TV, Madison, Wisc. — This transistorized chopper provides a means for checking video modulation without picture tearing.

Every television station must have a means of checking video modulation. The mechanical choppers usually employed to establish a zero voltage, or 100% modulation reference, have certain inherent disadvantages. The pulse, or pulses, of white reference tear the picture making it difficult to monitor the feed visually while the chopper is in operation. Even if a phased, synchronous device is used, the pulse may be too wide to be kept within the vertical blanking interval. To overcome these limitations and permit continuous observation of modulation level, we have designed a solid state chopper (Fig. 1).

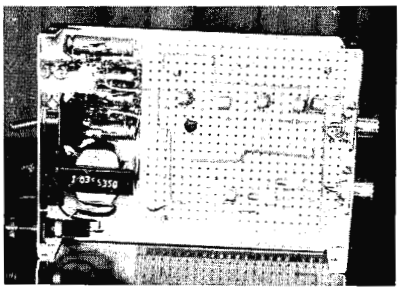

Fig. 1. Completed solid-state chopper.

Circuit Operation

The chopper produces a 100-microsecond reference pulse approximately three lines prior to end of vertical blanking. This pulse is wide enough to permit easy observation, yet not so wide as to adversely affect monitor synchronization. Since the pulse occurs during vertical blanking time it is not visible on scanned-out monitors and shows only as a white line at the top of underscanned monitors.

The chopper could be triggered directly from the station's vertical drive if local video sources were used exclusively. However, this method would not provide the proper phasing when remote signal sources such as network or video tape are used—the reference pulse would drift through the picture.

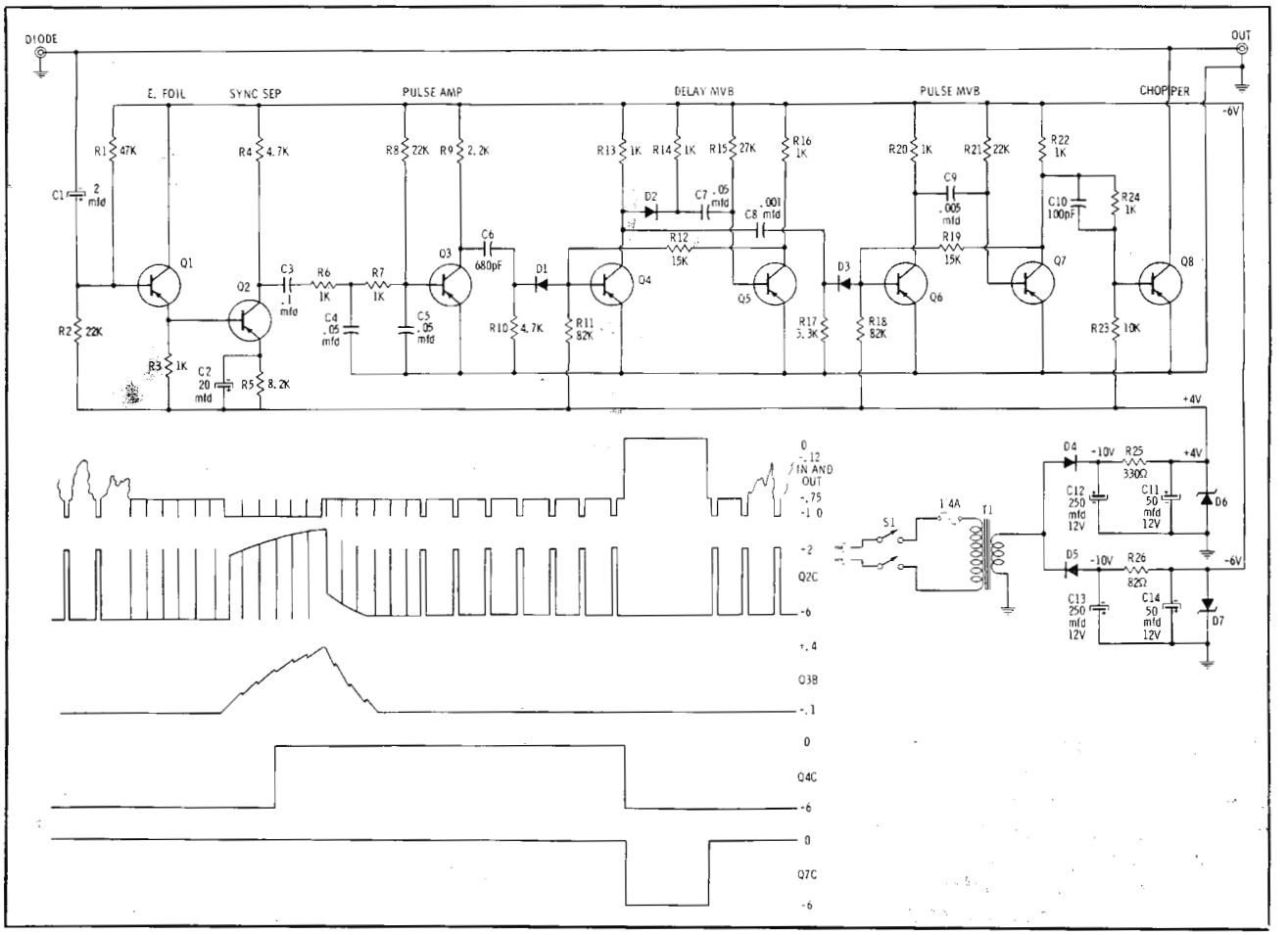

Fig. 2. Complete circuit of the solid-state chopper with waveforms of each stage for checking operation after installation.

EIMAC TUBES POWER VOICE OF AMERICA TRANSMITTERS

This is a transmitter used by U.S.I.A. for Voice of America. Collins Radio built it. Eimac supplied the tubes. Two Eimac 4CV100,000C tubes are used in the modulator, two in the final rf amplifier. And two Eimac 4CX3000A tubes are used as drivers in the modulator. The transmitter is part of one of the highest power international broadcasting stations ever built—yet one of the smallest ever designed, due to Collins engineering and Eimac's high efficiency vapor cooled tetrodes. This is another example of how Eimac leads the way in new ideas for greater efficiency in new tubes for new transmitter design concepts. Contact Eimac for a power tube to fit your needs.

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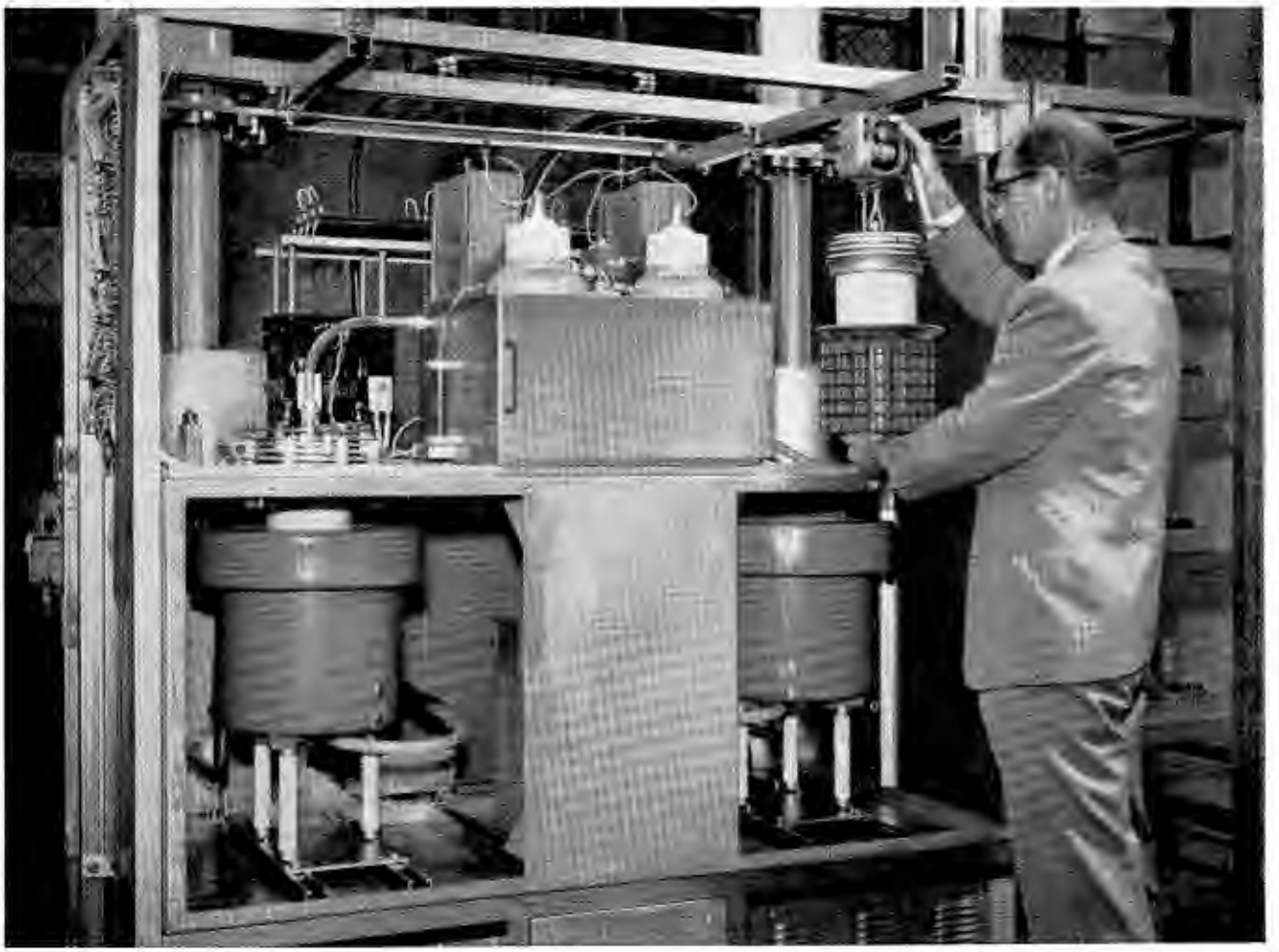


Circle Item 12 on Tech Data Card

Therefore, it is necessary to derive the timing information from the transmitter signal to keep the pulse in proper phase. To accomplish this, sync is stripped from the video and the integrated vertical sync pulse is used to trigger the chopper.

