FEBRUARY, 1960

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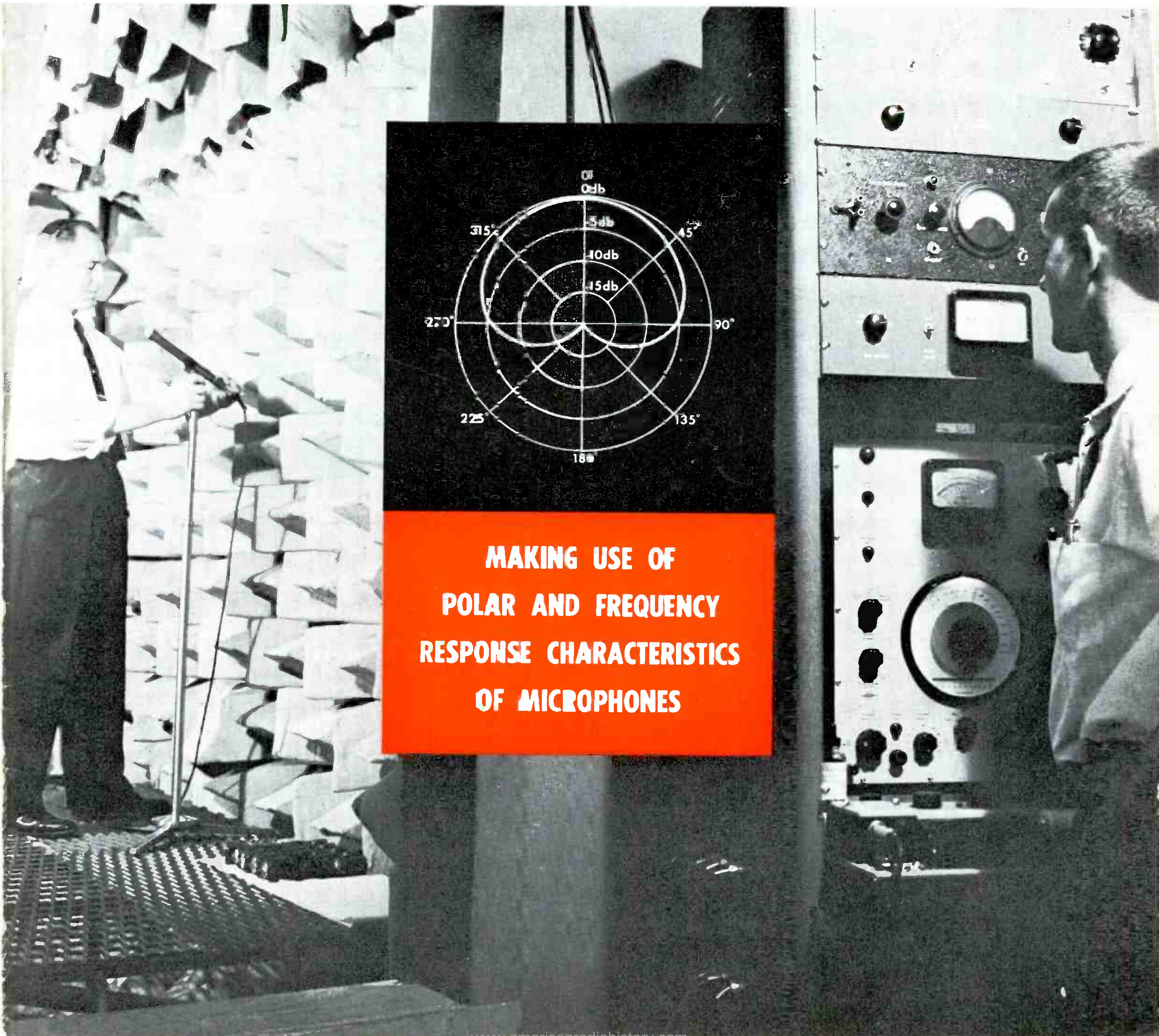
BROADCAST ENGINEERING

THE TECHNICAL JOURNAL OF THE BROADCAST INDUSTRY

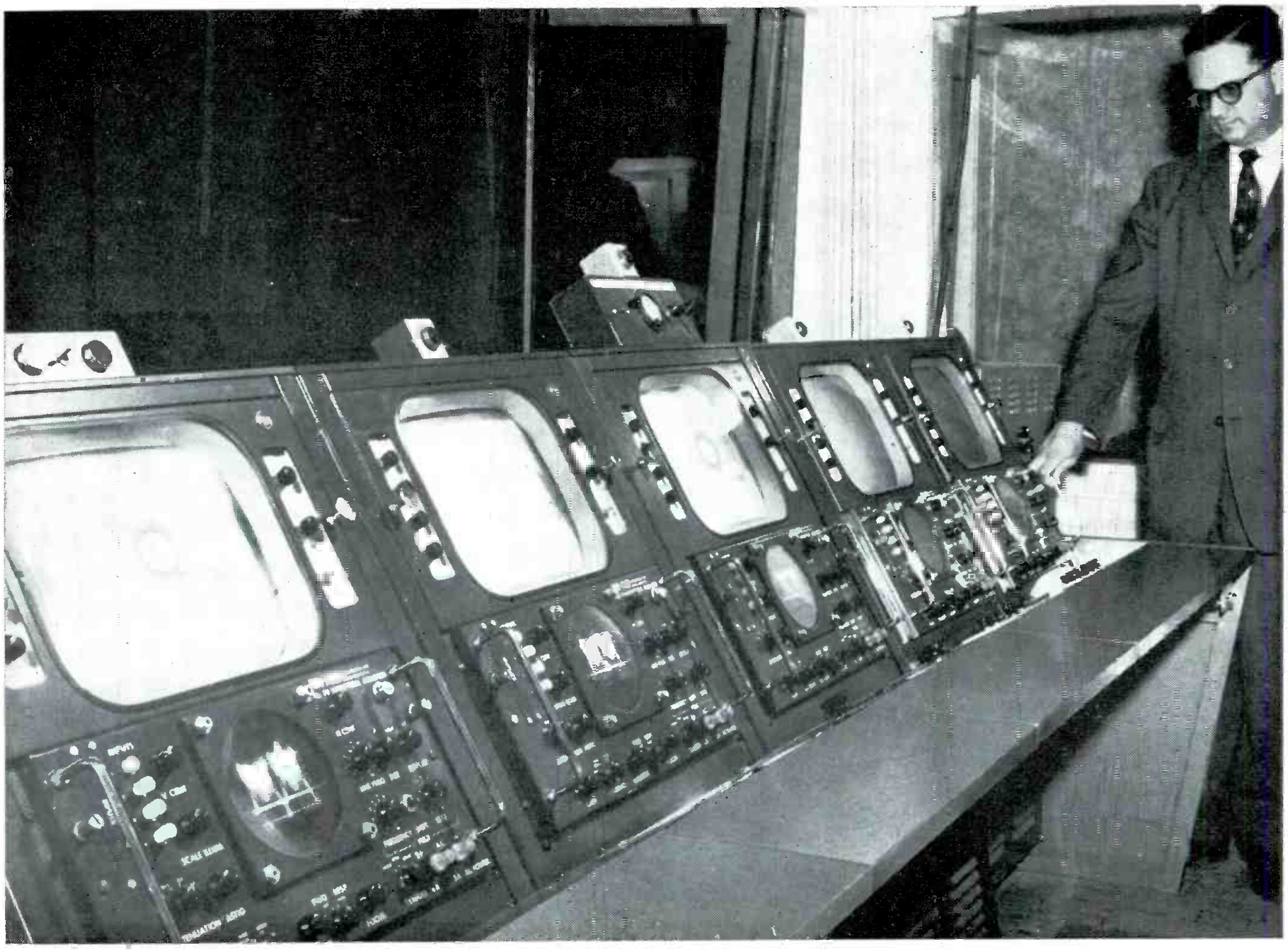


MAKING USE OF POLAR AND FREQUENCY RESPONSE CHARACTERISTICS OF MICROPHONES

Foto-Video® Waveform Monitor Faces Facts

— "THE FACTS OF CONTINUOUS OPERATION, DAY IN AND DAY OUT"

. . . says Charles Halle of WENH-TV, Durham, N. H. following a year's use of the new **FOTO-VIDEO** V-9B TV Waveform Monitor, the built-in features of which measure up to the precise requirements of this well-known consultant of educational TV stations.



Charles Halle is director of engineering at WENH-TV, the University of New Hampshire station, at Durham. Last December, after searching the field, he chose the rugged Foto-Video—an instrument of near perfection in this exacting phase of TV signal production—as most likely to meet the "operational FACTS of LIFE" in round the clock performance without deviation of characteristics. IT DID!

Mr. Halle was so impressed with the simplicity of design, operational convenience and built-in versatility of the Foto-Video V-9B's—result of years of exacting engineering and production—that he first bought two instruments, then later ordered five more for WENH-TV.

"Not only was the Foto-Video TV Waveform Monitor less expensive, but it also proved to be of better quality than other comparable units. It is extremely well-engineered, and a lot easier for the operators to handle. It shows that clever design may be accomplished without compromising the essentials needed in such equipment," Mr. Halle said.

SOME OF THE FEATURES OF THE FOTO-VIDEO V-9B TV WAVEFORM MONITOR:

1—Four inputs, with push-button selection, affording complete monitoring facilities (both pulse width and level—ITV or broadcast cameras), or quality and level in studio or master control. Any input may be connected either front or rear.
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BROADCAST ENGINEERING

THE TECHNICAL JOURNAL OF THE BROADCAST INDUSTRY

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Cover

The anechoic chamber of the Electro-Voice company is shown set up to determine the polar response of a microphone. The importance of polar response characteristics to microphone users is pointed out in the article beginning on page 6.

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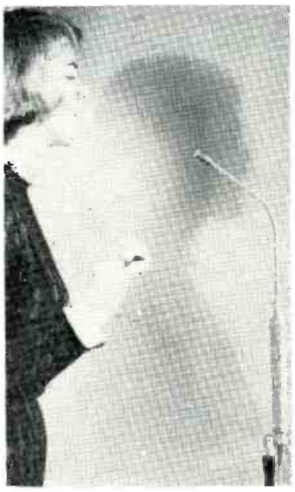
tools of the trade . . .

MICROPHONES



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A separate power supply accepts line voltage in the range of 110 to 240 volts. Extensive accessories are available.

TECHNICAL DATA

Frequency Range: 30 - 15000 cps.

Sensitivity (200 ohms): 1 mV/ubar.

Ratio of front to rear sensitivity: 20 db.

Preamplifier size: 1-1/32" diameter by 7" long.
Cartridge size: ¾" diameter.

C 12
CONDENSER POLYDIRECTIONAL MICROPHONE

With Remote Control of Directional Characteristics During Program Pick-Up.

The Type C 12 polydirectional condenser microphone, combined with a switch box for the remote control of its directional characteristics during program pick-up, opens many new avenues of pick-up technique.

TECHNICAL DATA

Frequency range: 30 - 15000 cps.

Frequency response: 0° omnidirectional cardioid, bidirectional, 180° cardioid.

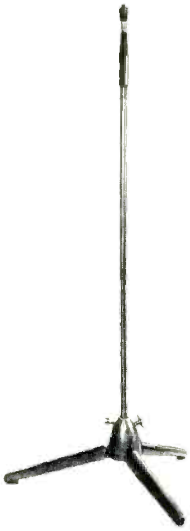
Output level: 33 db re 1 milliwatt for a sound field of over 10 dynes/sq. cm.

Sensitivity (for 200 ohms): 1 mV/ubar ± 1.5 db.

Output impedance: 50 and 200 ohms.

SHOCK-PROOF FLOOR STAND
ST 200

This stand is not only insensitive to shock and vibration but is also very stable, because of the unique design of its shock-dampening elements. These consist of an arrangement of iron struts embedded in live rubber blocks. The ingenious yet simple design provides isolation against vibration and shock without having to increase the size and weight of the floor stand and affords the necessary restoring force and attenuation against torsion.



electronic applications, inc.

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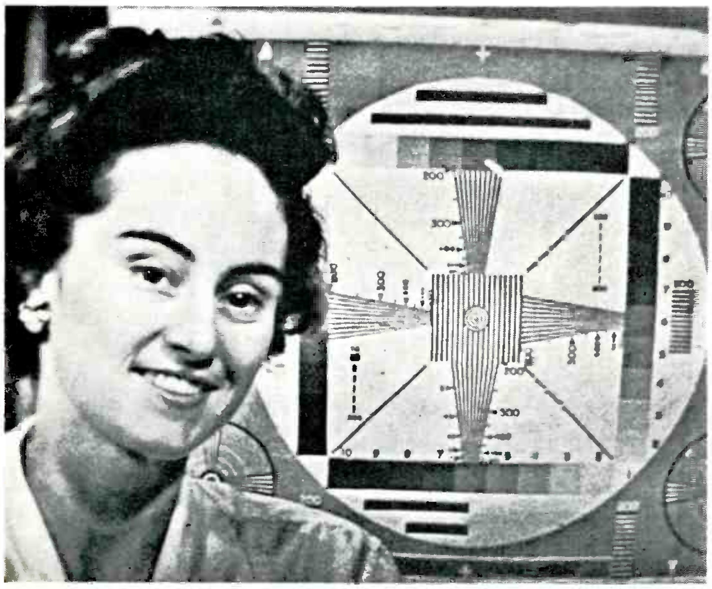
SUPER-SENSITIVE IMAGE ORTHICON

New camera tube is expected to widen the scope of both black-and-white and color television.