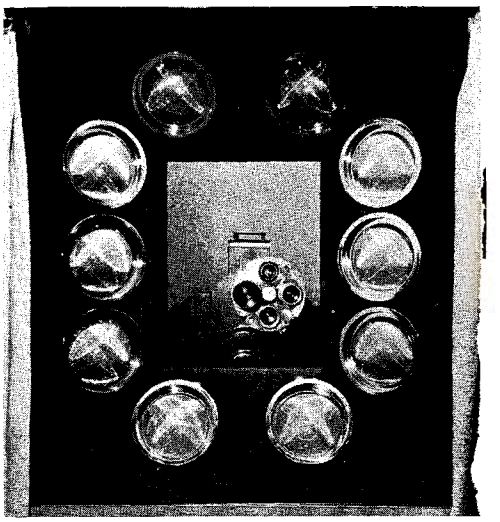
In operation, the monitor diode output of about 1-volt peak to peak is looped through the chopper input. Transistor Q1, an emitter follower (Fig. 2), presents a high input impedance to the video signal while driving the sync separator. In the next stage, Q2 is driven to saturation by the negative-going sync pulses. The discharge of C2 through R5 cuts the stage off slightly below blanking level, thus producing positive-going sync pulses at the collector. The RC integrator network which follows provides a .5-volt sawtooth pulse corresponding to the vertical sync. After the sawtooth is shaped into a squarewave by Q3, it has a rise time suitable for forming a trigger pulse. The short time-constant of C6 and R10 differentiates the squarewave while D1 eliminates the positive spike and applies a negative trigger to Q4.

Delay multivibrator Q4-Q5 produces a pulse of about 750 microseconds duration. This twelve-line delay is used to place the reference pulse on the vertical back porch. The delay waveform is differentiated and the negative spike produced by its trailing edge is used to trigger pulse multivibrator Q6-Q7. The 100-microsecond pulse thus generated is used to drive Q8, the chopper transistor. This final stage is cut off between pulses and appears as an open circuit to the video. When the negative pulse is applied to the base, the stage is driven to saturation, and video is shorted to ground through the low saturation resistance of Q8.

Cutoff bias is applied to the multivibrators and to Q8 from the 4-volt line. This assures adequate performance with respect to temperature and insures that the chopper transistor will be completely cut off between pulses.

Half-wave rectification was deemed adequate for the power supply. The negative 6-volt and positive 4-volt supplies have drains of only 40 ma and 20 ma, respectively. The relatively large capacitances of the filters give sufficient

A Preview of . . .



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with:

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A chronicle of the early years of television broadcasting in Canada.

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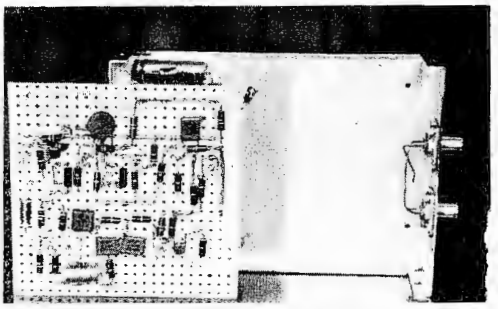


Fig. 3. Chassis box and bottom of board.

filtering; zener diodes provide voltage stabilization.

Construction

A Bud CU-2108A 5" x 7" x 3" box forms the housing for the choppers (Fig. 3). One inch was removed from the depth leaving a 5" x 7" x 2" box. The chopper circuit is built on a 4½" square piece of 85G24EP Vectorboard, using T-28 terminals. The power supply occupies one end of the box, while the board is supported on standoffs at the other end. The circuit is arranged in a "U" shape on the board so the leads to Q1 and Q8 are on the end near the coax connectors. The line to the collector of Q8 should be a short piece of No. 20 wire, and another short piece of No. 20 should run from the Q8 emitter to the coax-jack ground.

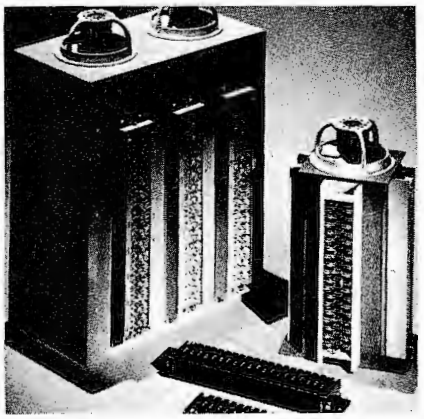
With a few exceptions, most components in the circuit are noncritical. Capacitors C7 and C9, both multivibrator timing components, are the Mylar type to insure temperature stability. 1N34's may be substituted for D1, D2, and D3 without affecting performance. If desired, R15 can be made adjustable to vary pulse delay.

Results

No degradation of video has been noticeable with the chopper connected to the monitor diode output. The chopper has no effect on the multiburst and stairstep signals used to check for frequency and phase distortion. The solid-state chopper output agrees with that of a mechanical chopper to within .02 volt. DAT-1710's were used in the first two stages of the original unit, but the 2N404 transistors specified will give equal performance.

This unit meets all design objectives. It may be operated continuously, giving a constant check on modulation, without disadvantages of a mechanical chopper. ▲

Solid-state rectifiers on . . . This Month's Cover



Shown on the cover this month (and in the photo above left) are silicon rectifier stacks and high-voltage stack assemblies used to supply power to transmitters at WLWO, Bethany, Ohio. The 200-kw Voice of America transmitters were previously supplied by three rectifiers employing 14 872A tubes, plus two spares, to provide bias and plate voltages. Initially, temporarily-rigged assemblies provided high and low voltage to two of WLWO's transmitters for seven months without a single moment of down time. Following this successful test, twelve high-voltage stacks were permanently installed, two stacks replacing each of the tubes; low voltage is provided by two of the smaller stacks, replacing eight additional 872A's. Shown in the photo on the right is one of the rectifier modules. It consists of eight silicon diodes arranged in series on special coupling plates. Four such units, each sealed in a case, make up a full-wave bridge, the best configuration for silicon diodes in high power applications. Typical of the trend toward solid-state circuits in many broadcast applications, the silicon-diode power supplies provide one million watts each at high efficiency with greatly reduced maintenance requirements.

(Photos through courtesy of Semiconductor Div., Westinghouse Electric Corp.)

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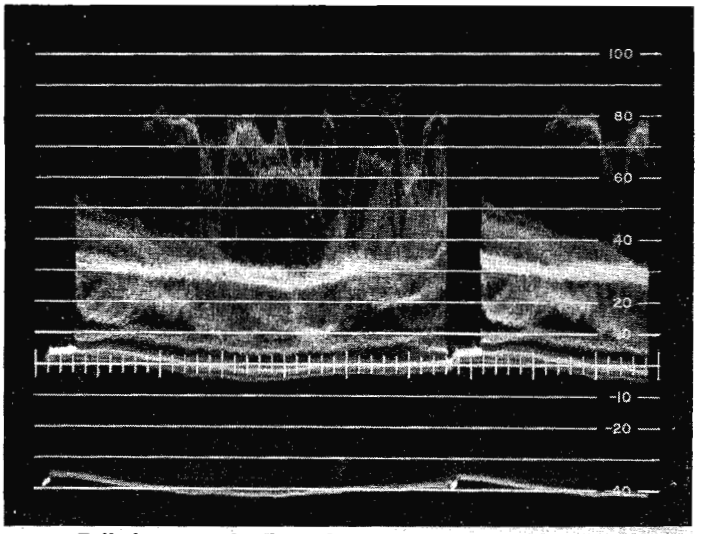
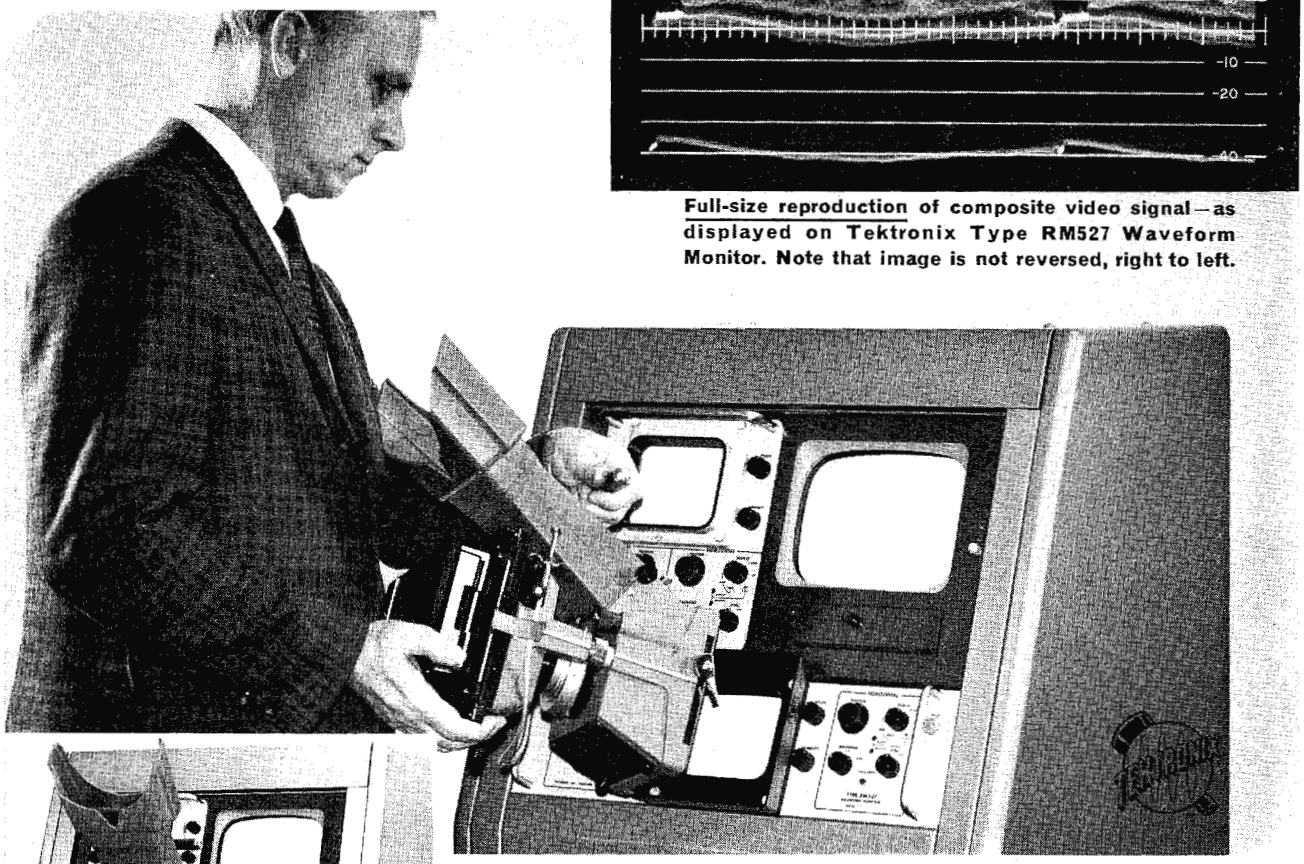
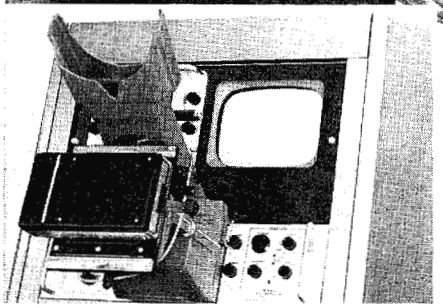


Full-size reproduction of composite video signal—as displayed on Tektronix Type RM527 Waveform Monitor. Note that image is not reversed, right to left.





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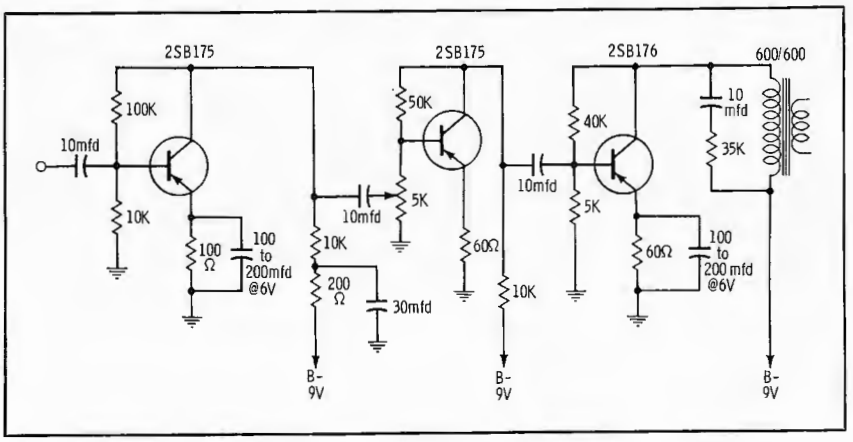


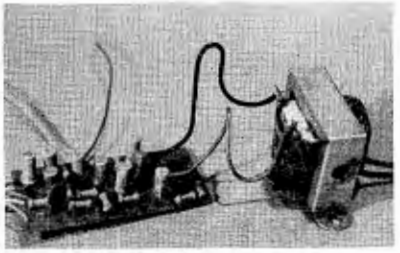
Basic Remote Amplifier

by Ronald Pesha, Staff Engineer, KREY-TV, Montrose, Colo.

Does your station need an extra remote or utility amplifier? Construct this miniature unit using a modified, transistorized module. Sound quality is excellent, and the cost can be held under fifteen dollars.

The amplifier module, readily available at many distributors and mail-order houses, consists of a three-transistor circuit on a printed board. When the unit is operated at line level, distortion is low and frequency response wide.

Two modifications are necessary. First, replace the emitter bypass capacitors in the first and third stages with 100- to 200-mfd 6-volt units; this flattens low frequency response. Next, replace the miniature output transformer (remove it from the board with soldering pencil and a sharp knife) with a 600/600-ohm line transformer having adequate inductance for extended low frequency response. Such a transformer is physically large compared with the printed board, so mount it externally. Connect the primary leads to the circuit through the two holes in which the leads of the original transformer were soldered. The photograph shows the new transformer electrically connected to the amplifier.



Mount the board and new transformer in a metal case. Wire the input, volume control, and battery leads according to the instructions supplied with the amplifier.

Input impedance of the amplifier is about 1000 ohms, suitable for a medium- or low-impedance microphone. Power for the circuit may be supplied by a 9-volt transistor radio battery, while six flashlight cells wired in series will provide longer battery life. Current drain is about 15 ma.

Voltage gain is about 36 db—seemingly marginal for some purposes, but adequate for local short-haul lines. The volume control may be present and fixed, or a level meter may be added for riding gain.

With an output of one volt into 600 ohms, distortion was measured at about .75% for the entire band from 30 to 15,000 cps. Distortion rises rapidly as the output is increased. Frequency response is down 1 db at 22,000 cps and about ½ db at 30 cps, the lower limit of the oscillator and distortion meter we used.

The low cost of remote amplifiers built in the manner described justifies construction for applications which do not require high gain or high output levels. Where long hauls are the rule, and in other cases where greater output is desired, similar four-transistor modules with push-pull output circuits may be used.

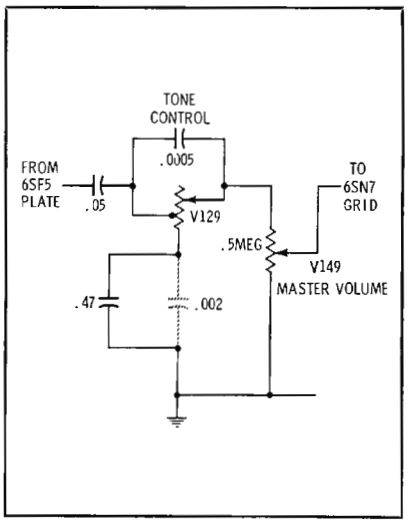
Automatic Timing for Tapes

by Al Robertson, WLBZ,
Bangor, Maine

We use 3½- and 5½-minute cartridges with a number of commercial or public service messages in sequence. We ran into occasional trouble when a cartridge tape stopped in the middle of a commercial we were transferring to it due to timing mistakes on the part of the operator. This made it necessary to redo the whole tape.

Solving the problem was simplicity itself. We wired a clock across the motor on our cartridge machine. The clock runs only when the tape is moving across the heads and provides a very accurate check of elapsed time and time remaining on the cartridge. On our regular reel-to-reel tape machines, the clock is also wired across the motor, since these machines are run remotely by starting and stopping the motor.

In all cases, the power to run the clock is wired to a keyed plug on the chassis to prevent accidental use of the plug for connecting devices other than the clock.



Tape Inputs via Spare Mixer

by Nelson Rupard, KIND,
Independence, Kansas.

Faced with a need for additional console tape inputs (a common dilemma), and with our limited budget in mind, we achieved satisfactory results by modifying a surplus amplifier. The unit is a David Bogen HOL program mixer which has four high impedance channels and a low impedance output.

To obtain tape head equalization on all four high-gain inputs, a .47 mfd capacitor was substituted for the .002 in the tone control circuit. A single-pole double throw switch was installed on the back of each volume control to permit connecting any channel to a cue buss (and separate cue amplifier). This arrangement allows the operator to monitor and cue any combination of channels while any other group is on the air.

The converted mixer was remounted on a 7″ by 19″ standard rack panel, and the four outputs fed to a single console input.

With this installation, we have gained four individually controlled tape deck inputs by using only one console channel. The unit is compact, serviceable, and represents a considerable saving over the cost of individual tape amplifiers. Similar modifications can, of course, be made with other program mixers. ▲

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Catalog Number "Coppergard" Shield	Attenuation (Nom. db @ 100 ft.) Ch. 6	Ch. 13	Nom. Overall O.D.
4920	0.88	1.50	.480"
4930	0.65	1.05	.652"

ALSO AVAILABLE: Self-supporting IM "Fig. 8" type and Double COPPERGARD shielded types for direct-burial use.

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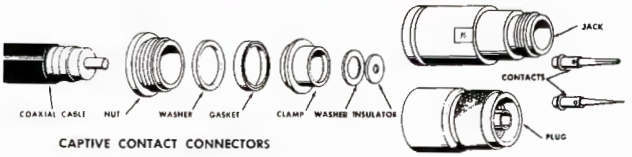

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Superior's Captive Contact Connectors eliminate the "pullouts" that cause blank screens by making positive never-fail contact between lengths of coaxial cable to maintain service. Designed to mate electrically and mechanically with #4920 and #4930 "Cell-O-Air" coaxial cable with "Coppergard" shield, Superior's captive contact connectors assure full-system compatibility.

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Circle Item 23 on Tech Data Card

PHASE CANCELLATION OF STEREO SIGNALS FROM MONO-PLAYED TAPES

by Roy Trumbull, Chief Engineer, KBRG, San Francisco, Calif. —
Discussion of the causes of mid-range frequency cancellation in playing back stereo tapes monaurally.

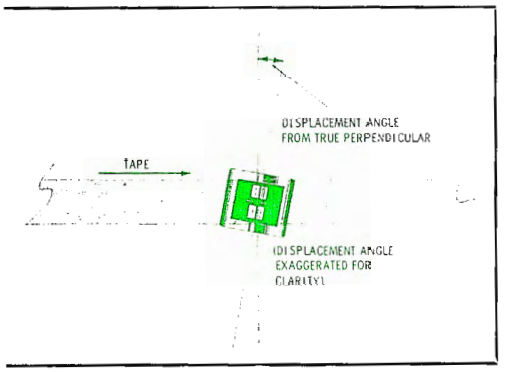


Fig. 1. Displacement of gap from true perpendicular to direction of tape travel.

This article is intended to fill a gap in data on a much talked about problem that occurs at recording studios and stations transmitting stereo. The problem is essentially: Why do the midrange frequencies disappear from stereo recordings when the left and right signals are tied together for mono transmission? Station engineers receive calls from the mono receiver audience, while recording engineers go nuts trying to make a master tape for the mono pressing of a stereo recording.

I would like to suggest the cause of this problem and propose a solution that varies in complexity according to the equipment involved.

The cause of the phase cancellation problem is displacement of recording and/or playback head gaps. Proper tape head design requires correct azimuth alignment to occur when the gaps are perpendicular to the direction of tape travel. We all know that this is seldom the case, since most tape heads must be skewed slightly for optimum azimuth alignment (Fig. 2). This is fine for mono recording but unacceptable for stereo. If the aligned position of one gap in a stacked head is displaced from that of the other gap by as little as .00075", the entire mid-range of recorded frequencies may be lost when played in mono mode.

I have chosen a displacement of .00075" because it serves to illustrate why only the middle frequencies are affected by this problem. The amount of tape used to record one cycle of a 10,000 cps tone at 7½ ips is .00075"; this segment passes the gap in 0.1 millisecond. The time for one cycle of 5000 cps is 0.2 milliseconds. Thus, the gap displacement would cause a 180° phase relationship of the two gap signals (Fig. 2). If the signals are combined, as in mono operation, the 5000 cps would be cancelled and frequencies on either side of 5 kc would be attenuated. The result is mid-range loss.

Gap displacement has little effect at 1 kc since the time required for recording one cycle is one millisecond. At 10 kc the displacement causes a shift of 360°, so there is no cancellation there and only erratic cancellation at frequencies beyond (Fig. 3).

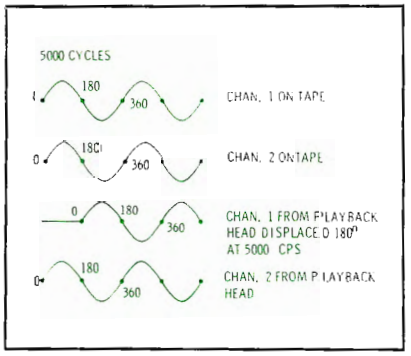


Fig. 2. Relation of 5-kc stereo signals.