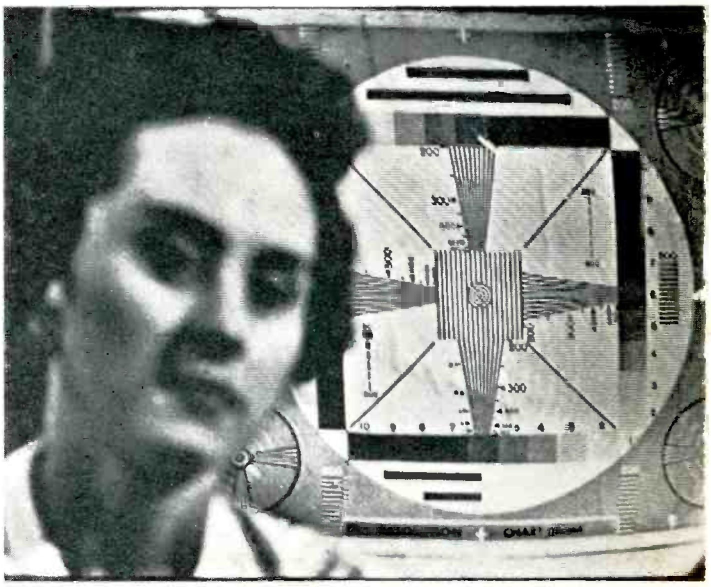
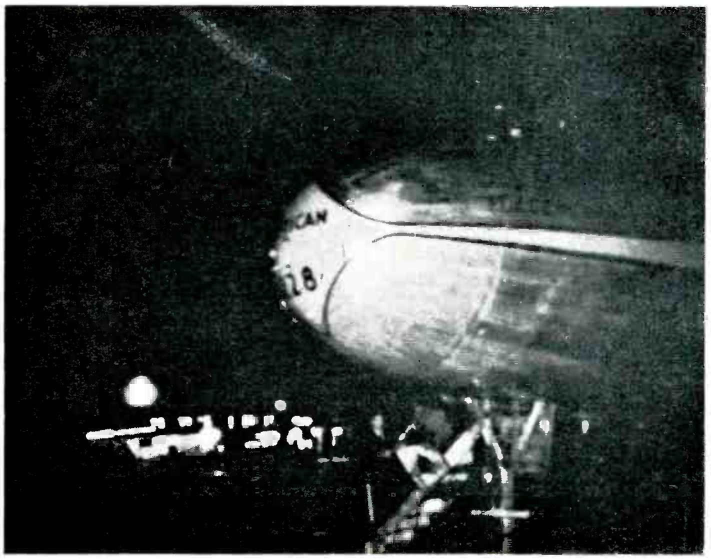


Figure 1. Improved depth of focus obtainable with the new image orthicon tube is illustrated in the above photographs. The monitor presentation on the right shows a scene picked up by a camera equipped with the type 7629. Light level in the studio was approximately 40 foot-candles and the lens was open to f. 22. The photograph on the left shows the same scene picked up by a standard 5820 image orthicon. The light level was the same as the pick up on the right; however, the lens was open to f. 5 due to the lower sensitivity of the 5820.

Figure 2. Gain in sensitivity of the new GL-7629 over the standard 5820 image orthicon is shown in the above photographs of monitor presentations. Available light at the airport, and the lens settings on both cameras were equal for both pictures. The camera used for the left photograph was equipped with the 5820 and the camera on the right with the 7629.



TUBE

A NEW super-sensitive image orthicon camera tube which promises to widen the scope of black-and-white television, and to extend the general application of color television has been introduced by the General Electric Co.

The new tube is physically and electrically interchangeable with standard tubes. It requires from 1/10 to 1/20 the light required by standard image orthicons. It can produce pictures of usable black-and-white quality at one foot-candle of scene illumination or less, compared to the ten foot-candles required by standard black-and-white image orthicons at the same lens setting.

The super-sensitivity permits the origination of studio colorcasts under normal black-and-white lighting levels. Removal of the high lighting requirements of standard color camera tubes will make possible colorcasts from sports arenas, auditoriums and light-equipped ballparks without the addition of special lighting, since the new tube produces quality color pictures with light levels as low as 40 foot-candles. Under these conditions color television can have most of the programming flexibility of black-and-white television.

The increased sensitivity of the new tube results mainly from a high-gain, thin-film target of magnesium oxide approximately two millionths of an inch thick. It is approximately 1/100 of the thickness of the targets used in conventional camera tubes. If 1,500 of the thin-film targets were stacked, they would equal the thickness of a single human hair.

Scientists have long endeavored to improve the targets of conventional image orthicon tubes. All such targets ultimately become sticky and retain the image for longer and longer periods of time. When this stickiness becomes noticeable by causing images of a previous scene to smear over the new scene, the tube must be retired. Stickiness is a major reason for tube replacement.

LIGHT TRANSFER CHARACTERISTIC

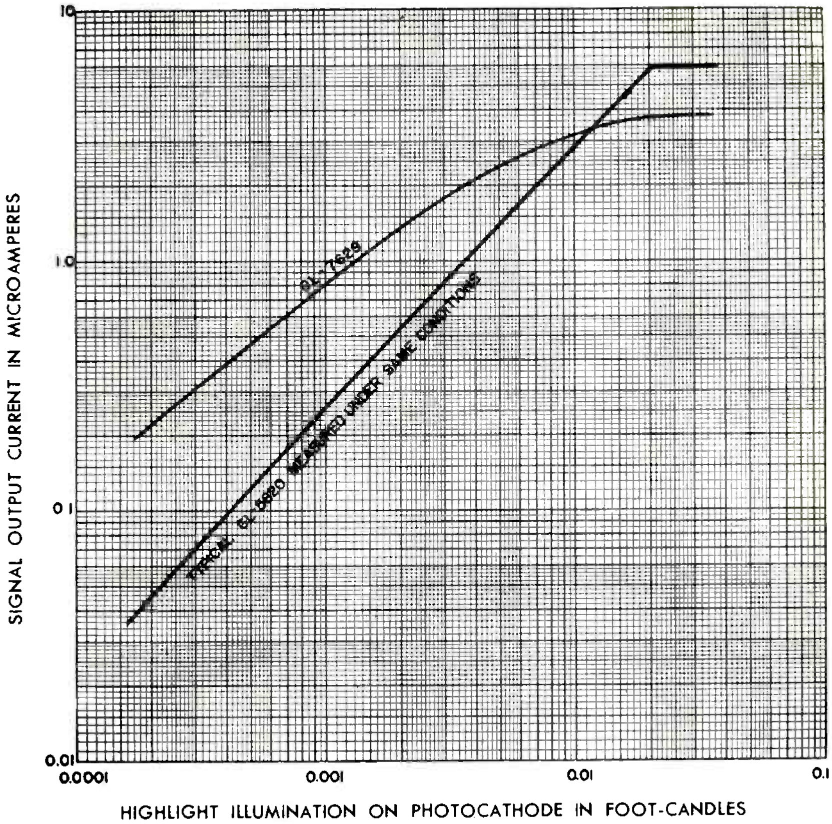


Figure 3

Another limitation of conventional targets has been their susceptibility to permanent damage from "burn-in," which is caused by aiming the camera at a bright, stationary highlight for too long a time. When this happens, the target acquires a permanent after-image or "burn" which is evident in all transmitted pictures from that time on. "Burn-in" has also been another reason for tube replacement.

Targets in the new tube utilize a different principle of conduction. Conventional targets rely on ion conduction. Because this conduction is irreversible, the ions are ultimately exhausted and the useful life of the tube is ended. The new tube uses electron conduction. This is a reversible process, and the life of the tube is not limited by the exhaustion of charged carriers. Thus, the problems of "stickiness" and "burn-in" are virtually eliminated so that expected tube life is appreciably extended.

Twenty-five to 50 per cent more resolution is claimed for the new tube over present image orthicons. The extreme thinness of the new target inhibits sideways leakage, thus preventing loss of resolution. Moreover, its super-sensitivity allows improved depth of focus, since the lens opening at normal light levels may be stopped down. While the normal network transmission bandwidth of 325-350 lines limits use of this extra resolution in daily television fare, it can be used to advantage with special-purpose camera chains for military and industrial applications.

Initial application of the new tube was made by WLW-T, Cincinnati. The station originated the first colorcasts of professional basketball games over a major network on Nov. 21 and 22. They are also planning the transmission of night baseball games during 1960.

POLAR RESPONSE OF MICROPHONES

An understanding of microphone polar response provides a solid foundation for solving specific pickup problems.

A PRACTICAL working knowledge of all types of microphones is, of course, a valuable asset. A complete understanding of polar patterns and frequency response characteristics supplementing practical experience opens up new avenues of application and can quite often provide the solution to otherwise seemingly difficult problems. It can also add those many improvements to sound pickup technique which distinguish one broadcast or television station from another. This factor becomes more important as receiving equipment is improved and the listening audience becomes more quality-conscious. The purpose of this article will be to discuss the various aspects of polar response of the popular types of microphones and their application with the aim of encouraging trial of new approaches to sound pickup using polar and frequency response characteristics as the useful tools they are.

Significance of Polar Response

Quite often, we take for granted the fact that we have microphones available that provide a variety of pickup characteristics, losing sight of their greatest value. Sound waves, it seems, are arbitrary to their action. While they can be directed to some extent, they normally spread out in all directions and delight in bouncing off any hard surface. Since a sound pressure wave consists merely of an abnormal bunching together of air molecules, these molecules will eventually lose the energy used to push them together and move them along and return to a normal state. We say then that the sound wave has been absorbed. But before that happens they spread out, bend and bounce around setting up standing waves and reverberation which play havoc with our sound pickup and eventual reproduction. We can speed up this absorption by adding "sound absorbent" materials to the walls and ceilings of our auditoriums and studios. These materials merely break up the advancing pressure wave (picture it as a solid wave) into smaller and smaller segments and absorb its energy until the pressure is equalized and the "sound" is no more.

But we cannot throw up sound absorbent material promiscuously. In some places it is physically im-

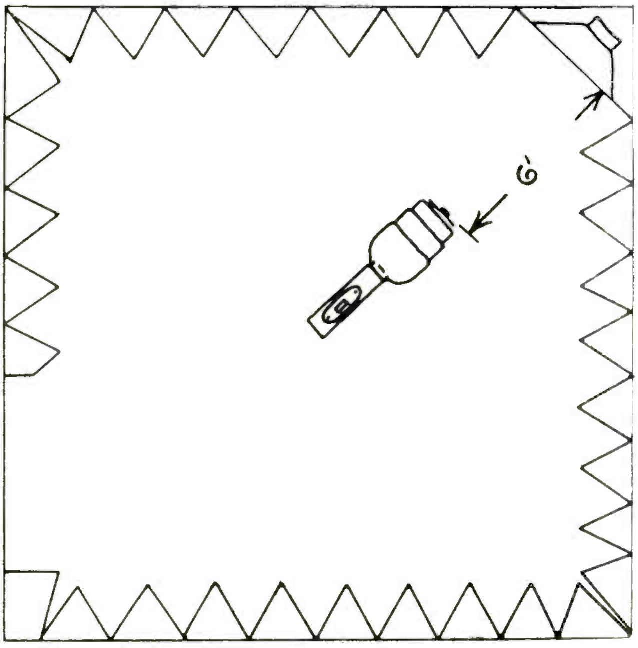


Figure 1. Placement of microphone for measuring polar response.

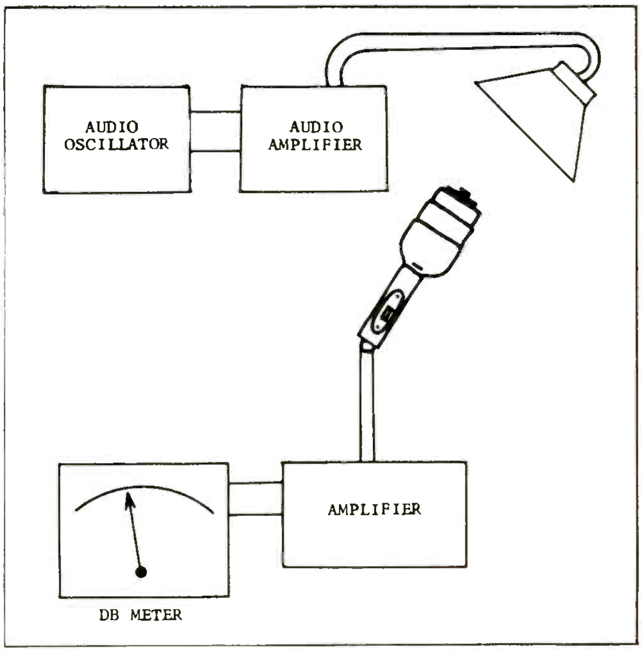
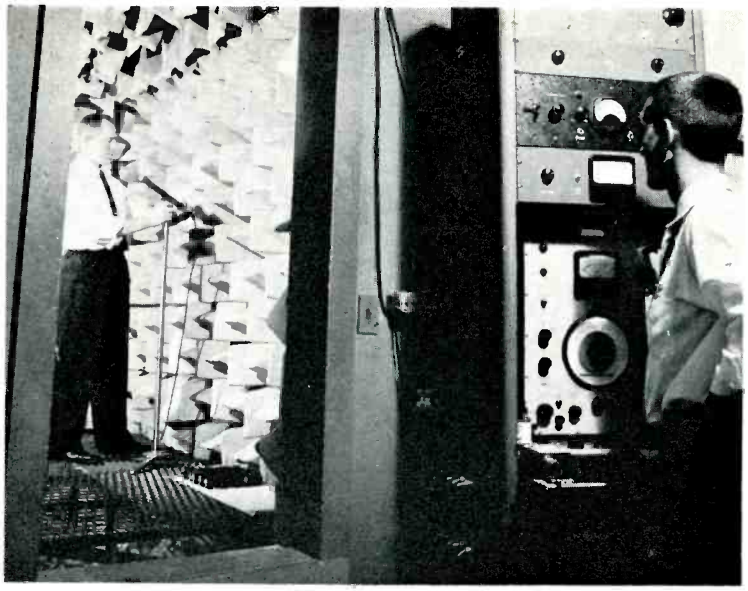


Figure 2. Arrangement of equipment for measuring polar response.

Setting up equipment to measure polar response.



By GEORGE R. RILEY*

possible and, perhaps more importantly, it becomes very expensive very fast. If it is overdone, the rate of absorption becomes too great and resulting reproduction is hollow or "dead". The point is this: Many times it is *impossible* to control the acoustics under which we must pick up sound and even under controlled conditions better results can be obtained by controlling the sound picked up. This can be accomplished most readily and inexpensively at the microphone itself—providing the microphone produces the desired characteristics and that these are properly used.