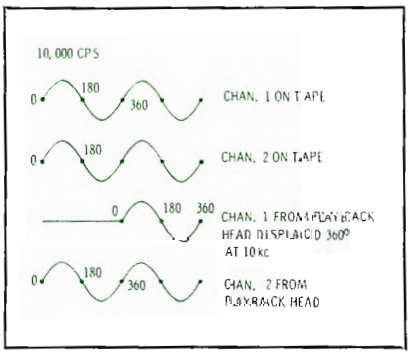


Fig. 3. Relation of 10-kc stereo signals.

Now, what can be done about this problem? An entirely new alignment procedure must be adopted. The main items needed are a standard **full-track** alignment tape and an oscilloscope that is flat from at least 400 cps to 15 kc. If you have been using a meter during alignment you may continue to do so, but the scope is essential.

1. Connect the outputs of channels one and two together and apply them to the vertical input of the scope (Fig. 4).

2. Start the alignment tape. The first tone is 10,000 cps for azimuth alignment. Adjust the playback head for a maximum amplitude of the scope display.

3. Next are a series of tones for response check: 10 kc, 7.5 kc, 5 kc, 2.5 kc, 1 kc, and down to 50 cps. Watch the scope display for a cancellation at 7.5 and 5 kc. Align the head for maximum amplitude at the frequency that shows the greatest cancellation.

4. Now go back to 10 kc and see how much the last adjustment has affected the high frequency amplitude—in some cases 10 kc will be sharply attentuated. Try to work out a compromise alignment between the two frequencies. (If a compromise shows no improvement, you are sharing a problem with many people who own stereo recorders encompassing a great price range.)

5. Remove the alignment tape and place a reel of blank tape on the recorder.

6. Connect an audio generator to the input of both channels and

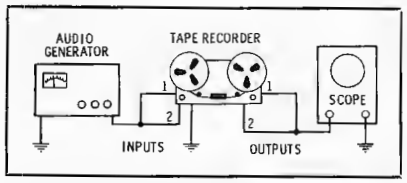


Fig. 4. Test setup for stereo alignment.

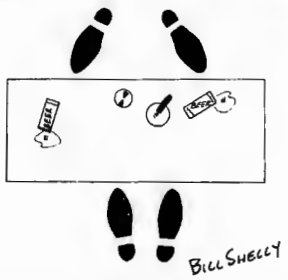
place the recorder in the record mode. The scope should remain connected to the output of the playback head preamps. Set the generator at 10 kc and adjust the inputs for normal recording level.

7. There is a delay between the adjustments you'll make on the recording head and the resulting scope display. Align the recording head for correct azimuth as indicated by the scope trace from the playback heads.

8. Switch the generator to the frequency that showed the greatest cancellation during the playback alignment, and align the record head for the best compromise between that frequency and 10 kc.

If you have a problem recorder or playback deck that does not respond to the above alignment procedure, write to the manufacturer and explain the situation. Most stereo recorders are factory tested only as stereo recorders—the user must often make do with certain inherent problems.

If stereo speakers are separated by a considerable distance, the listener may never notice this phase cancellation. But the broadcaster and recording engineer cannot put up with such a problem. As I noted earlier, this problem occurs in recorders of all price ranges. However, the more money that goes into the heads, the more likely they are to respond to the alignment procedure outlined above. ▲



"Don't worry, Figby, when we automate the station you won't be replaced. Science has yet to come up with a 'goofing off' machine!"

Isolation Pads

(Continued from page 15)

sented by the pad becomes greater, the change in input impedance for a given change in terminating impedance decreases. Thus, the network more effectively decouples the input from the output circuits, while at the same time maintaining impedance match at the input end.

For a further check on network characteristics we shall now determine the change in input impedance of the 20-db pad under the extreme conditions of unloaded and shorted output terminals. In the shorted condition (Fig. 5A),

$$Z = 490 + \frac{121 \times 490}{121 + 490} = 587.4 \text{ ohms}$$

For the open circuit, or unloaded condition,

$$Z = 490 + 121 = 611 \text{ ohms}$$

Useful for smoothing out impedance irregularities of telephone lines, equalizers, and wave filters undermeasurement, 20-db pads also present constant resistance terminations at both input and output ends of a network. Where isolating requirements are not so critical, 6- or 10-db pads will do.

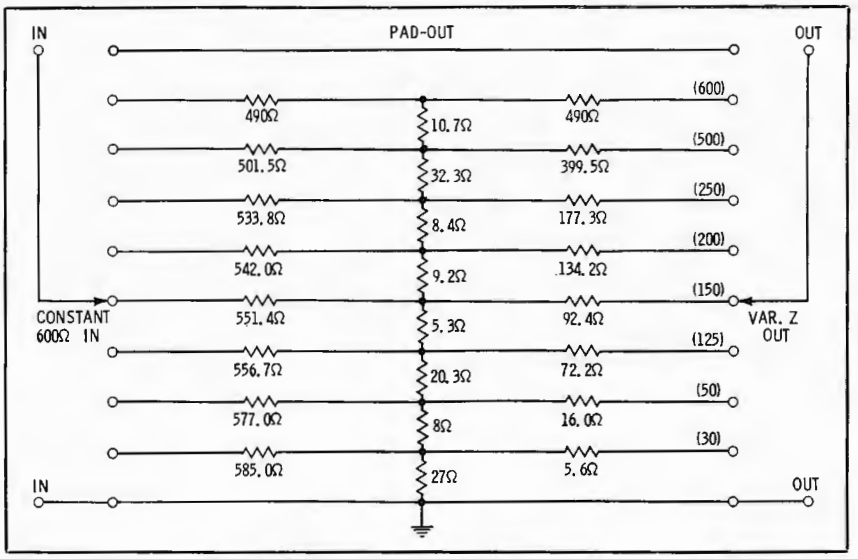


Fig. 7. Unbalanced version of the rotary impedance matching network for 20-db loss.

Symmetrical Bridged-T

We shall consider next the design of another symmetrical network, the bridged-T pad. For a loss of 6 db and from the design equations of Fig. 4A, part 1, Zo is 600 ohms and K is 2. Therefore:

$$ZA = Zo\,(K - 1) = 600(2 - 1) = 600 \text{ ohms}$$

and,

$$ZB = \frac{Zo}{K - 1} = \frac{600}{2 - 1} = 600 \text{ ohms}$$

The completed unbalanced pad is shown in Fig. 6A. Note that all arms as well as terminating impedances are equal to 600 ohms; each arm sees its own image impedance. If any arm was removed the input impedance at the terminal to which it had been connected would be 600 ohms, as long as the network is

Book Review

Antenna Engineering Handbook, Henry Jasik, Editor; McGraw-Hill Book Co., Inc.; 1,040 pages, $22.00. This reference handbook should be on the shelf of every engineer who has a broad interest in antennas. The 35 chapters are divided into four groups: I, "Introduction and Fundamentals," by the Editor, fine for review; II, "Antenna Types and Methods," a good reference section on all major antenna types, 16 chapters; III, "Applications," ten chapters on design and use of antennas, including seven chapters of pertinent interest to radio engineers (some written by well-known consulting engineers); and IV, "Topics Associated with Antennas," six chapters on important facets of antenna use, including one on measurements.

This book is valuable for the engineer who needs a quick reference or a detailed explanation. Of course it contains mathematics, but practical, applicable math, not esoteric derivations which may delight a research mathematician while only confusing a working engineer.

terminated at both ends by 600 ohms.

The balanced form of the symmetrical bridge network is the H pad shown in Fig. 6B. The bridged H may be derived by designing two 300 ohm, 6-db bridged-T pads and connecting them as illustrated.

Dissymmetrical Minimum-Loss

You may recall at the beginning of the article, last month, we mentioned a rotary impedance matching network which has a constant loss of 20 db at all positions of the control. This network offers a constant input impedance of 600 ohms at the input side, and a selection of 30, 50, 125, 200, 250, 500, or 600 ohms at the output. Such a circuit is used in the source, or sending, end of a transmission measuring set. The rotary impedance matching network shown here in Fig. 1 was designed by use of the equations for the taper pad (given in Fig. 5 of part 1).

Minimum-loss taper pads are useful in program systems for matching circuits of different impedances, such as a 250-ohm circuit to a 600-ohm input, or a 150-ohm circuit to 600 ohms.

250- to 500-Ohm Pad

As an example, we will now design a minimum-loss pad to match a 250-ohm source to a 600-ohm load. In this case,

$$Z_{11}/Z_{12} = \frac{600}{250} = 2.4$$

Table 3 tells us that the minimum loss for this impedance ratio is 8.74 db, and tanh N is 0.7636. Using the formula,

$$ZA = Z_{11} \times \tanh N$$

we have,

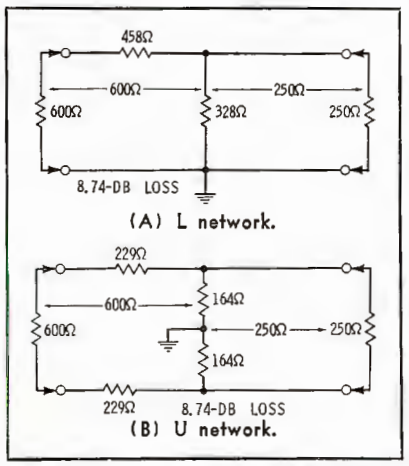


Fig. 8. Minimum-loss, 600 to 250 ohms.

$600 \times 0.7636 =$ approx. 458 ohms

And for the center arm,

$$ZC = \frac{Z_{11}}{\tanh N} = \frac{250}{0.7636} = 328 \text{ ohms}$$

Circuit diagrams for both the balanced and unbalanced versions of this network are shown in Fig. 8.

600- to 150-Ohm Pad

A second example is a pad for matching impedances of 600 and 150 ohms. From Table 3 we find an impedance ratio of 4 corresponds to a minimum loss of 11.4 db, and tanh N is 0.8652. Then:

$$ZA = 600 \times 0.8652 = 519 \text{ ohms}$$

and,

$$ZC = \frac{500}{0.8652} = 173 \text{ ohms}$$

600- to 500-Ohm Pad

Finally, let's investigate one of the most useful of the minimum-loss networks—the 600- to 500-ohm matching pad. The ratio of 600 to 500 is 1.2, which corresponds to a minimum loss of 3.77 db; tanh N is 0.4078 (Table 3). Using these values:

$$ZA = 600 \times 0.4078 = 244 \text{ ohms}$$

and,

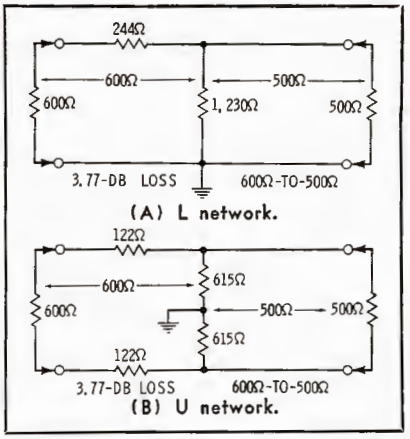


Fig. 9. Minimum loss, 600 to 500 ohms.

$$ZC = \frac{500}{0.4078} = 1.23 \text{ ohms}$$

The completed pad circuit is shown in Fig. 9.