Measurement of Polar Response

Perhaps the most practical method of explaining polar response and of creating a true understanding of the directional properties of microphones is to begin by explaining how polar response is measured. This must be related to some extent to the frequency response of the microphone, itself; but at this point we will say only that the frequency response curves shown on typical specifications are axial response or response measured with the front of the microphone pointed at the source of sound. With this, we know what to expect when the microphone is pointed directly at the source of sound. The polar response will tell us how the frequency response varies to sounds arriving off the front axis of the microphone.

Usually, it is quite easy to determine by a listening test whether the axial response of a particular microphone is adequate for a given job. But it is difficult to determine the polar response by the same method. Much time can be consumed with

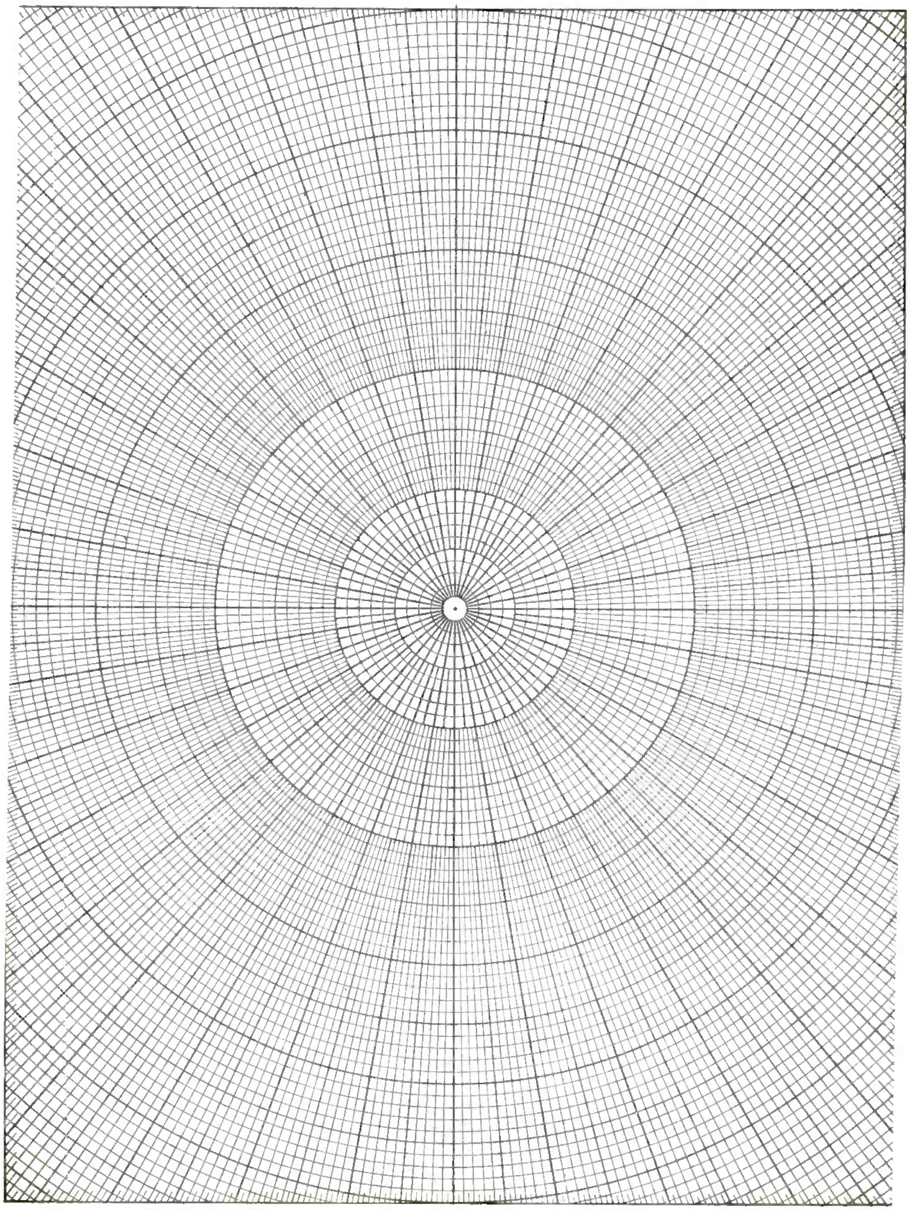
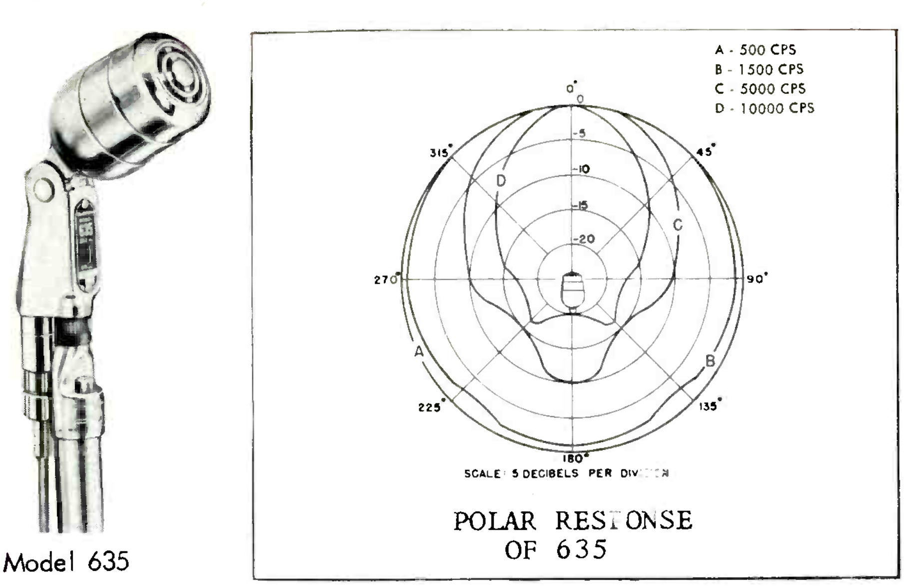


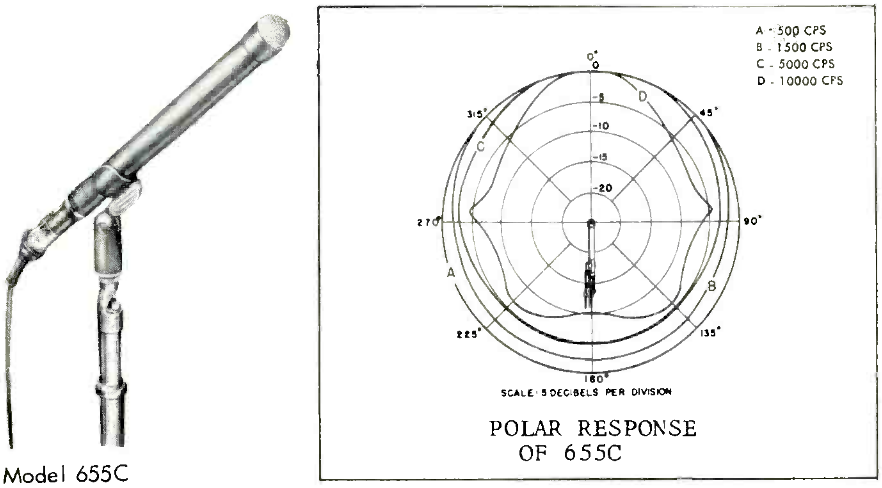
Fig. 3. Graph paper with polar coordinates.

*Manager, Commercial Products Div., Electro-Voice, Inc., Buchanan, Mich.



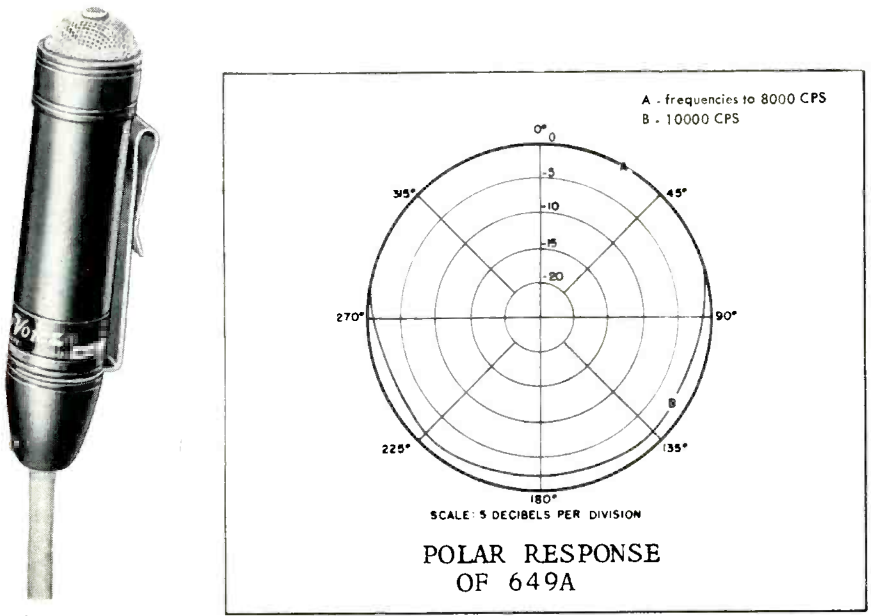
Model 635

Figure 4. Polar response of "Saltshaker" style nondirectional broadcast dynamic microphone.



Model 655C

Figure 5. Polar response of slim type nondirectional broadcast dynamic microphone.



Model 649A

Figure 6. Poler response of miniature nondirectional broadcast dynamic microphone.

such listening tests and the results at best are inconclusive. When the polar curves of your microphones are known, however, it is usually quite simple to make the proper choice without having to spend time on a listening comparison.

To determine the polar response of a microphone an anechoic or echo-free room is required. This type room is used to make certain that there is no reverberation or ambient noise present since these will distort the polar response and produce misleading results. Only under these conditions can we be certain to obtain the true performance of the microphone. Figure 1 shows the arrangement used in the anechoic room and Figure 2 diagrams the associated audio equipment. The microphone is placed on a stand of proper height and carefully aimed at the center of the loudspeaker which provides the source of sound.

With the oscillator set at 10 kc, a level is established with the microphone in this position. Since the microphone output at all other positions off the front axis of the microphone will be less, this output on axis is referred to as zero on the polar chart.

In plotting the curve, standard circular polar chart paper is used. The general type used is shown in Figure 3 although because of the small size used in most illustrations, the 1 db steps are not shown. Zero db at zero degrees (front axis of the microphone) is located and marked in and each heavy concentric ring is identified as a difference of 5 db from zero db on the outside ring to minus 20 db at the smallest ring toward the center. The center of the chart would represent minus 25 db as compared to the outside ring.

Instead of leaving the microphone fixed and moving the source of sound around it as might be done on a listening test, we merely rotate the microphone, which produces the same effect. On the typical nondirectional microphone shown in Figure 2, the level at 10 kc drops to minus 5 db at 30 degrees, to minus 8½ db at 45 degrees to minus 15 db at about 80 degrees, to minus 17½ db at 90 degrees and to minus 20 db at 180 degrees. As rotation is continued beyond 180 degrees, the curve repeats itself as shown on the chart. At each point the level is plotted and

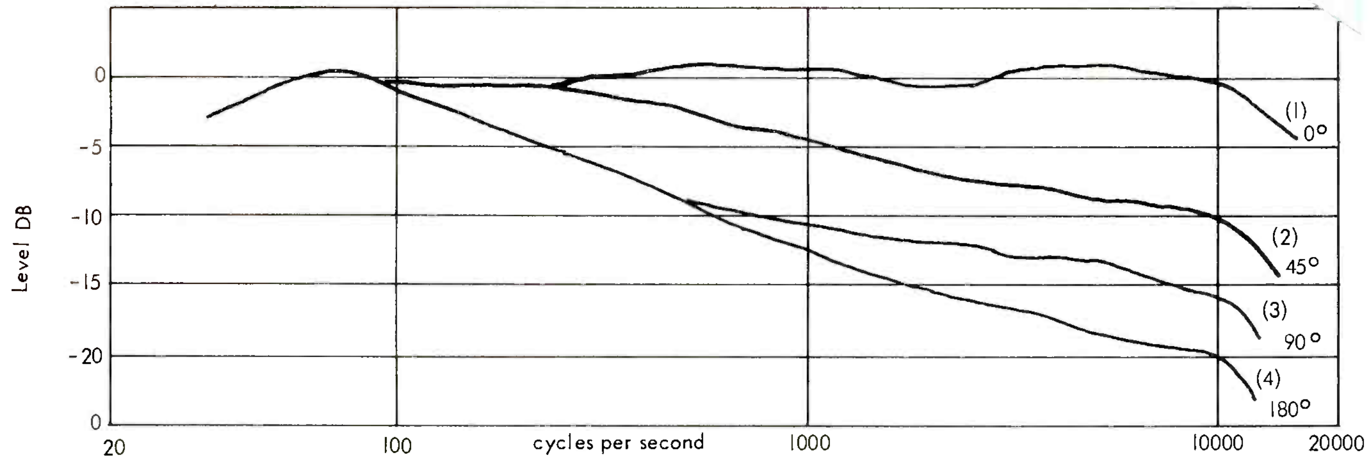


Figure 7. How angle of pickup affects microphone output.

the process is repeated with the oscillator set at other frequencies to give us a picture of the over-all action of the microphone throughout the audio spectrum. In actually analyzing the performance of a particular microphone, many more frequencies are used than are shown. Only those are included where a significant change has taken place.

Polar curves disclose many interesting characteristics of microphones and can explain a number of points that might be puzzling if they were not available. For example, nondirectional microphones are usually lumped into one category denoted as "pressure" microphones since they respond to sound *pressure* rather than sound *velocity,* as is the case with ribbon microphones. Any microphone constructed with a case which is closed on the back sealing off the back of the diaphragm from sound pressures that can strike the front is called a pressure or nondirectional microphone. Yet, in examining the polar charts of various nondirectional microphones, we find that this is a rather broad category and that many of these microphones become directional at the higher audio frequencies. Some manufacturers refer to these types as "semidirectional" rather than "nondirectional". Figures 4, 5 and 6 show the polar response for several different nondirectional or pressure microphones.