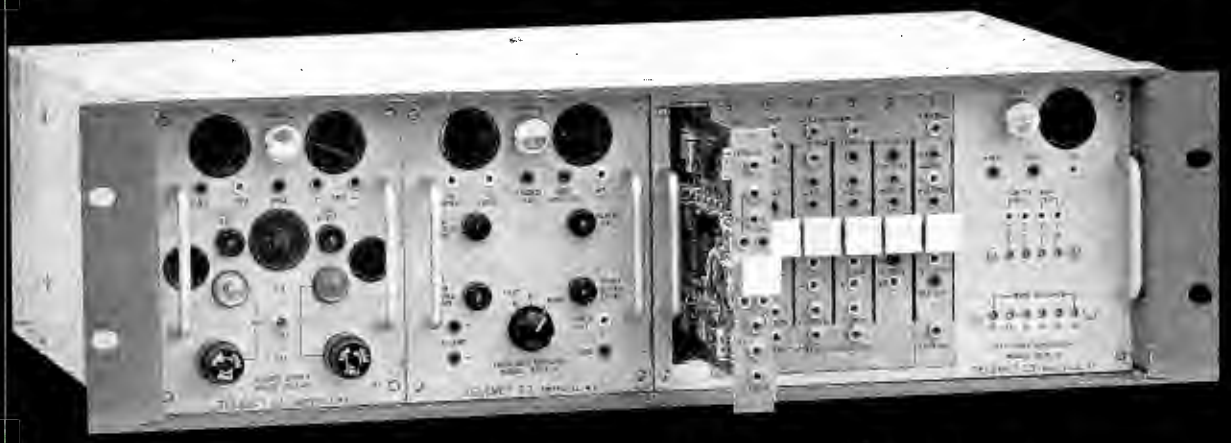
Conclusion

Several networks of the T, H, bridged-T, and L varieties have been discussed. We have examined the circuits from both the theoretical and application standpoints. Ladder-type networks were not included in this article since they are not used for matching or isolating purposes. ▲

Table 3. Minimum Loss in db's and Tanh N as Functions of Impedance Ratio.

$Z1_1/Z1_2$	db Loss	Tanh N	$Z1_1/Z1_2$	db Loss	Tanh N
1.1	2.705	0.3013	2.8	9.580	0.8005
1.2	3.770	0.4078	2.9	9.775	0.8089
1.3	4.548	0.4800	3.0	9.960	0.8161
1.4	5.180	0.5334	4.0	11.430	0.8652
1.5	5.723	0.5770	5.0	12.530	0.8939
1.6	6.190	0.6119	6.0	13.410	0.9124
1.7	6.615	0.6410	7.0	14.130	0.9252
1.8	6.990	0.6657	8.0	14.770	0.9351
1.9	7.340	0.6879	9.0	15.300	0.9423
2.0	7.665	0.7069	10.0	15.790	0.9483
2.1	7.955	0.7235	12.0	16.630	0.9572
2.2	8.235	0.7384	14.0	17.320	0.9633
2.3	8.490	0.7513	26.0	17.920	0.9680
2.4	8.740	0.7636	28.0	18.430	0.9715
2.5	8.970	0.7739	20.0	18.920	0.9745
2.6	9.185	0.7841	25.0	19.910	0.9796
2.7	9.388	0.7928			

Telechrome*
SOLID STATE TV SPECIAL EFFECTS



MODEL 3801A1 TV SPECIAL EFFECTS PICTURED WITH MODEL 13802A1 POSITIONER

*Brand Name

Designed for studio or mobile applications, the new TELECHROME Solid State Special Effects Generator, Model 3801A1, produces a multitude of visual effects to enhance scene changes, insert keying for commercials and bulletins, etc. The system comprises a power supply, switching amplifier and waveform generator in a 5¼" high rack mounting frame and remote control units. The waveform generator contains 7 plug-in cards, 6 for the effects and one for the accessory joy stick positioner. A newly designed effects remote control unit provides an illuminated pictorial of the selected effects–plus Thumb-Wheel control for rapid and positive wipe selection.

FEATURES

- Occupies only 5¼" of rack space.
- Fully transistorized for reliable service free operation.
- Color or monochrome operation.
- Plug-in waveform generating cards.
- Inserts camera control and chroma keying.
- Up to 72 effects; including both horizontal and vertical wipes, diagonals, rectangle, diamond, circle, etc.
- Individual plug-in switching amplifier, waveform generator, and power supply.
- New compact remote control units occupy less console space.
- Thumb-wheel wipe selector eliminates parallax.
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Microwave Equipment

(Continued from page 18)

directly to the vertical amplifier of an oscilloscope. The transmitter may be deviated in frequency by a 60-cps sinewave which is also applied to the horizontal input of the oscilloscope. The display on the oscilloscope will then show the amplitude of the transmitter output as it goes across its frequency band. The frequency meter will cause an amplitude notch 1 or 2 db deep in the output display. By moving this notch back and forth, one can measure the center frequency of the transmitter and get a rough indication of deviation bandwidth which may be correlated with input signal level.

Fade Margin

A very valuable routine test measurement on a video microwave system is the determination of permissible fade level. This is done very simply by placing a variable attenuator (Fig. 6) in either the waveguide output of a transmitter or at the input of a receiver. With the attenuator set on zero, the picture quality is observed. Then the value of attenuation is increased to the point where picture degradation just becomes noticeable. The amount of attenuation inserted before degradation becomes apparent is called the fade margin of the system. In typical installations, this will be 25 to 35 db.

If this test is performed on a quantitative basis, one can learn much about the tolerance of the system. In order to run fade-margin tests on a quantitative basis, the system should be set for some convenient video output (a typical value is 1 volt). Then the video input to the transmitter should be

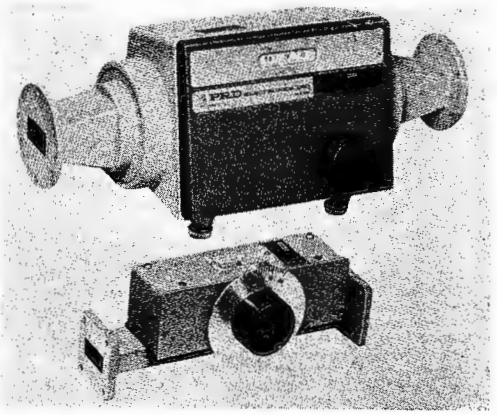


Fig. 6. Variable microwave attenuators.

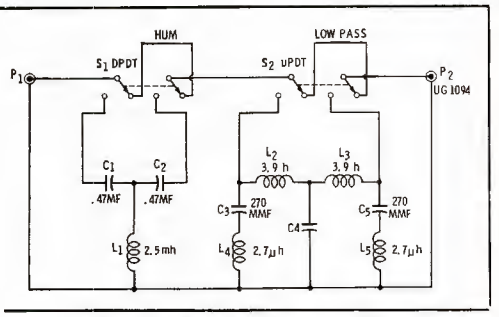


Fig. 7. Hum and low-pass filters for 75-ohm video line from microwave receiver.

disconnected, and the noise voltage out of the receiver should be measured on a wideband (30 cps to 7 mc) voltmeter. Since video signal-to-noise ratios are often quoted in terms of the ratio between peak-to-peak video and rms noise, the number of decibels below 1 volt (measuring only the noise) will be the video-signal-to-noise ratio. While measuring the noise output of the receiver, the waveguide attenuator can be adjusted until the video-signal-to-noise ratio reaches its lowest acceptable value (typically 30 or 40 db, depending on the picture quality desired), and the fade margin of the system can be read from the microwave attenuator.

On systems which have very good fade margin, it is not unusual for the video-signal-to-noise ratio to exceed the signal-to-hum ratio. In order to measure signal-to-noise ratio in this case, some sort of hum filter is needed. If the system has high-frequency sound subcarriers, these must also be eliminated before signal-to-noise ratio can be measured. A convenient hum-and-low-pass filter, which can be put in the 75-ohm video-output line from a microwave receiver, is shown in Fig. 7. The two switches allow this filter to be switched in or out as desired during the test. When the hum filter is inserted in the line, one can be sure that all of the noise measured by the voltmeter will be random noise above 3 kc. When the low-pass filter is inserted in the line, it will cut off FM sound carriers and noise above 4.5 mc.

By measuring the signal-to-noise ratio about once a month and keeping a record of the values obtained, the microwave maintenance engineer can often determine that something is wrong with a link before an actual component failure takes place and causes a system outage. ▲

Winter to Summer

(Continued from page 13)

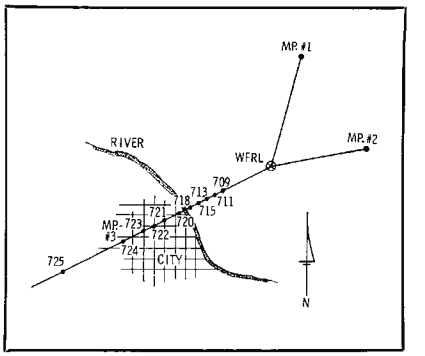


Fig. 5. Relation of WFRL site to the city.

clude a request for a new field intensity limit at the monitor point to allow for the change in soil conductivity. I also suggest that you send a ratio analysis (on semi-log-graph paper) to substantiate the change in conductivity.

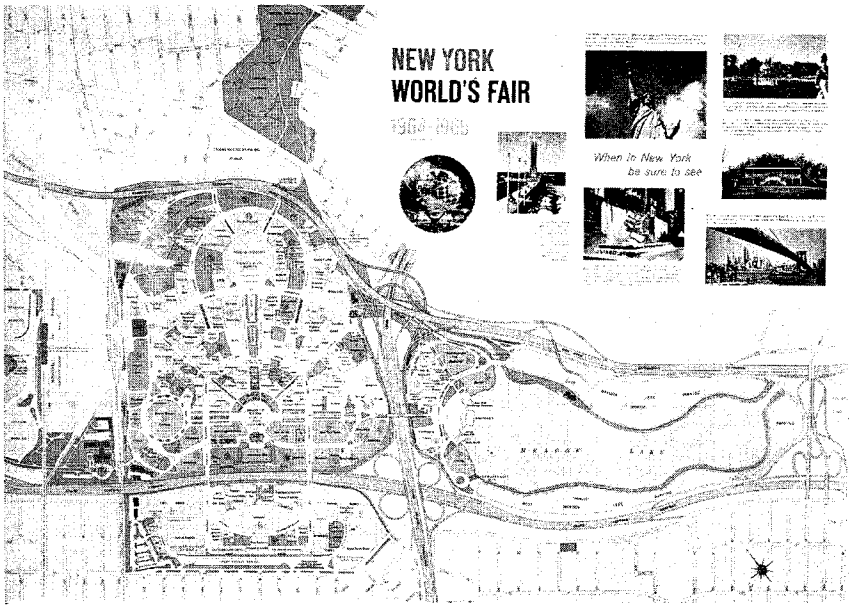
Conclusion

In summary: Soil conductivity in all areas, particularly the colder northern states, will vary from season to season and from year to year. As the conductivity varies it will cause the measured field intensity at a given location to change. When you notice the signal at any of your monitor points shifting seasonally without an accompanying change in base currents or phase angles, it's a safe bet you're a victim of soil conductivity variations. If so, try analyzing sufficient field measurements by the ratio method to isolate the problem. If at this stage you are still in doubt as to whether radiation shifts or soil conductivity changes have taken place, it might not be a bad idea to call your station's consulting engineer. He probably has had experience in similar cases and can provide first-hand help in solving your troubles with changing soil conductivity. ▲

Table 2. WFRL 245° Radial.