In investigating the cause of directional properties in this type microphone, we see in the polar charts a pattern that provides an easy solution. Figure 6 which of the three shows the least directional discrimination at all frequencies is a polar chart of a tiny lavalier type microphone with a case diameter of only ¾-inch. Significant directional discrimination is shown in Figure 5 only at very high audio frequencies. This is the polar chart of the popular slim type broadcast dynamic microphone with a case diameter of 1-inch. The remaining curve in Figure 4 is that of a "saltshaker" style dynamic with a case diameter of 2 inches and this exhibits even greater directional effects.

As these curves show, a "nondirectional" microphone is not nondirectional at all frequencies. The larger the case diameter, the lower the frequency becomes at which the microphone begins to show directional properties. This is due to the fact that sound waves resist being bent around an object. The resistance to bending increases as the frequency rises. Thus, there will be a greater loss of level at 5 kc than at 1 kc when these frequencies must bend around a microphone to arrive at the diaphragm. As the case diameter of the microphone increases, the loss in off-axis sound increases as the frequency rises. As a result, the size and shape of a pressure microphone controls its polar response. This is usually termed "baffle effect". "Saltshaker" style dynamics are sometimes furnished with flat, circular baffles which can be fitted over the front of the microphone to increase its baffle area and cause the microphone to become directional at lower frequencies.

While the popular small dynamic nondirectional microphones show little in the way of directional discrimination, the larger types can be depended upon to discriminate against the higher frequency sounds arriving from off-axis. Our polar charts tell us the extent of this discrimination, the directions involved and how we can use or compensate for this characteristic.

Analyzing the Polar Chart

We are now at the point where we can correlate frequency response for sounds arriving from directions off the front axis of the microphone

(Continued on page 26)

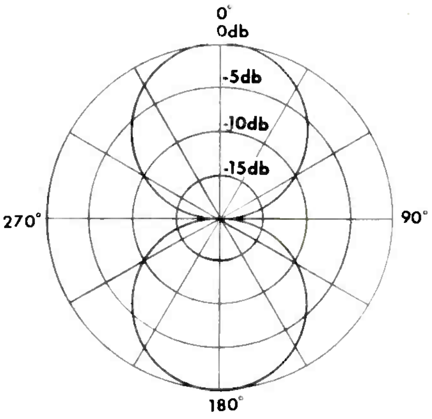


Figure 8. Bidirectional polar response of the velocity microphone.

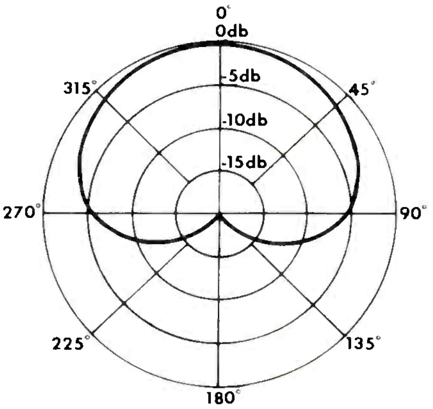


Figure 9. Unidirectional polar response of the cardiod microphone.

√

NEW EQUIPMENT FOR MEASURING

A discussion of the envelope delay characteristics in television systems and a description of a new measurement technique.

THE ENVELOPE delay characteristic is an extremely important factor in television systems. The effect of improper envelope delay is quite pronounced in color television, but a properly corrected system is also necessary for monochrome transmission if the optimum in picture quality is to be obtained. A new measuring technique has been developed which provides a low frequency reference to relate properly the envelope delay of the high and low frequency components of the video signal. The RCA BW-8A Envelope Delay Measuring Set utilizes this new technique, and is designed for television station use. This discussion highlights the importance of the envelope delay characteristic and describes the new measurement technique.

Envelope Delay

The phase-versus-frequency characteristic of television systems is usually referred to in terms of time

*Manager, RCA Broadcast Transmitter and Antenna Marketing, Camden, N. J.

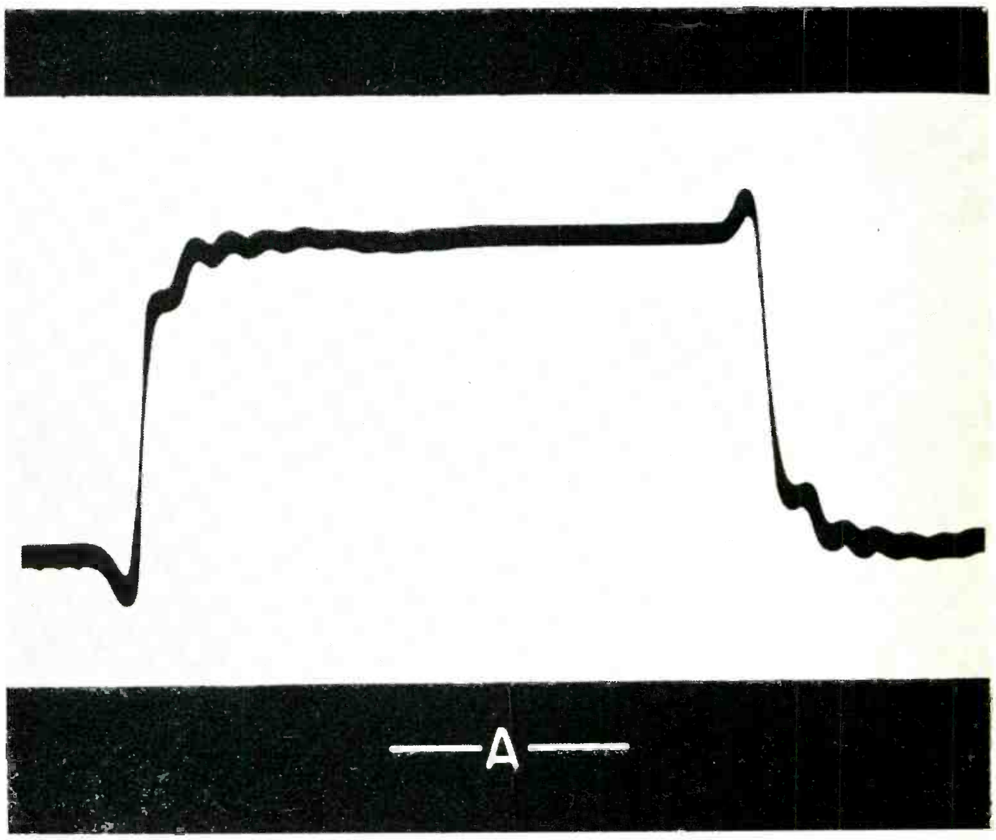


Figure 1. Typical uncorrected TV system response of 100 kc square wave.

ENVELOPE DELAY

By EDWARD NOEL LUDDY*

delay or envelope delay. Time delay is equal to the phase shift divided by the angular frequency. Envelope delay is a somewhat more sensitive term used for expressing phase shift, and is equal to the incremental slope of the phase-versus-frequency characteristic. An ideal system has a linear phase characteristic and equal envelope delay at all video frequencies. The effects of improper phase relationship between the various frequencies in a television system are well known, producing leading white, trailing smear, ringing and misregistration.

The television system used in the United States is a band-limited system of approximately 4 mc, and one sideband is partially attenuated to conserve spectrum space. Such a system has many advantages, but inherently introduces phase distortions that must be properly compensated before optimum picture quality can be achieved.

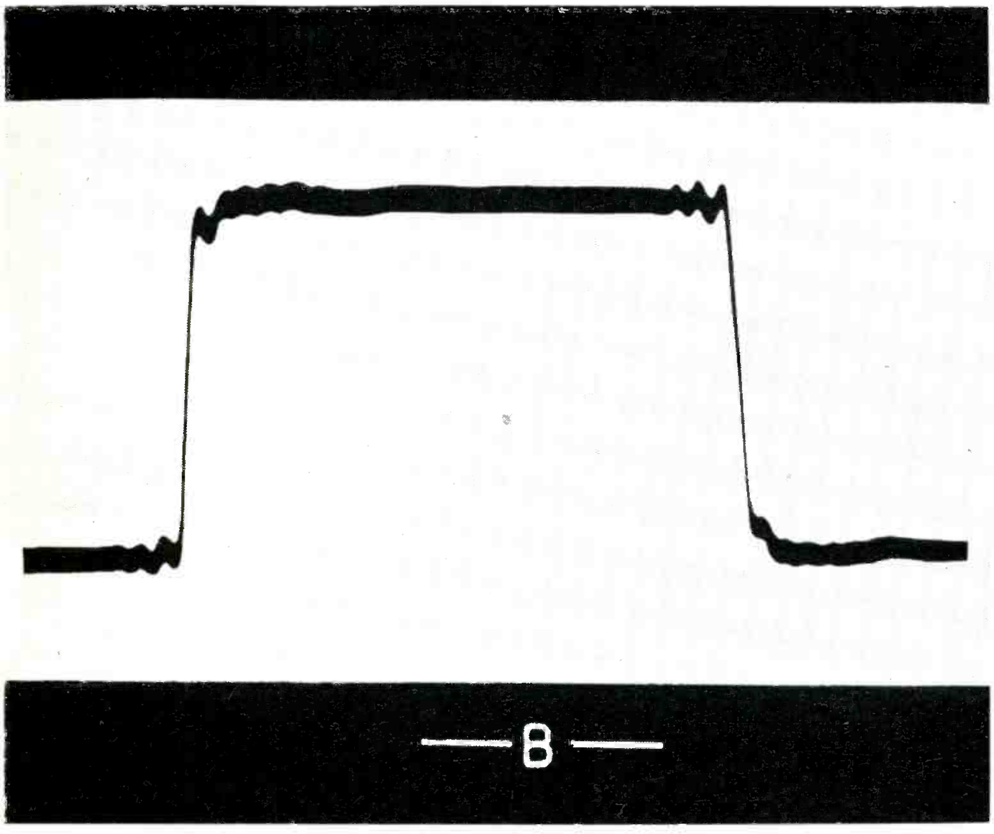


Figure 2. Typical phase corrected TV system response of 100 kc square wave.

Phase Distortion

The results of phase distortion caused by band-limited vestigial sideband transmission are shown in Figure 1. The anticipatory transients preceding the transitions, and the rounding of the corners of the square wave after the transitions, are due to low frequency phase distortion caused by the attenuation of the lower sideband. The ringing following the transitions is caused by the attenuation of the upper sideband and resulting phase distortion.

These defects resulting from delay distortions cannot be completely eliminated but can be reduced in magnitude. Figure 2 shows the square wave response of a system that has been corrected by means of phase correction networks in the video input circuit of the transmitter. The anticipatory transients preceding the transitions have been eliminated and the corners following the transitions have been made square. These improvements were made by correcting the low frequency phase characteristic. The ringing has been distributed before and after the transition, and reduced in magnitude by means of high frequency phase correction.

The FCC specifies the envelope delay characteristic required in the transmission of color television signals as shown in Figure 3. The relative envelope delay throughout the video region is referred to the average delay between 50 and 200 kilocycles and is required to be constant except in the region above 3 mc which is pre-distorted to compensate for the phase characteristic of the sound

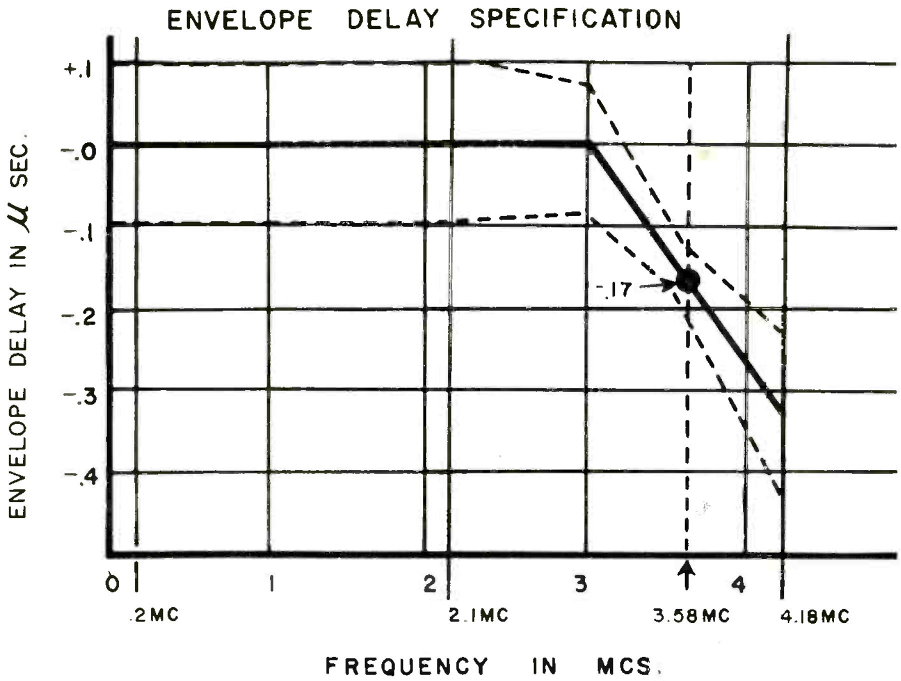


Figure 3. FCC transmitter envelope delay curve for color TV transmission.

notch in a typical television receiver. The tolerances are shown by the dotted lines. The transmitter is required to correct only for its own phase distortion in the low frequency region and each receiver is to correct for any phase distortion it may introduce at the low frequencies.

BW-8A Measuring Set

There is a need for field test equipment to measure the envelope delay characteristic of television transmitter systems in accordance with FCC specifications. Quantitative measurements have been rather difficult to make in the field, and many stations have made only approximate checks by means of square wave responses. The BW-8A Envelope Delay Measuring Set, shown in Figure 4, was designed to fill this need. It is a small unit, easy to use, and provides a low frequency phase reference. The BW-8A measures the relative envelope delay in the region from 1.3 mc to 4.3 mc as referred to the average delay between 0 and 189 kc. The unit is designed for standard 19-inch rack mounting, and occupies 10½ inches of rack space.

The BW-8A Envelope Delay Measuring Set consists of a generator section that feeds the system to be measured, and a receiver section which evaluates the envelope delay of the signals after they have passed through the system under test. A block diagram of the unit is shown in Figure 5. A fixed modulating frequency of 189 kc can be obtained from an internal crystal oscillator or can be derived as the twelfth harmonic of the horizontal sync frequency supplied from an external source. Switch S1 selects the source of the modulating frequency and adds sync and blanking if desired.

Figure 4. RCA Type BW-8A Envelope Delay Measuring Set.

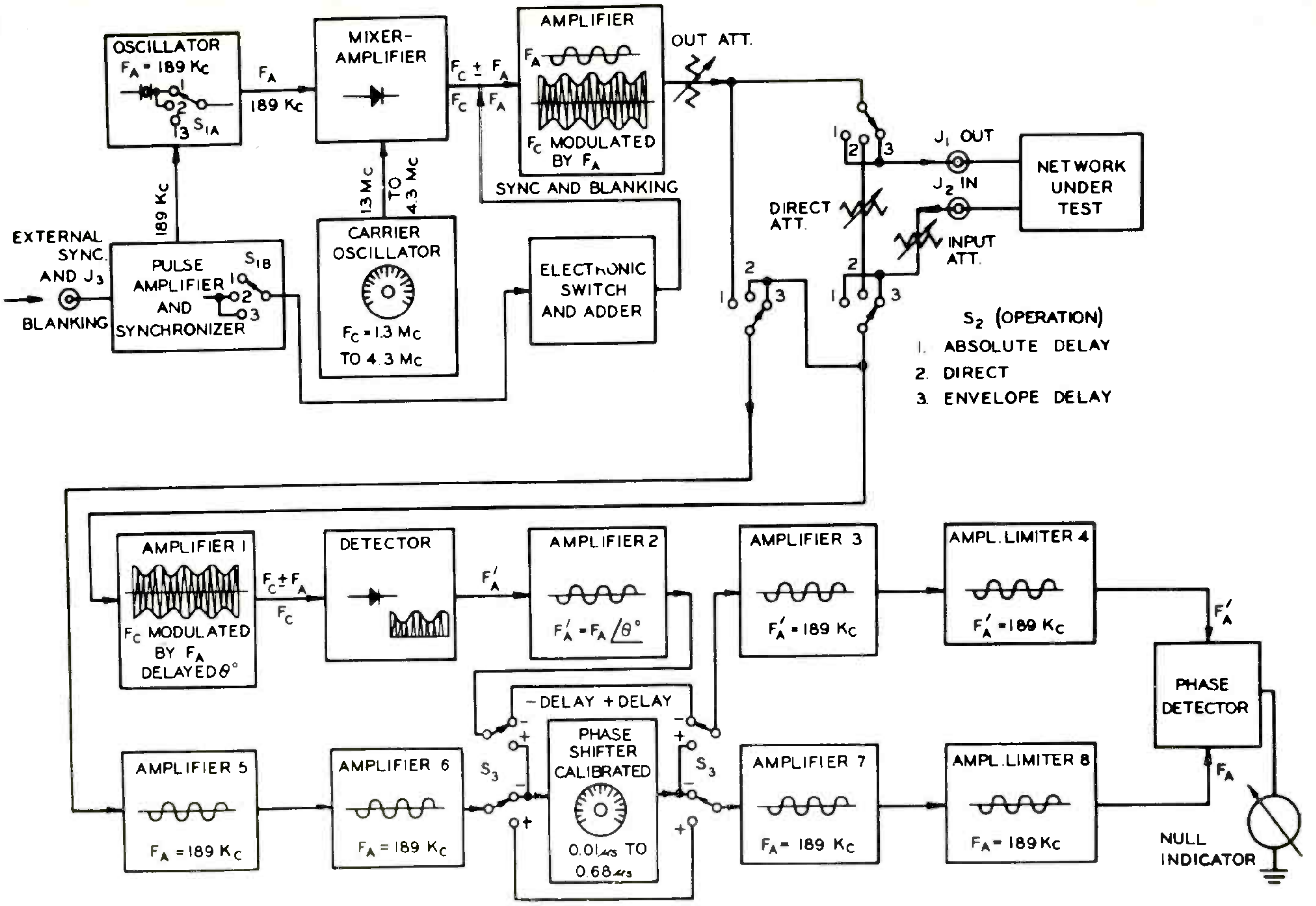


Figure 5. Block Diagram of RCA BW-8A Envelope Delay Measuring Set.

The fixed 189 kc modulating signal is fed to a mixer amplifier together with a carrier frequency that is variable in the range of 1.3 mc to 4.3 mc. This carrier is modulated to a depth of about 50 per cent by a portion of the output of the fixed 189 kc oscillator. The original 189 kc frequency and the modulated carrier frequency are recovered at the output of the mixer. Sync and blanking are added if desired, and the signal is amplified.

The output of the generator portion of the BW-8A can be fed directly to the receiver portion of the unit for calibration purposes. The output of the generator is then switched to the input of the transmitter system under test and the demodulated output of the transmitter is fed into the input of the receiver section.

The receiver section is composed of two chains. The first amplifier is tuned to the modulated carrier fre-

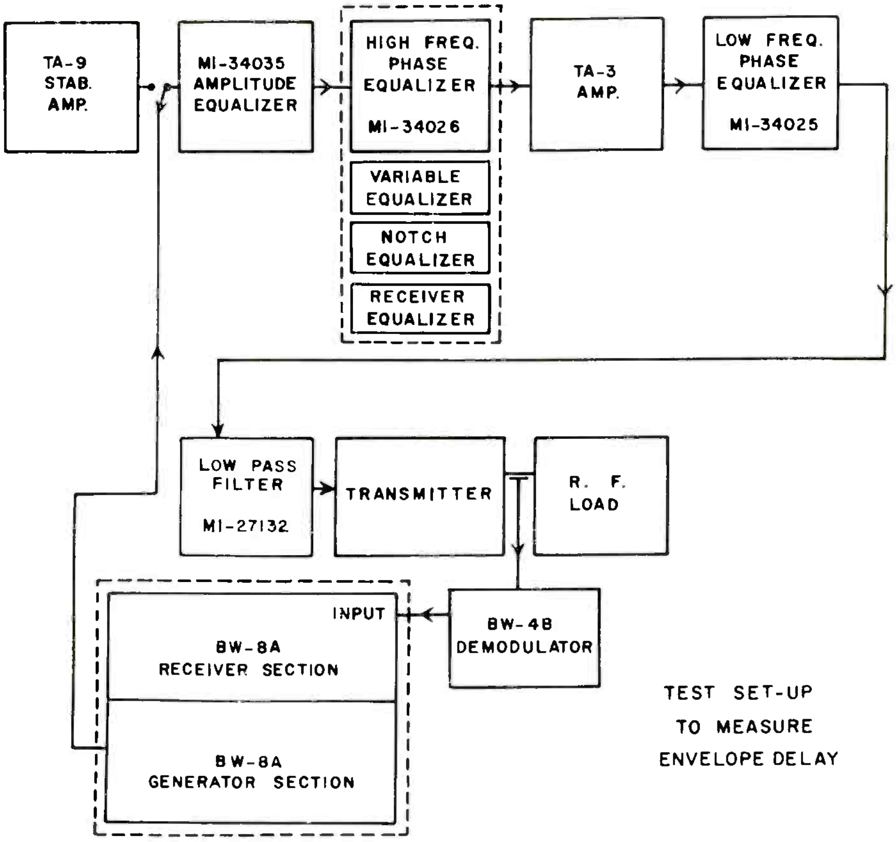


Figure 6. Typical test set-up to measure envelope delay.

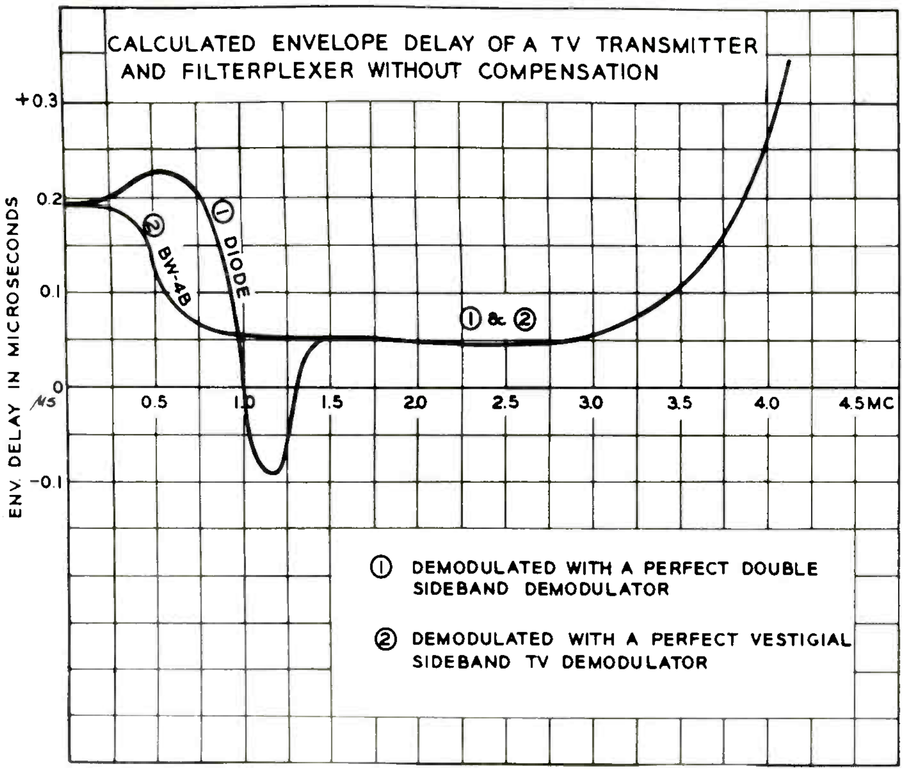


Figure 7. Calculated envelope delay of TV transmitter and filterplexer without phase compensation.

quency. The signal is then detected and the 189 kc modulating component recovered. The demodulated signal is amplified and fed to a phase detector. The other amplifier chain is tuned to the 189 kc signal that has passed directly through the system. This signal is also amplified and fed into the phase detector. The phase shifter consists of an RLC network and may be switched into either amplifier chain to permit compensation of either positive or negative time delay. The phase shifter is calibrated directly in microseconds and reads the relative envelope delay between the carrier frequency and the reference average envelope delay between 0 and 189 kc. Envelope delays up to 0.68 microseconds may be measured with an accuracy of ± (3% ± .01) microseconds.

Typical Test Setup

A typical test setup using the BW-8A Envelope Delay Measuring Set is shown in Figure 6. The output of the generator section is fed to the video input of the transmitter ahead of the phase equalizers and low pass filter. It may be fed into the input of the stabilizing amplifier if sync and blanking are added. The output of the transmitter must be demodulated to recover the video component. A standard vestigial demodulator such as the RCA BW-4B can be used for this purpose, or a diode may be employed. The output of the vestigial demodulator or diode is fed to the receiver section of the BW-8A.

Envelope Delay Characteristics

The envelope delay characteristic is specified by the FCC in terms of a perfect vestigial demodulator. Standard demodulators, such as the RCA BW-4B, approach the ideal receiver characteristics within very close limits. A standard vestigial demodulator should be used to monitor television signals at the output of the sideband filter as it will provide the best indication of picture quality as viewed on good home receivers.

When fed with a vestigial sideband signal, the diode demodulator not only provides a non-uniform video amplitude response, but also a distorted phase characteristic as shown in Figure 7. Although vestigial sideband signals cannot be satisfactorily monitored from a diode demodulator, it was deemed desirable to be able to use this type of demodulator to measure the envelope delay characteristic of the transmitter system. By utilizing the diode as a check against the vestigial demodulator, the error due to a poorly aligned or poorly compensated vestigial demodulator can be isolated.

The calculated envelope delay characteristics of a television transmitter and filterplexer combination that is not phase compensated is shown in Figure 7. Calculated curves for both a diode demodulator and an ideal vestigial demodulator are

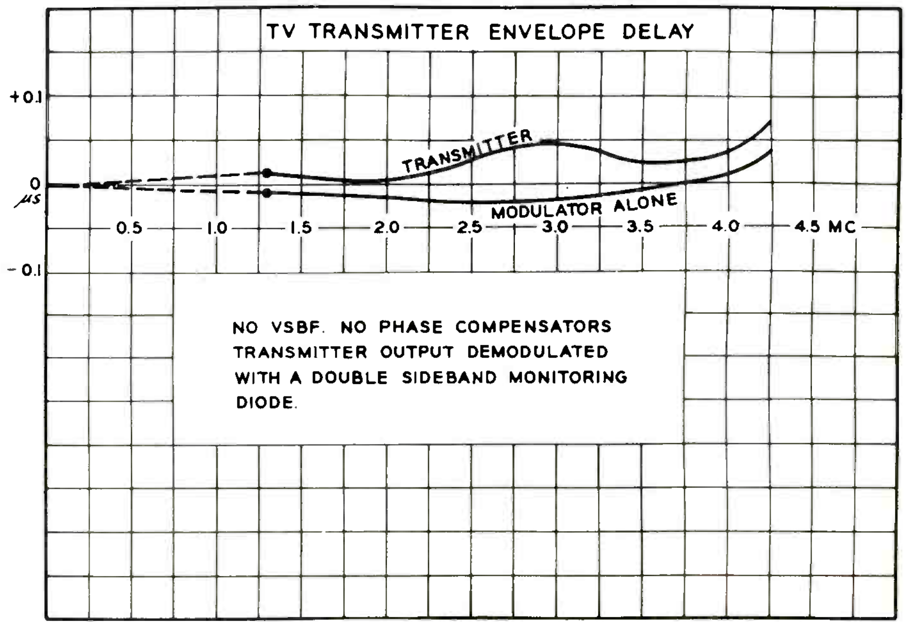


Figure 8. Measured envelope delay of TV transmitter visual modulator and overall transmitter characteristic.