Location Number	Proof December	Reproof August	Distance
709	80 mv/m	80 mv/m	0.9 miles
711	69	70	1.1
713	65	65	1.3
715	59	60	1.5
718	57	55	1.8
720	39	33	2.0
721	39	27.5	2.3
722	26	20	2.6
723	15.5	11	3.1
724 (mntr. pt.)	16	8.0	3.5
725	8.8	5.1	5.8

NEWS OF THE INDUSTRY



World's Fair Map

A **Rand-McNally** World's Fair map in full-color has been announced as a free offer with Eveready flashlights and battery products by **Union Carbide's Consumer Products Div.** The handsome 2′ x 1½′ x 9″ map, which folds to pocket size, shows in detail all exhibits and lists major exhibitors with numbers indicating their locations. Parking areas, waterways, restaurants, transportation, and lake amusement area pavilions are included. On the reverse side is a street map of New York City with transit facilities, parks, public buildings, churches, TV studios, stores, theaters, hotels, transportation terminals and sight-seeing attractions. The authoritative World's Fair Map is available with Eveready photo, transistor, instrument and alkaline batteries, as well as the No. 65 "Eveready" Magnet Utility Lite.

Educational Television Center

Brooklyn College has dedicated one of the most modern and complete educational television production centers in the Northwestern United States. Ceremonies were attended by leading educators and broadcasters. Brooklyn College president **Harry D. Gideonse** pointed out that in addition to preparing instructional tapes to be used in classrooms, the center will be a significant source of programs for metropolitan viewers, and will help to supply trained personnel for the television industry. The main address was delivered by President **Donald H. McGannon** of Westinghouse Broadcasting Co. who challenged Brooklyn College and all educators to play an active role in the development of American television, urging that programs be developed that adapt to the medium the contributions of great scholars. The television center includes two studios, the larger of which has over 2000 square feet floor space and a complete complement of broadcast equipment. Studio-quality cameras, special effects generator, and video tape recorders will make it possible for Brooklyn College to prepare programs for all purposes.

IRS Reacts to Decision

The **Internal Revenue Service** announced that it will not follow the decision of the United States District Court for the Eastern District of Tennessee in **WDEF Broadcasting Company v. United States.** In that case the issue presented was whether expenditures incurred by the taxpayer in acquiring a television construction permit and a television license may be amortized for income tax purposes over the period of construction and the first three-year period of the license. Internal Revenue's position is that if the expenditures result in obtaining permission to use the televison facility, the amounts thereof constitute a part of the cost basis of an asset of a permanent nature and a deduction for depreciation thereon is now allowable, since the useful life of a television license is of an indeterminate duration. The District Court, looking primarily at the stated term of the television license in question, held that the taxpayer should be permitted to amortize the expenses over the period of construction and the period of its initial television license. Internal Revenue said that although no appeal was taken, the decision will not be followed as a precedent in the disposition of similar cases.

Rep Firm Formed

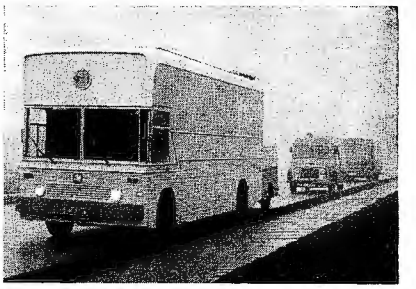
A new sales representative and consulting firm, **Webster Engineering Co.,** Park Ridge, Ill., has been formed. Specializing in equipment and services for broadcasters, educational institutions, government groups, and major distributors, the company will cover Illinois, Eastern Iowa, Northern Michigan, and Wisconsin. The organization is headed by Glenn E. Webster, long known in the broadcast field due to his association with G-E, Collins, and NBC as engineer and salesman. In addition to representing manufacturers of a wide range of broadcast gear, the firm offers engineering service to any station or organization requiring help in selection of equipment, design, and layout of systems, and applications of communications devices.

Property Transactions

Radio Station **KWIP,** Merced, California, has been sold subject to FCC approval, by **Yosemite Broadcasters, Inc.,** to **Radio Call Service, Ltd.** KWIP operates with 1000 watts, days, on 1580 kc.

QXR Network has been acquired by a new group, **Market 1 Network, Inc.** The 47 station coast-to-coast network has been operated by **Novo Broadcasting** since 1962. The Network was formerly owned by the **New York Times.** The new operation plans major expansion of markets and program format.

O.B. Van at Winter Olympics



Shown moving slowly through the Chelmsford, Essex, fog enroute to the Winter Olympic Games in Austria, are three vehicles used in covering the events for international television. Leading the caravan is an outside broadcast vehicle designed to carry at least eight black-and-white cameras or three color cameras. During the games there were two additional cameras at remote sites linked to the van by microwave radio links. In the mobile television facility full vision-mixing facilities are provided for all camera channels, while the sound mixer can accommodate up to sixteen microphone channels, four of which can be switched to a high level input. Equipment is mounted on sliding racks to provide easy access for maintenance; the unique layout provides abundant space for the production area within the van. The field unit included a full operating crew comprising 24 engineers and technicians with a total of four equipment and supply vehicles. In addition to covering the finish of some of the downhill ski races, the unit provided the sole coverage of the bobsleigh and toboggan events where the crew's experience of televising the World Bobsleigh Championships at Innsbruck last year proved to be very valuable.

GE ELECTRONICS


GL-8507


GL-7735a

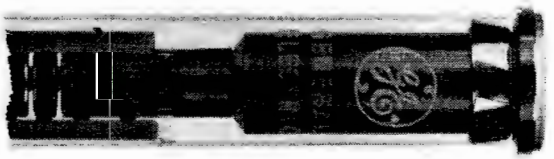

GL-7226

GL-7325

10 ways to improve your image

GL-8511

GL-7697

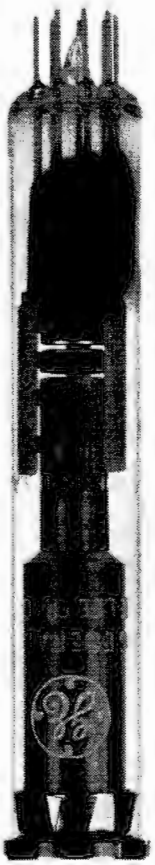


GL-7262a

GL-7263a

GL-8541

GL-7038



Live pickup? . . . Film? . . . Studio? . . . Remote? . . . Industrial? . . . No matter what your TV application, there's a G-E vidicon to fit your exact pickup needs. Ten types to choose from. Why don't you try one in your camera? You'd be surprised how much it can improve your image.

GL-7038 . . . for film pickup applications . . . monochrome or color . . . a direct replacement for the 6198a

GL-7325 . . . high sensitivity for live pickup . . . lower lag at low light . . . ideal for industrial use

GL-7735a . . . highest sensitivity, lowest lag at low light levels . . . for studio or remote pickup

GL-7697 . . . for cameras with automatic sensitivity control . . . fine for industrial use . . . similar to 7735a

GL-7226 . . . low heater power cathode of 0.9 watt . . . for transistorized cameras . . . good live pickup

GL-8511 . . . also designed for transistorized cameras . . . high-sensitivity photoconductor

GL-7262a . . . low heater rating of 0.6 watt . . . excellent sensitivity and low lag at low light

GL-7263a . . . specially designed to withstand severe shock, vibration and high humidity

GL-8507 . . . extended resolution capability . . . higher amplitude response . . . similar to GL-7735a

GL-8541 . . . for transistorized cameras . . . similar to GL-8507 except 0.6 watt rating . . . high sensitivity, low lag

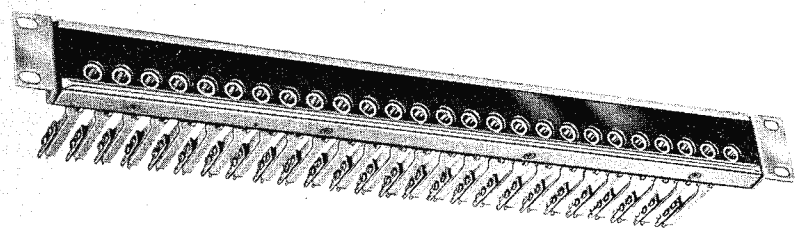
Write us for your free facts folder containing data and specifications on the expanding line of G-E vidicons. Tube Department; 316 E. 9th St.; Owensboro, Ky.

Progress Is Our Most Important Product

GENERAL ELECTRIC

Circle Item 28 on Tech Data Card

NEW PRODUCTS



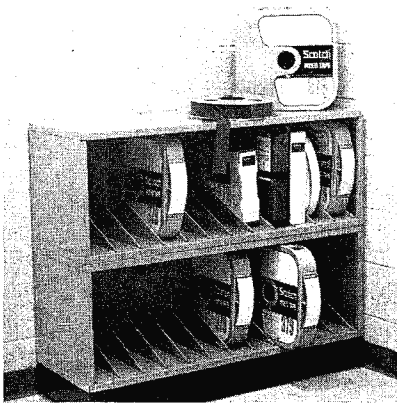
Phenolic Jack Panels

Two phenolic jack panel series have been introduced by **Switchcraft, Inc.** They are molded of solid phenolic and reinforced with steel to provide maximum rigidity and strength. Both series are designed to fit a 19" relay rack and are ideal for broadcast applications. Series 1400 supports 26 jacks in a single row and is available with "T-Jax," long frame telephone jacks, mounted on the panel. Jack "ground-lugs" can be offset to provide easy tying together of ground terminals. Series 1500 accommodates 26 jacks in a single row and is available with "MT-Jax," military phone jacks, already mounted. Each series features one designation strip for identification purposes.

Circle Item 42 on Tech Data Card

Storage Case for Video Tape

The **3M Co.** has developed a new plastic shipping and storage case for 10½" and 12½" reels of "Scotch" video tape and has announced cost-sharing plans on video tape storage equipment. Interior pressure pads prevent movement of the reel and keep it from touching the sides of the case. A two-position lock is provided for shipping or temporary use and a plastic sponge seal keeps tape and reel dustfree. The case is bright blue for easy spotting at shipping terminals, stands on end for storage, and has a carrying handle. 3M said the new cases are available with tape at no increase in price over the old-style fiber case or separately for $9.50 each in quantities of six or more.