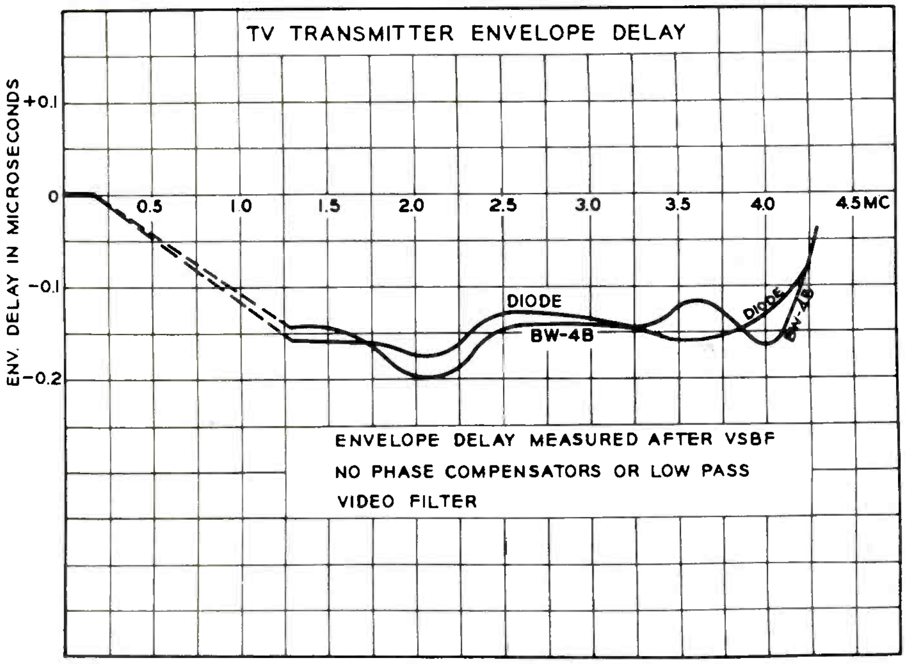


Figure 9. Measured uncompensated TV transmitter envelope delay at output of sideband filter using both diode and vestigial demodulators.

shown. It can be seen that in the low frequency region where a double sideband signal is available the two demodulators provide essentially the same over-all envelope delay. In the region where the lower sideband is being attenuated the two curves differ quite widely. After the lower sideband has been attenuated the two envelope delay curves become identical. This indicates that a diode demodulator can be used to determine the envelope delay characteristic of video frequencies above approximately 1.5 mc as compared with a reference in the range below 200 kc. This is the important region to be investigated as the envelope delay in the range from approximately 200 kc to 1.5 mc is controlled only by minimum phase shift networks as far as the transmitter is concerned. Variations in the phase characteristic of the transmitter upper sideband in this region are related to the amplitude response which is generally quite flat at these relatively low modulating frequencies. The over-all video phase response in this area is largely dependent on the degree to which the demodulator that is used accepts or rejects the lower sideband.

The envelope delay characteristic of a visual modulator as measured by the BW-8A is shown in Figure 8. The modulator alone contributes relatively little delay except at the very high frequency end where the frequency response is being attenuated. The over-all transmitter envelope delay characteristic utilizing a diode demodulator is also shown in Figure 8. Only minor variations in the basic transmitter envelope delay response are experienced before sideband shaping is applied.

The envelope delay of a television transmitter and vestigial sideband filter is shown in Figure 9. No phase correction was employed in the transmitter input, and the need for about 0.15 microsecond low frequency equalization is apparent. The measurements taken with the diode demodulator and vestigial demodulator agree quite closely in the range from 1.3 mc to 4.3 mc. Either type of demodulator may be used with the BW-8A Envelope Delay Measuring Set.

The final over-all envelope delay characteristic is usually taken with all phase correction networks in the circuit including properly adjusted low frequency and receiver equalizers. An over-all envelope delay curve of an RCA TT-11AH Transmitter is shown in Figure 10. The curve shows the relative delay at various video modulating frequencies as compared with the average envelope delay between 0 and 189 kc. The FCC tolerances are shown by the dotted curves.

Conclusions

It is vital that television transmitting systems be properly corrected for envelope delay deficiencies in order to broadcast high quality pictures. It is hoped that the BW-8A Envelope Delay Measuring Set will make it easier to test and align television transmitting systems to improve fidelity of transmission.

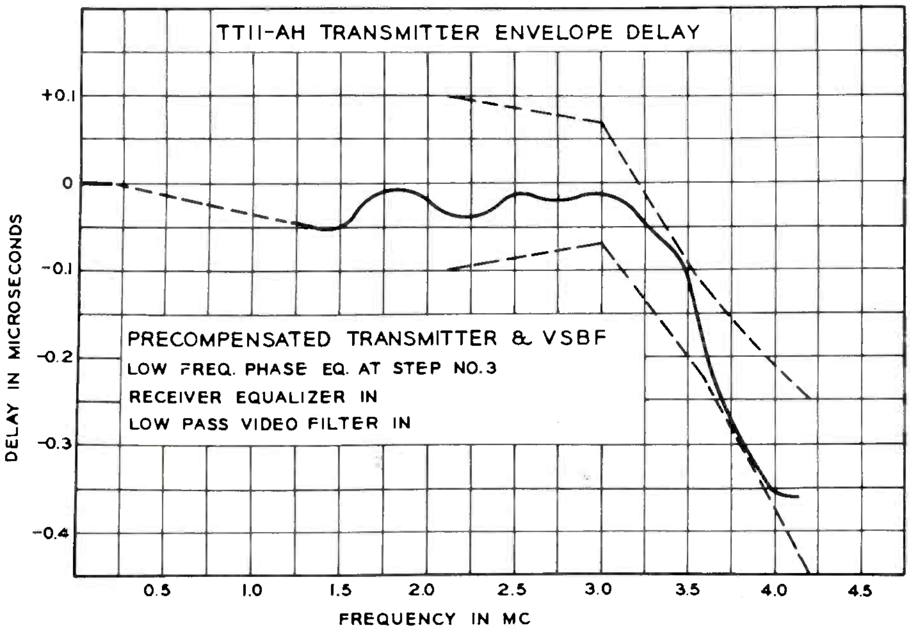


Figure 10. Measured envelope delay characteristic of RCA TT-11AH Transmitter.

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RADIO CORPORATION of AMERICA

BROADCAST AND TELEVISION EQUIPMENT · CAMDEN, N. J.

ANOTHER WAY RCA SERVES BROADCASTERS THROUGH ELECTRONICS

THE OBSTINATE PERVERSITY OF OBJECTS

The law of O.P.O.O. is exposed for the benefit of the broadcast industry.

By PROFESSOR OSCAR VON DER SNIKRAH

HISTORY will show that when certain natural functions of nature are discovered to be present at all times, a law is soon worded up that describes this otherwise unexplainable phenomenon.

The law of gravity is a typical example. In the fields of electricity, magnetism and electronics, there are many basic laws which cannot be refuted. Ohms Law, Kirchoff's Law, Bessel Functions and Faraday's Law cannot always be explained but nevertheless have never been proven wrong.

Such is the case of the Law of "OPOO" which resulted from many events that occur frequently in the life of every broadcast engineer. How else can you explain why it is that every time you build up an amplifier it turns out to be an oscillator and at the same time if you connect up a circuit that is supposed to oscillate it invariably functions better as an amplifier?

Mysterious forces are obviously functioning when you invariably connect pairs of wires together the wrong way first. Then in the case of shooting trouble, the last tube in the unit is always the one that is bad.

This is the Law of "OPOO" always functioning at your side. This is not peculiar to the engineering field only. Take the case of the guy who had to catch a bus to work every day. For months the bus was always at least minutes late every morning. The first morning he was five minutes late, the bus ran on time. You can't beat the Law of OPOO.

Or consider the case of the station engineer who faithfully tested the emergency generator plant once each week for nine years. After all these years of successful tests a general power failure occurred and — you guessed it! — the emergency generator wouldn't start. The starter button had failed, having been worn out by the many years of testing each week.

Joe Combo some years ago tried to pass the first class ticket exam five times until he finally made it. Before he could get a job, the rules were changed and it wasn't necessary.

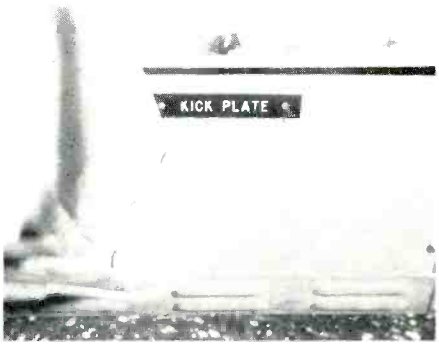
How else can you explain the fact that the intermittent in the transmitter never shows up when you are trying to find it but always waits until you are miles away to kick the rig off the air?

Then in the case of TV, little production "problems" such as an upside down slide only appear when the most important sponsor is involved. It's the Law of OPOO!

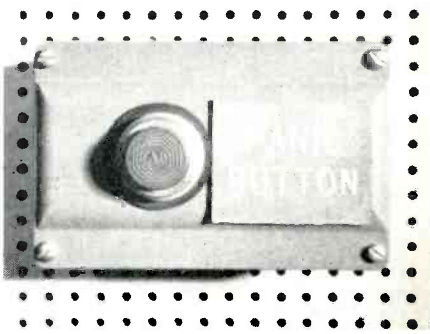
Now that you have the idea, you can no doubt remember many incidents of a similar nature.

Although the basic Law of OPOO cannot be defeated, if you are aware of it, you can take steps in your mind to prevent complete frustration. Even though you act oppositely to your first intuition, the law will still defeat your reasoning powers.

The next time you leave on a fishing trip you can assume that some foolish thing is going to blow up at the station while you are gone. The Law of OPOO will see to it that no one else is around to fix it. With a firm decision to lay the blame entirely on the Law of OPOO, a new found peace of mind will engulf you.



Although not a "cure all", the kick plate as installed at the bottom of the rack will often prevent the law of "OPOO" from taking over. (Made from high tensile steel, the kick plate will withstand 227% more than the average kick as measured in PSI. Such intermittents as stuck relays and cold solder joints are thus easily cured.)



Now in use by many stations, the "panic" button is used to initiate a series of events that simulates an honest to goodness power failure or other event so as to remove the responsibility from the staff. Usually located in the chief engineers office, it must be used with discretion otherwise the law of "OPOO" takes over.

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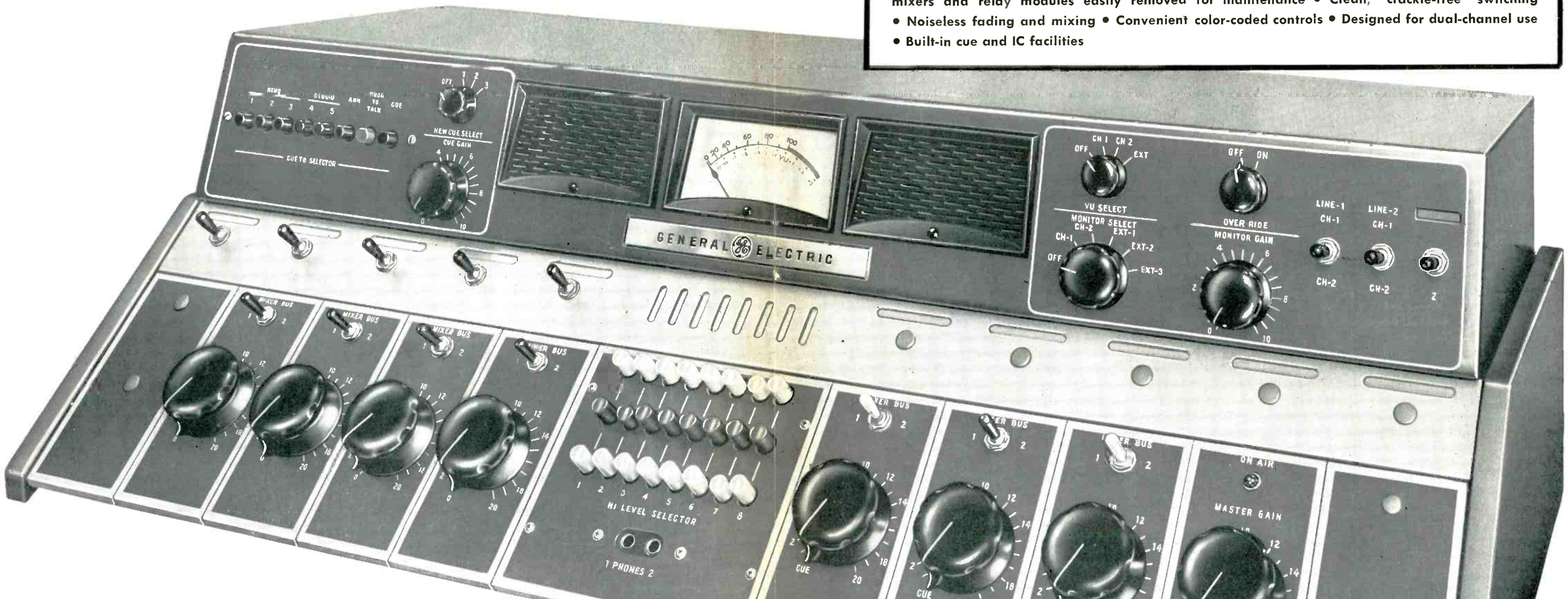

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WNED—Buffalo, N. Y.	WXYZ—Detroit, Mich.

Howell Recording Studio, Buffalo, New York

GENERAL ELECTRIC

MULTIPLEX MONITOR DESIGN

The circuits of a linear demodulator for sampling the output of an FM transmitter are detailed.

By DWIGHT "RED" HARKINS*

In order to properly adjust an FM transmitter that is being used for the transmission of multiplexed subcarriers, a method must be provided to sample and demodulate the signal as it is presented to the antenna.

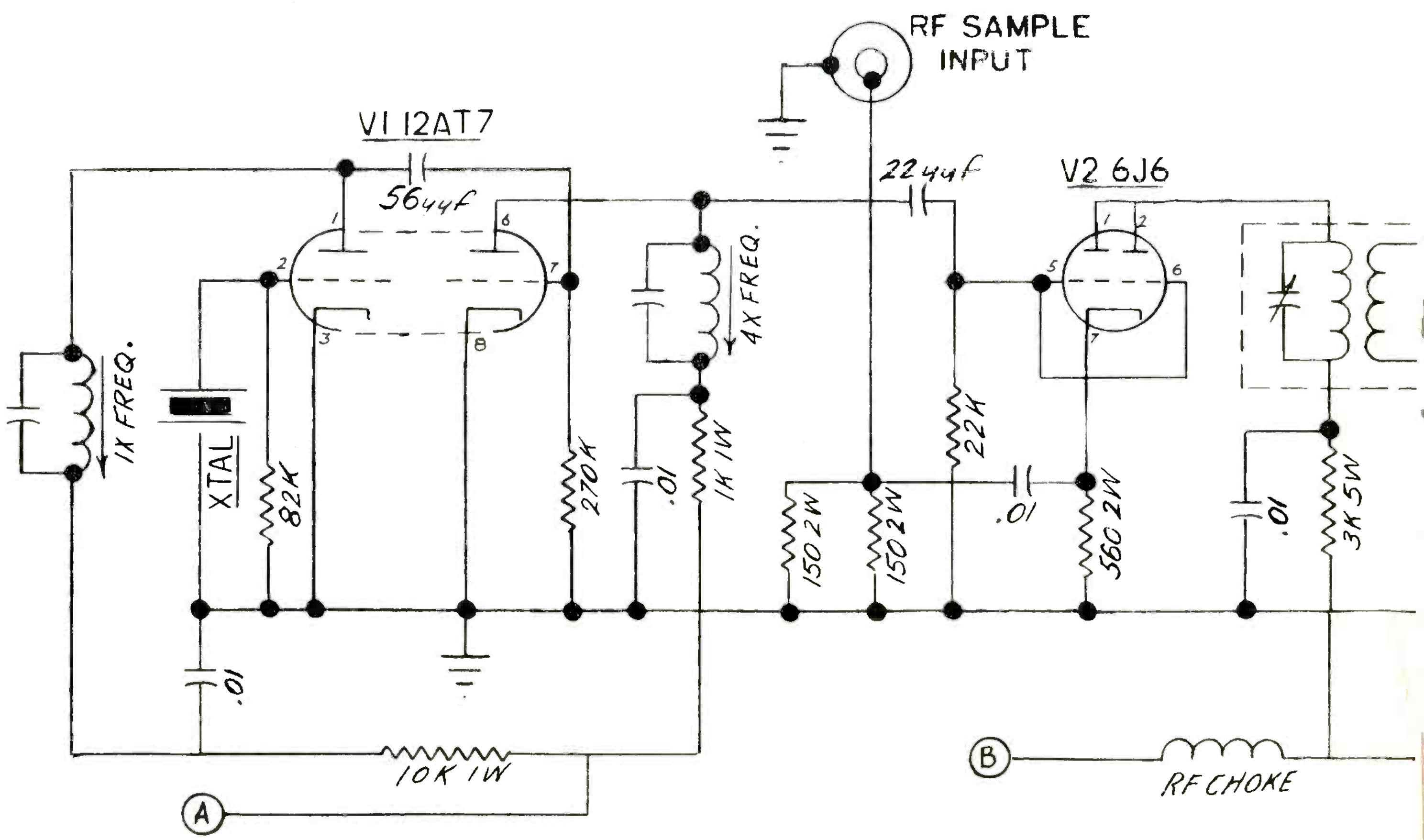
In the immediate proximity of a transmitter, an ordinary multiplex receiver is unsatisfactory for this purpose for several reasons. First, the different power stages of the transmitter radiate a strong signal on the premises which makes it impossible to determine whether the signal from the final amplifier is actually being received; and secondly, the receivers themselves contain non-linearities that cover up transmitter defects.

The same circuits in receivers which provide for sensitivity to weak signals are also prone to produce serious intermodulation when operated in the presence of a strong R.F. signal such as near the transmitter location.

The first function then of a multiplex monitor will be to sample only the R.F. from the output of the transmitter as it is introduced into the transmission line to the antenna. It will function as an insensitive receiver capable of demodulating the sample signal without introduction of any additional effects of its own.

In order to be a useful tool, the monitor must be able to convert all of the frequency deviations of the carrier caused by modulation into a true reproduction of the original signal. If the monitor is of known accuracy and linearity, then defects of the transmitter, such as intermodulation, are readily detected and corrective measures can be taken.

*Harkins Radio, Inc., 4141 East Washington, Phoenix, Ariz.



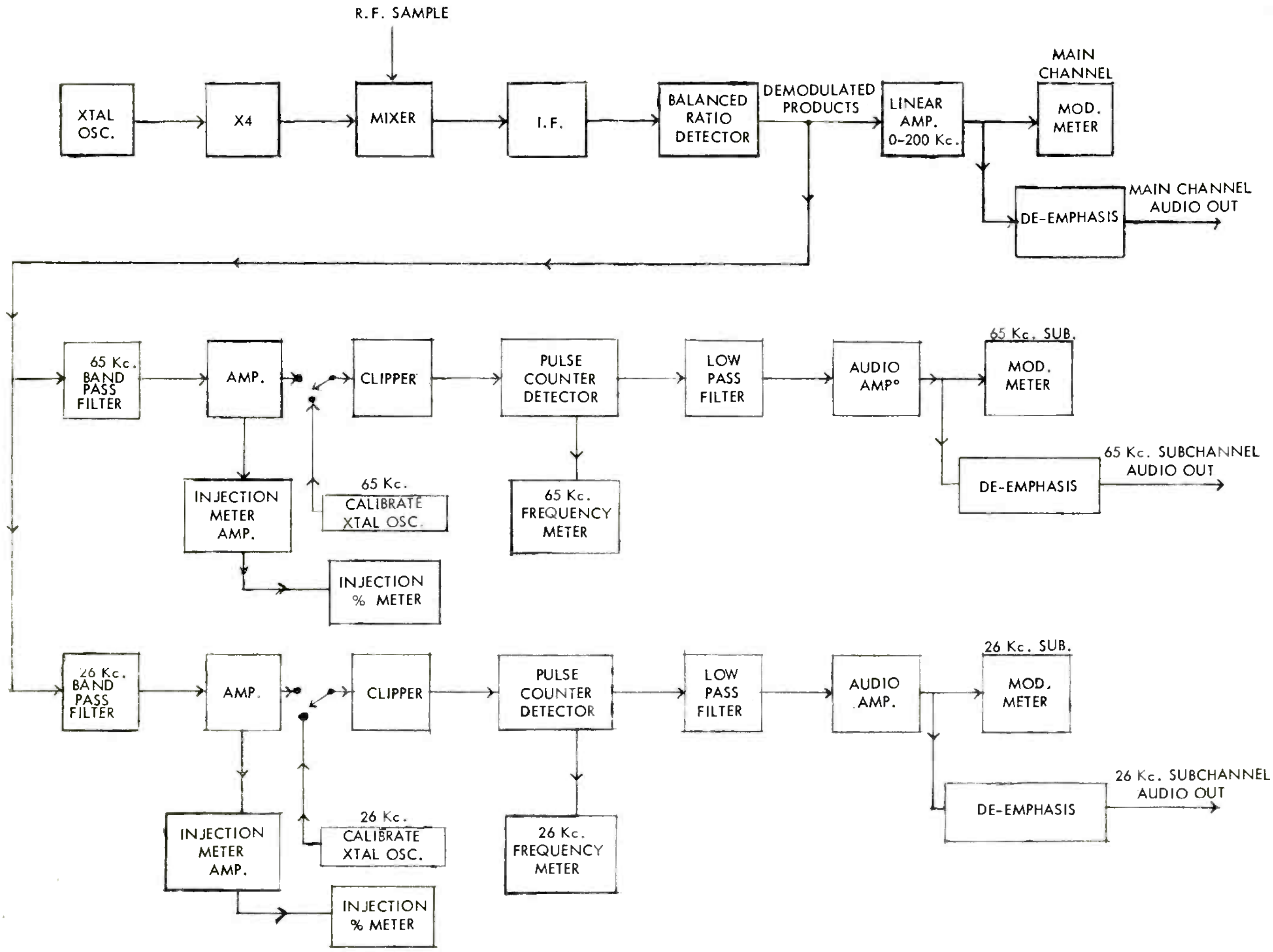
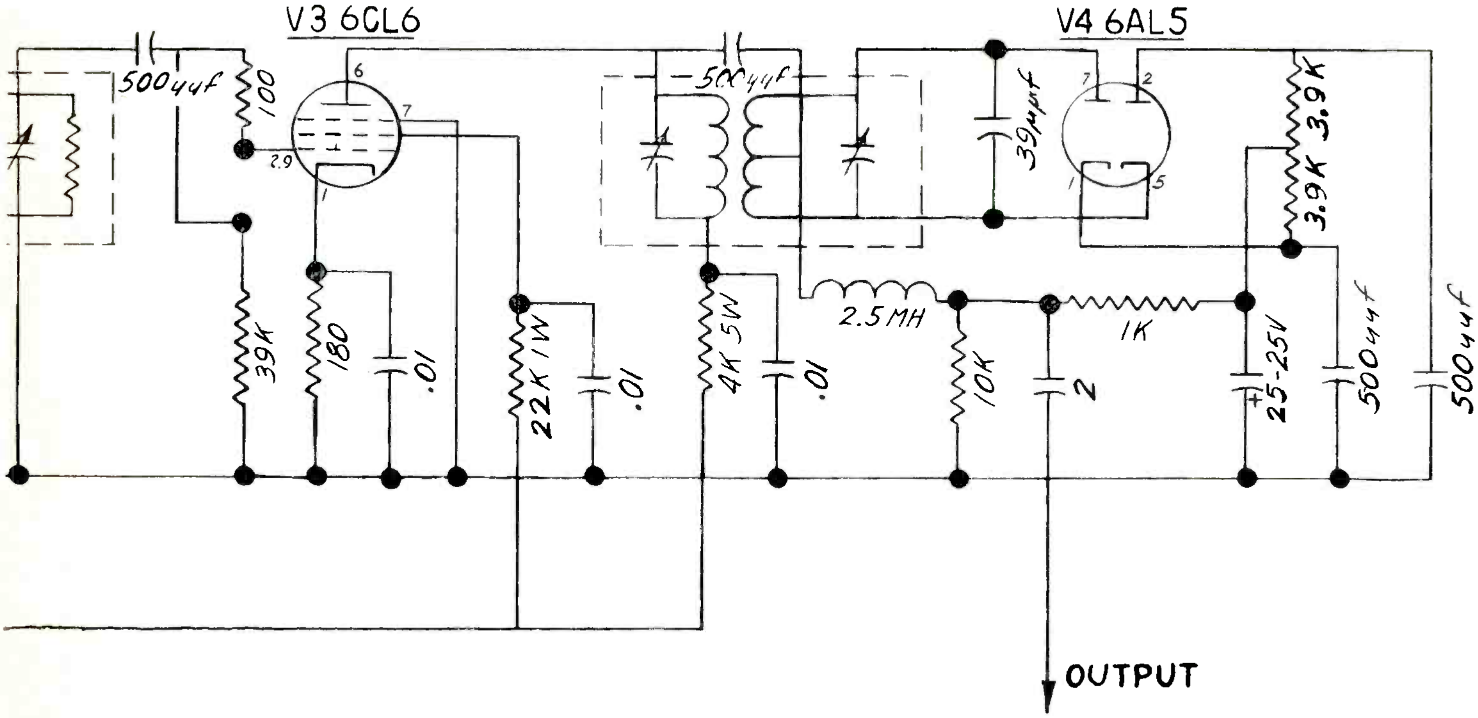


Figure 1
Block diagram of an FM multiplex monitor showing the various functions which are necessary.

Figure 2
Schematic diagram of input section of multiplex. monitor.



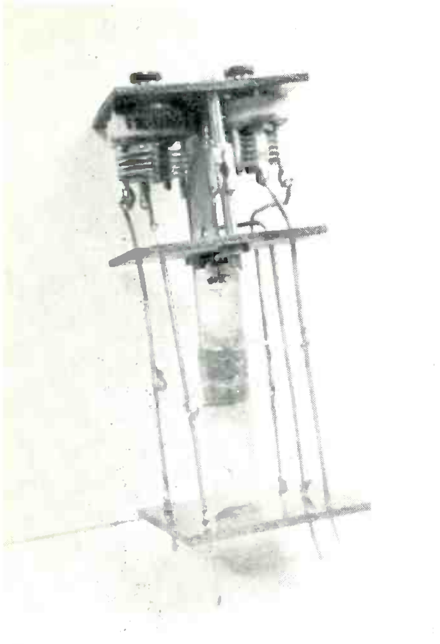


Figure 3
I.F. transformer used in multiplex monitor between mixer plate and amplifier.

As outlined in previous articles appearing in BROADCAST ENGINEERING, the main transmission trouble is crosstalk of the main channel modulation into the subcarriers. This crosstalk or intermodulation of the subcarrier cannot be correctly isolated or cured unless a crosstalk-free monitor is available for measurement and maintenance purposes.

Reference is invited to earlier papers appearing in this journal which detail how the misadjustment of multipliers, amplifiers, coupling circuits and antennas can all produce crosstalk which is measured best in a station monitor designed for this purpose.

Although this part of a two section article will detail the demodulation portion of a multiplex monitor, Figure 1 shows a block diagram of the functions necessary in a complete monitor.

The monitor reads the percentage of modulation of all products on the main channel. This has been provided because most of the existing monitors in use do not properly indicate modulating frequencies above 15,000 cps. It is necessary to read up to 75,000 cps. in order to properly inject the supersonic subcarriers. This unit reads to over 200 kc.

The Commissions standards require that the total arithmetic sum of the subcarriers shall not exceed 30 per cent modulation of the carrier. This cannot be indicated if the monitor itself cuts off shortly above the audio range of 15,000 cps.

Still more important however, will be the ability of the monitor to recover the supersonic modulation products without intermodulation from the regular audio range components present.