Circle Item 43 on Tech Data Card

Parametric Amplifier Developed

PERA (Production Engineering Research Association of Great Britain) has developed a new type of parametric amplifier for use on the VHF and UHF bands. Parametric amplifiers are used in television link networks and in satellite communications to amplify weak signals. Since they add very little noise, they enable even extremely weak signals from distant transmitters to be heard without difficulty in the receiver. The PERA amplifier uses a computer diode for the parametric device and a new type of transistor for the pump source. Instead of the distributed circuit normally used, a lumped circuit has been developed. Operating in the nondegenerative mode, excellent results have been obtained on the 145-mc communication band where measured performance has shown that the internal noise factor does not exceed 1 db over a 2-mc bandwidth with a gain factor of 17 db. Experiments have shown that a very low noise factor can be obtained at television frequencies.

Circle Item 44 on Tech Data Card

Dynamic Lavalier Microphone

An ultra-slim, ¾" diameter, dynamic lavalier microphone is available from **Shure Brothers, Inc.** The Model 570 is specially designed to meet the critical requirements of professional studio and broadcast use. Only 2½" long and weighing 2 oz., the microphone features a response characteristic tailored for clean, natural reproduction, while minimizing mechanical and handling noises inherent in lavalier applications. Frequency response is from 50 to 12,000 cps with a rising characteristic at 6000 cps. The EIA microphone sensitivity rating is —152 db. Complete with a "Flex-Grip" lavalier assembly, cord-retaining belt clip, and 30' of cable, the unit is priced at $57.00.

Circle Item 45 on Tech Data Card

Klystron for UHF Television

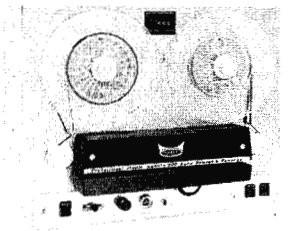
In anticipation of the recent FCC rulings fostering the growth of UHF TV and the resultant large market for UHF transmitters, **Amperex Electronic Corp.**

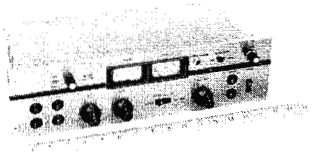
is marketing an air cooled, long life, power glystron that is rated at 11 kw sync power output. Because of its innovations, this klystron can simplify the design of UHF television transmitters. Designated the YK1001, it is the first UHF power klystron to employ permanent-magnet focusing and air cooling; it is warranted fo 5000 hours and can even be mounted outdoors on a TV antenna tower. The YK1001 is a ceramic-and-metal, four-cavity klystron, designed especially for UHF television broadcasting.

Circle Item 46 on Tech Data Card

Automatic Tape Recorder

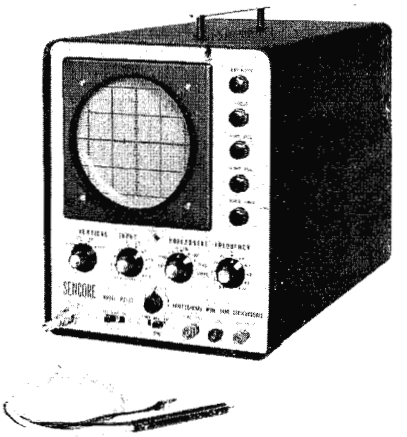
Freeman Electronics has introduced the Model 200-DPA fully automatic deck





and preamplifier for custom installations. The machine uses solid state circuitry throughout, hence generates almost no heat; circuitry can last indefinitely under normal usage. Under conditions of continuous play, the tape recorder never runs hot. The 200-DPA takes reels up to 7" (3600' max.) and operates at 7½ or 3¾ ips. It offers automatic reverse and continuous play in both directions; playback can be as selective as desired because metallic activating strips attached to the tape will cause only selected portions to be repeated. Price of the recorder is $495.

Circle Item 47 on Tech Data Card



Sensitive Broadband Oscilloscope

Sencore, Inc., has announced availability of a highly sensitive broadband oscilloscope. The instrument, designated PS127, does not require a narrowband function since sensitivity is .017 volts rms for 1" deflection. Although simple in design, the unit offers Z-axis modulation and direct plate connections. Frequency response is down only 3 db at 10 cps, thus making the scope excellent for audio as well as video applications. The 5000 volt breakdown rating of the low capacitance probe enables the user to check waveforms in high voltage circuits which are usually not measurable. A horizontal sweep range to 500 kc and positive sync locking round out the features. Price is $169.50.

Circle Item 48 on Tech Data Card

ENGINEERS' TECH DATA

AUDIO & RECORDING EQUIPMENT

60. AKG—Technical specs and other information on microphones and accessories is provided in brochures.
61. ATLAS—Illustrated catalog has specs on PA speakers, special purpose speakers, microphone stands, and accessories.
62. BROWNING—Catalog includes SCA receivers and tuners as well as FM relay receivers.
63. CANNON—Catalog lists audio and video connectors for microphones, recorders, instruments, cameras, and control devices.
64. FAIRCHILD—Technical bulletins describe several devices for control of audio level and response.
65. FERRODYNAMICS—Product sheets list line of magnetic products, including tape kits, reels, mailers, and audio recording tape.
66. GIBBS—Folders describe sound reverberation units for mobile and home receivers.
67. CROWN—Full line of magnetic tape recorders for professional applications are shown in set of bulletins.
68. MAGNASYNC—Catalog covers magnetic film and tape recorders and accessories.
69. MILES REPRODUCER—Description of automatic logging recorder is contained in packet of brochures.
70. NEWCOMB—Series of transistorized tape recorders is shown in spec sheet.
71. QUAM—General line catalog lists speakers for general replacement, PA, and audio system use.
72. RCA—Two microphones, polydirectional ribbon and dynamic lavilier, are covered in bulletins.
73. SCULLY—Solid-state professional tape recorder for studio use is detailed in folder.

COMPONENTS & MATERIALS

74. ALPHA WIRE—Catalog lists complete series of RG-type coaxial cable.
75. CALVERT—Price list includes thousands of electron tubes.
76. EIMAC—Spec sheets cover klystron and ceramic power tubes.
77. HICKOK—Data sheets describe tube testers, VTVM's, VOM's, field strength meters, and stereo generators.
78. UNIVERSITY—Brochures list line of speakers and microphones for audio and recording applications.
79. MILO—Spec sheets and catalogs list products from 145 different manufacturers.
80. OHMITE—Bulletin describes 3- and 5½-watt wirewound resistors and explains increased power ratings.
81. SWITCHCRAFT—Compact phone jack that mounts on ⅝" centers, available in five models, is covered by bulletin.
82. SPRAGUE—Short form catalog lists line of transistors for wide range of applications.

MICROWAVE DEVICES

83. A E L—Lists include 60 models of microwave antennas and that many solid-state microwave switches.
84. MICRO LINK—Data sheets cover three microwave systems, two for business band, one for 2500-mc instructional TV band.

POWER DEVICES

85. CENTRAL TRANSFORMER—Two bulletins describe automatic voltage regulating transformers and principles of operation.
86. TERADO—Portable AC power source with self-contained battery, inverter, charger, meter, and carrying case is detailed in bulletin.

RADIO & CONTROL ROOM EQUIPMENT

87. AUDIO DEVICES—Brochure presents tape cartridge for broadcast applications.
88. BROADCAST ELECTRONICS—Packet of material contains specs and prices for line of cartridge tape devices.
89. FINNEY—Brochure illustrates FM bandpass filter for elimination of interference from FM reception.
80. SPARTA—Product sheet describes cartridge time delay unit with built-in reverberation feature.

REFERENCE MATERIAL & SCHOOLS

91. CLEVELAND INSTITUTE—Booklet discusses courses in electronics for broadcast and communications.

STUDIO & CAMERA EQUIPMENT

92. BOSTON INSULATED WIRE & CABLE—Four-page brochure on TV camera cables and accessories gives specs and attenuation data.
93. CONTINENTAL—Product bulletin describes vidicon television camera for industrial, educational, and broadcast uses.

TELEVISION EQUIPMENT

94. AMPEX—Brochure provides description and specs of VR-2000 television tape recorder.
95. INTERNATIONAL NUCLEAR—Product circular provides information on TSA1 clamping/equalizing amplifier.
96. REEVES—Report provides properties of video recording tape with long life characteristics.

TEST EQUIPMENT & INSTRUMENTS

97. BIRD—Bulletins describe RF directional wattmeters for rigid transmission lines and a protective power monitor and station alarm.
98. DELTA—Application bulletin describes installation and use of common-point impedance bridges.
99. ENTRON—Two-color catalog sheet has information on line tester for checking line termination, testing for open and shorted lines and for isolating trunk trouble.
100. MARCONI—Instrument catalog lists transistorized distortion meter, wave analyzer, audio oscillator, transmission set and other devices.
101. SENNHEISER—Brochure describes VTVM, noise level weighing filter, and distortion analyzer.

TRANSMITTER & ANTENNA DEVICES

102. CCA—Catalog sheets cover line of AM and FM broadcast transmitters.
103. CO. EL.—Booklets cover broadband dipole TV antennas for VHF and UHF, multiguide slot antennas, directional antennas for 1-kw UHF, wideband antennas, VHF and UHF notch diplexers, and filterplexers.
104. GATES—Booklets cover FM transmitter, stereo generators, cartridge tape equipment, and direct crystal-controlled cascade FM exciters.
105. JAMPRO—Paper covers high power wideband FM antenna system capable of handling four transmitters spread up to 2.8 mc apart.
106. STANDARD ELECTRONICS—Spec sheet provides information on transistorized 2-kw television transmitter, using only five tubes throughout.

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

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

EQUIPMENT FOR SALE

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

Will buy or trade used tape and disc recording equipment—Ampex, Concertone, Magnecord, Presto, etc. Audio equipment for sale. Boynton Studio, 295 Main St., Tuckahoe, N. Y. 1-64 tf

Ampex Head Assemblies for 300 and 400 series recorders reconditioned. Service includes lapping and polishing all three head stacks, cleaning entire assembly, readjusting and replacement of guides and realignment of stacks as to azimuth and zenith. Full track assemblies—$60.00. Taber Manufacturing & Engineering Co., 2619 Lincoln Ave., Alameda, California. 5-64 tf

Trim 504 Audio Patch Cords $4.00—Audio Jack Panels for 19" racks, 12 pair $9.95—10 pair $8.95. Repeat coils 500-500 ohm flat to 20 kc, $4.00—relay racks and equipment cabinets—write for list. Gulf Electro Sales, Inc., 7031 Burkett, Houston, Texas. 4-64 3t

TRANSMITTING TUBE SALE—All tubes are new with a 1,000 hour Pro Rata Warranty. 3X2500A3—$125, 4-400A—$36, 4-1000A—$85, 4X150A—$14, 892R—$275. Write for complete price list **THOR ELECTRONICS CORP.**, 287 Morris Ave., Elizabeth, N. J. 07207. 5-64 2t

Television and Video Tape Recording Studio (3 years old anly only 15 months of use), must dispose of all equipment as soon as possible, including RCA Tk31A orthicon cameras, 3 Ampex recorders, zoom and fixed lenses, 77 DX microphones plus many other types, tape and film editing equipment, racks of terminal and test equipment, etc. Will send equipment list—contact Al Ajar, Video Projects Company, 163 Atlantic Avenue, Brooklyn 1, N.Y., Tele. UL 2-4864. 5-64 tf

GOVERNMENT SURPLUS. New 6 foot diameter aluminum parabolic reflectors solid surface. $175.00 ea. Radio Research Inst. Co., 550 5th Ave., New York 36, N. Y. 3-64 tf

GOVERNMENT SURPLUS, NEW 10 CM WEATHER RADAR SYSTEM—Raytheon, 275 KW peak output S band. Rotating yoke P.P.I. Weather Band 4, 20 and 80 mi. range. Price $975 complete. Has picked up clouds at 50 mi. Wt. 488 lbs. Radio Research Inst. Co., 550 5th Ave., New York, New York. 5-64 tf

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

Cannon 50/200mm. f/4.0 LENSES, Model TV-1S3 (CTZ-2). Two Units, used once, excellent condition, including aluminum carrying case—$1,500.00 each. Contact John Horvath, Dage Television Company, 455 Sheridan Avenue, Michigan City, Indiana. Phone: TRiangle 4-3251. 6-64 1t

RCA TS-30D Field Switcher in very good condition. Reasonably priced. Write 3614 Southwest Archer Road. Gainesville, Florida, or call 305 372-254. 6-64 1t

Remote Pickup Broadcast systems for Sale, cheap. 26 mc. or 160 mc. systems complete. Reconditioned like new. GE, Motorola, RCA, and Link. For information call or write World Wide Communications, Seminary Hts., Weatherford, Texas, LY 4-5172. 6-64 1t

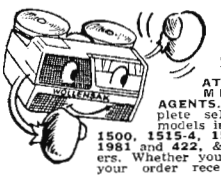
For Sale: Grampian record cutterhead. Will sacrifice. Also recording lathe and Ampex Stereo recorder—very reasonable. We offer repair service of Grampian cutters. 3 weeks required work done in England. Complete overhaul. New coils. Fully guaranteed. Cook Enterprises, 3905 West Slauson Ave., Los Angeles, Calif. 90043. 6-64 1t

Andrew antenna tuning unit—$200, two Gates turntables, Audax tone arms, G.E. cartridges—$270. Gates limiting amplifier—$200, Doolittle frequency monitor—$250, RCA modulation monitor—$85, RCA design program amplifier—$65, new transistorized remote amplifier—$78.50. All items in excellent condition, clean throughout. We buy, sell and trade all types of broadcasting equipment. Broadcast Equipment and Supply Co., Box 3141, Bristol, Tennessee. 6-64 1t

TWO slightly used Model 816X Magnacord playback units. 3¾ & 7½ ips. Play 8 hrs. Up to 14" reels. Al Lee, 2425 W. 25th Dr., Burley, Idaho. 6-64 1t

PERSONNEL

Chief Engineer desires parmanent position. Good technical background. Many years AM-FM, construction and maintenance. 6-64 1t



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Tape Recorders
deliver a wallop bigger than many twice the size.
ATTN: SCHOOLS & GOVERNMENT PURCHASING AGENTS. We have the most complete selection anywhere. New models include: **524, 1400, 1440, 1500, 1515-4, 1570, 1780, 1580, 1980, 1981** and **422,** & **SA-421** speaker/amplifiers. Whether you order 1 or 1000 units, your order receives prompt attention.

REQUEST COMPLETE TAPE RECORDER DISCOUNT SHEET

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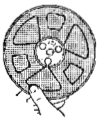
275' Plastic, 3" reel	.35
600' acetate (plastic), 5 inch	.70
600' MYLAR 5 inch reel	.75
900' MYLAR (Polyester), 5 inch	.89
1200' MYLAR, ½ mil. 5 inch reel	1.18
1200' acetate (plastic), 7 inch	.99
1200' MYLAR, 1½ mil. (strong)	.98
1800' acetate (plastic) 7 inch	1.19
1800' MYLAR 1 mil. thick, 7 inch	1.59
2400' MYLAR, untensilized, 7 inch	2.25
2400' MYLAR, tensilized, 7 inch	2.79
3600' MYLAR, tensilized, 7 inch	3.89

(Greater discounts to quantity buyers)



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Technician—First Class Radiotelephone license, A.A.S. degree in electrical technology, one year experience with A.T.&T. carrier and microwave. Desire technical position with television station. Twenty-one years old, willing to relocate any part of country. Broadcast Engineering Dept. 110. 6-64 1t

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REMOTE THERMOMETER
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Outside temperature from mike position. Installed in less than 1 hour. Ask about our other weather equipment. Send for Brochure. P. O. Box 6111, 1246 Shafter St., San Diego 6, Calif. 2-64 1t

- SYNCHRONOUS MAGNETIC FILM RECORDER/REPRODUCER
- MAGNETIC TAPE RECORDERS
- NEW—THE portable MINITAPE synchronous 13 lb., battery operated magnetic tape recorder for field recording.

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Dept. B HO 4-7461

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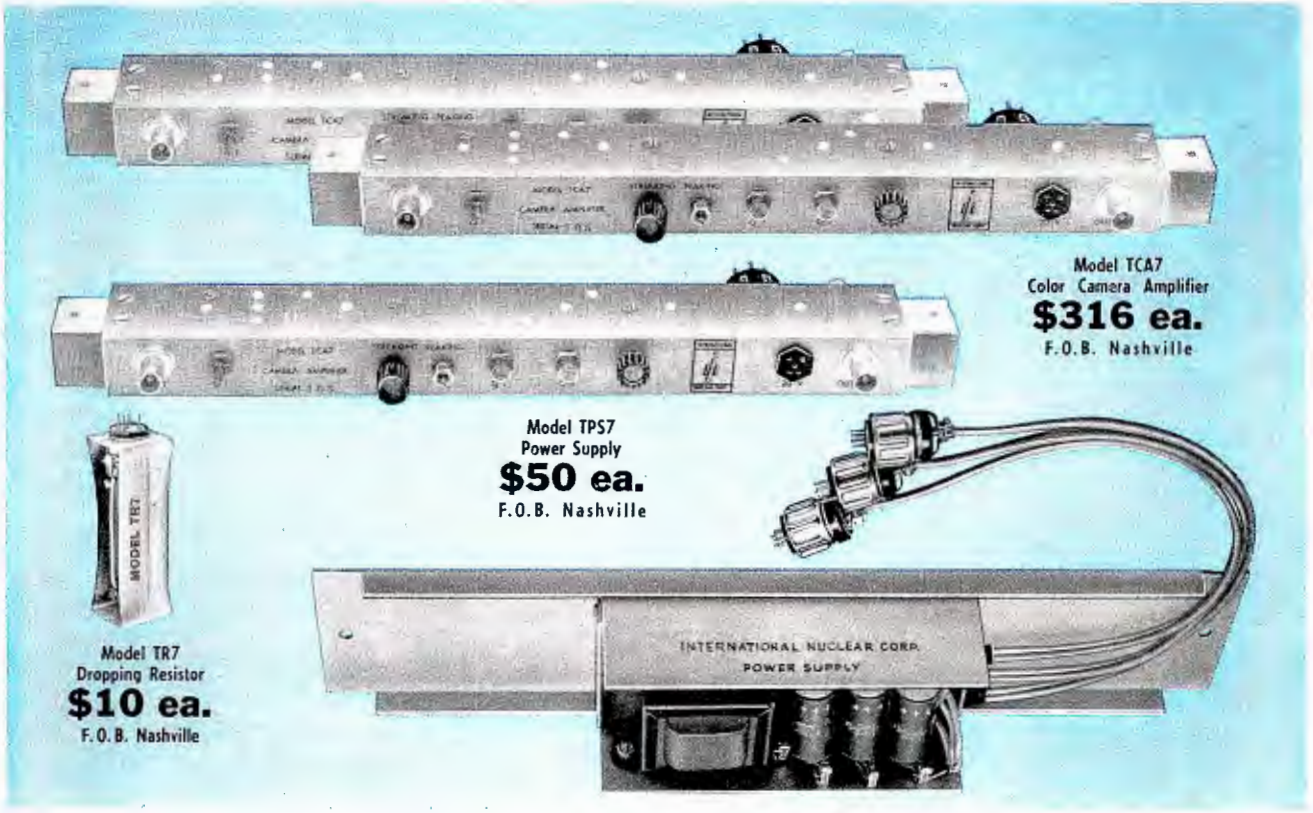

REPLACE TUBE-TYPE AMPLIFIERS IN YOUR COLOR CAMERA WITH INTERNATIONAL NUCLEAR ALL-TRANSISTORIZED PREAMPS

MODEL TCA7 is designed specifically for the RCA TK-41 color camera chain and replaces mechanically and electrically tube-type preamplifiers.

- **ELIMINATE MICROPHONICS**
- **REDUCE NOISE**
- **REDUCE HEAT**
- **GET HIGH GAIN-BANDWIDTH PRODUCT**
- **GAIN STABILITY**

Model TCA7 can be installed in about thirty minutes. Mounting dimensions and hardware identical to replaced tube amplifier. Can be powered by TPS7 solid state power supply or directly from the 280 volt camera supply by using a model TR7 dropping resistor with each TCA7.

INTERNATIONAL
NUCLEAR CORP.

Write for complete information and specifications to Dept. T-7

INTERNATIONAL NUCLEAR CORPORATION

608 Norris Ave. Nashville, Tenn. Phone 254-3366

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RCA-5820A 3-INCH IMAGE ORTHICON

Today's Most Popular General Purpose Camera Tube

- HIGHER SIGNAL-TO-NOISE RATIO than the original 5820: 45:1 at 4.5 Mc.
- HIGH SENSITIVITY: requires only 5 footcandles scene illumination, 0.02 footcandles on faceplate.
- UNIFORM SIGNAL OUTPUT
- UNIFORM BACKGROUND
- IMPROVED AMPLITUDE RESPONSE FOR HIGHER RESOLUTION
- LOW MICROPHONICS
- EXCEPTIONAL UNIFORMITY FROM TUBE TO TUBE
- THE MOST POPULAR AND RELIABLE general-purpose image orthicon on the market. For black-and-white pickup outdoors or in the studio.

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