The incoming R.F. at a level of approximately 15 volts is mixed with the fourth harmonic of the local crystal oscillator to form the I.F. in the 10 Mc. range. In the schematic of Figure 2 it will be seen that after passing through a special transformer it is amplified by a 6CL6 which also acts as a limiter. This in turn feeds the ratio detector coupling transformer to the 6AL5 which delivers the demodulated products. It is linear to 200,000 cps., thus accurately making available for measurement the total demodulated signals in this range.

If the carrier is deviated 100 per cent (plus or minus 75 Kc.) the recovered voltage out of the 6AL5 is 0.1 volts RMS. This output is used to operate the balance of the function of the monitor as shown in the block diagram.

Figure 3 illustrates the interstage coupling transformer designed for use between the mixer plate and the I.F. grid of the 6CL6. This special unit was found necessary as all existing I.F. transformers produced unusable crosstalk of the audio products deviating the main channel into the supersonic subcarriers.

The regular I.F. transformers as used in receivers are designed for high Q and result in high gain. This characteristic is obtained through the use of powdered iron cores which also appear in the form of variable tuning slugs. Unfortunately, the desirable characteristics of this approach are overshadowed by the little publicized side effect which produces intermodulation.

Previous to multiplexing, the design of an I.F. transformer revolved around the problems of gain and bandwidth. The additional task of passing the by-products of supersonic subcarriers brought up the problem of phase linearity. By overcoupling and swamping, an amplitude linear band pass was realized but the phase linearity was not achieved sufficiently to erase cross modulation into the subcarriers. A parallel problem exists in the multipliers and power stages of the transmitter as well as in the transmitting antenna system.

To obtain phase linearity, the transformer uses air core, capacitor tuned coils electrostatically shielded. By adjusting the coupling, the bandwidth is quite wide.

The goal of the design is to provide complete passage of all of the side band products without producing any phase non-linear characteristics that would show up later as unwanted crosstalk. When sweeping out the transformer, the oscilloscope pattern of Figure 4 shows that the pass band is well over 2,000 Kc. wide.

The same design precautions are used in the construction of the ratio detector transformer that couples into the 6AL5. The linear slope obtained on the familiar "S" curve is well over 2,000 Kc. Although this results in a low level of recovered modulation voltage, the lack of intermodulation is the important feature.

The linearity of this I.F. and demodulation combination permits linear recovery of the modulation components without intermodulation. The frequency response is flat within 0.5 db from 5 cps. to 200,000 cps. The broad band width also makes for long term stability and non-critical operation.

In the second part of this article, which will appear next month, the design of the circuits which follow the linear demodulator will be presented along with the methods used in actual operation.

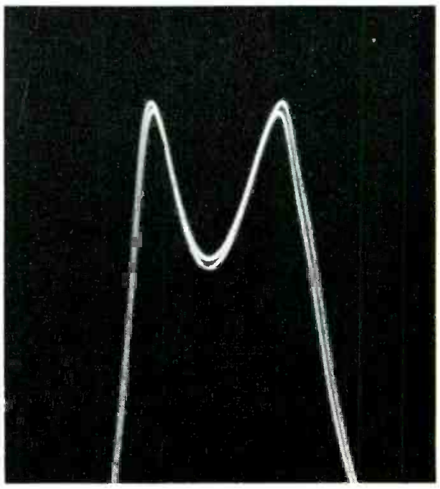
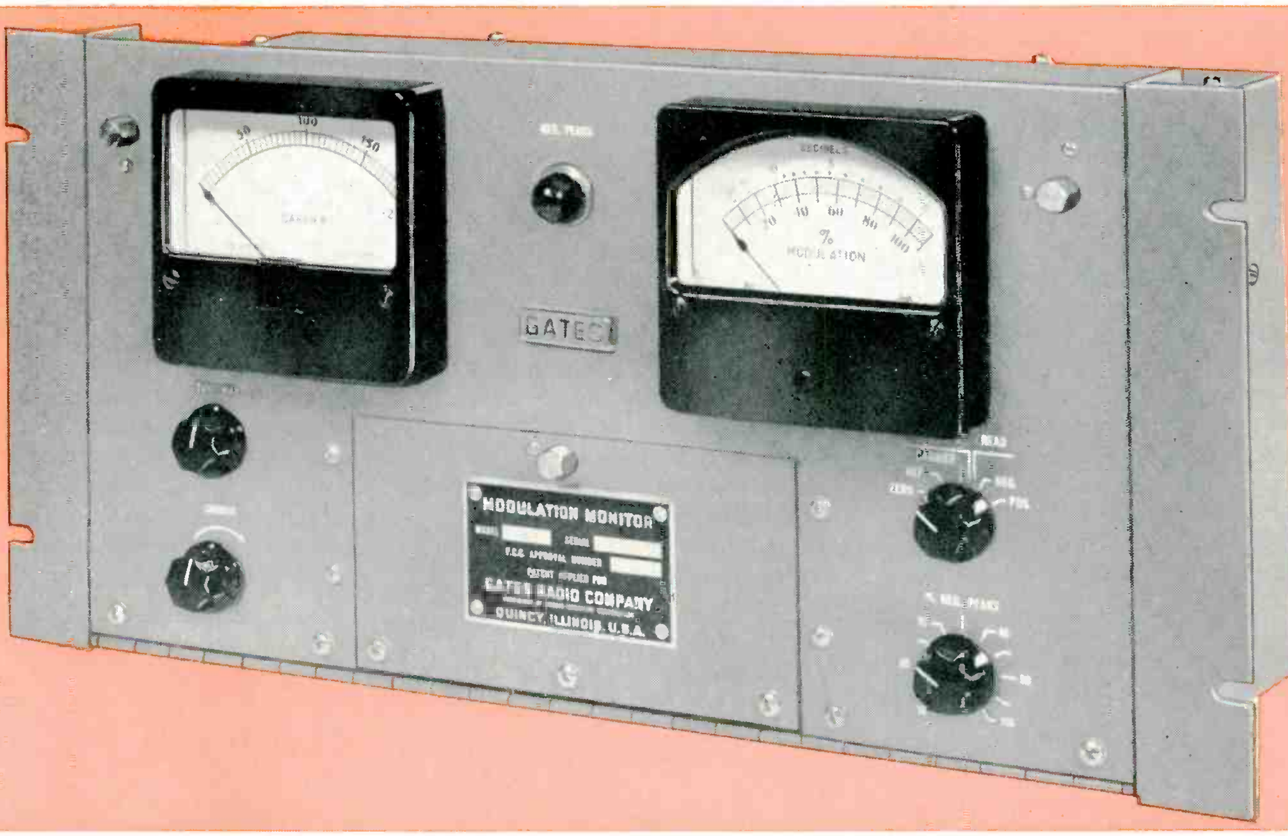


Figure 4
Bandwidth of I.F. coupling transformer is 2 Mc. from peak to peak of above curve. The effect of overcoupling is plainly evident.

A Major Break-Through in the search for a Better Modulation Monitor

The ALL NEW GATES M-5693 Modulation Monitor



The Gates M-5693 modulation monitor operates on an entirely new principle, with patent applied for. Employing direct coupling, this new monitor will read the true values of positive and negative peaks regardless of the presence of carrier shift. With the fastest meter allowable, it will, in addition, give correct peak indications on single program pulses as short as approximately 50 milliseconds and will measure the true peak amplitude of program or tone regardless of the wave forms encountered.

Older modulation monitors required the engineer to provide certain safety factors to prevent overmodulation. The new M-5693 monitor with true peak indication regardless of the complex waveform in standard programming, assures accuracy to the point that often greater modulation of the transmitter is possible, resulting in valuable increased signal strength.

The new Gates modulation monitor uses the difference in the rectified carrier voltage and the reference voltage for negative peaks, and the error from carrier shift decreases as the percentage modulation increases. The error is zero for 100% modulation. Indication of exact readings at high modulation is now possible and downward allowance for the error factor is no longer necessary.

The self-calibrating feature and the accuracy of indication makes this new monitor ideal for the annual proof-of-performance measurements. An oscilloscope is not even necessary.

The new monitor can be located at the transmitter and operated by remote control, with compensating adjustments in the monitor for imperfect telephone lines. There are many more exclusive features in this all new modulation monitor, which are discussed in detail in Engineering Bulletin No. 117-L. Write for your copy today—yours for the asking.

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". . . family of curves shows the microphone response . . ."

POLAR RESPONSE starts on page 6

to polar response. The frequency response of the microphone for sounds arriving at any angle can be noted mentally or actually drawn from the frequency response and polar charts.

For an illustration, refer again to Figure 4. Presuming the axial frequency response of this microphone is that shown as curve (1) in Figure 7, we can construct a family of curves representing the response of the microphone for sounds arriving from various directions off the front axis. In plotting each curve, we merely select the angle, such as 45 degrees shown in curve (2) and referring to the Polar Chart (Figure 4) read toward the center on the 45-degree radius. Wherever a polar curve crosses this radius, we note the frequency represented by that curve, how many db down it is at that angle and plot this point on the chart in Figure 7.

While a family of curves such as this will show the true performance of the microphone, it is seldom used. The reason is merely because a visual comparison of the axial and polar response charts provides the same information at a glance once these charts are understood.

From this point, we can move on to the remaining types of polar curves. While some intermediate patterns can be obtained, the most common types are the bidirectional response obtained from ribbon or velocity microphones (Figure 8) and the cardioid produced by unidirectional microphones (Figure 9). It must be borne in mind when looking at polar charts such as these that they are in no way a pictorial representation of the performance of the microphone but an actual polar graph which must be read rather than visualized.

For example, it is commonly stated that a bidirectional microphone (Figure 8) is "dead" at the sides, that is, a 90 degrees and 270 degrees off the front axis. In this case, the statement would be true only if the microphone were placed in an anechoic chamber and if the sound source were infinitely small in size and placed at exactly 90 degrees or 270 degrees. Since in use we must deal with room reverberation and other conditions far less than ideal, to be accurate we must speak in terms of ratios and compare all levels to that at 0 degrees on the chart.

In Figure 9, it can be seen that sounds reaching this cardioid on the back axis (180 degrees) are attenuated approximately 20 db. Stated another way, a sound of given intensity and fixed distance on the rear axis of the microphone will produce an output level 20 db below what it would produce at front axis. The microphone has a front-to-back ratio of 20 db. While 20 db of attenuation is substantial, the microphone is never actually "dead" at the back just as the bidirectional type in Figure 6 is not "dead" at the sides.

A practical example may further clarify this vital point. Using the microphone which produces the polar chart shown in Figure 9 to make a recording we would find the following on a listening test: With a person talking at 10 feet on axis and another talking at the same level but at 180 degrees off axis, the voice on axis would be recorded approximately 20 db louder. Now, if the person at 180 degrees moves up to one foot, both will be recorded at equal levels. Move the one at the rear to 90 degrees and the voices will be equal if he is 5 feet from the microphone. If he is moved to 10 feet, his voice will be only half as loud as the one on axis.

One important point remains in respect to use of polar charts. In dealing with pickup of sound waves, we are dealing with three dimensions. To be accurate, polar charts should be drawn in three dimensions. In printing polar curves for directional microphones, it has been customary to show those produced in the horizontal plane. This was done for two reasons: First, because this was the position in which the microphone was used and sounds normally have somewhat horizontal directivity; second, because the microphone if not symmetrical in shape produced the most desirable characteristics in this plane. The second point is most significant.

In lieu of three-dimensional graph paper which has not yet been developed and elaborate perspective drawings which are not always satisfactory, somewhat controlled distortion of toy balloons plus some imagination may be used to produce three-dimensional polar curves. That for an ideal nondirectional microphone would be represented by the perfect sphere imagining the microphone to be in the center. For the bidirectional microphone we might take this sphere, tie a string about the equator and draw it together forming two adjacent spheres. The microphone would then be imagined at the point of tangency, or the point where the two spheres are joined. Producing the three-dimensional cardioid pattern requires more imagination. However, it can be roughly reproduced by pointing a finger toward the center of the balloon and then moving it along with the surface to a point where the end of the finger is at what was the center of the sphere. This approximates a solid of heart-shaped cross section and the microphone would be located at the end of the finger.

The purpose of this balloon and imagination stretching is to illustrate one highly significant point. Symmetrical polar patterns are very desirable in practical use since we often need to cancel sound such as reverberation which in effect comes from all directions. If the case of a microphone is not symmetrical, its three-dimensional polar pattern cannot be symmetrical except at very low frequencies. It may be a cardioid in the horizontal plane and bidirectional or nondirectional in the vertical plane, thus greatly reducing its effectiveness.

Once true understanding of polar response is achieved, this knowledge can be used either to explain past experiences concerning pickup problems or provide a solid foundation for future applications, or both. Continual correlation of polar and axial data on specific applications generates a "feel" for sound pickup which is a skill probably better defined as applied knowledge. Such correlations are in themselves a topic to be covered in a following article.

New developments bring about new techniques in this ever-improving field but, thankfully, the vital basic principles remain the same.

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AMENDMENTS AND PROPOSED CHANGES OF F.C.C. REGULATIONS

STATION LOGS AND RECORDS
Inspection and Duplication

In the matter of amendment of Part I of the Commission's rules by the addition of a new § 1.76 to clarify requirements concerning inspection and duplication of station logs and records and to make provision for removal of logs and records from the licensee's premises.

1. Notice is hereby given of proposed rule making in the above-captioned matter.

2. It is proposed to add a new § 1.76 to the Commission's rules to clarify Commission requirements concerning inspection and duplication of station records and logs and to make provision for removal of such logs and records from the licensee's premises when so requested by the Commission or its representatives.

3. Inspection of records and logs is necessary in the performance of the Commission's enforcement functions. At times such logs or records may not be available for inspection because they have been stored at places remote from that at which an inspection is conducted, or a detailed examination may be necessary.

4. When records or logs are removed by Commission representatives, a receipt will be furnished so that licensees may maintain a record of custody.

5. The proposed amendments are issued pursuant to the authority contained in sections 4 (i), 303 (n) and 303 (r) of the Communications Act of 1934, as amended.

6. Any interested person who is of the opinion that the proposed amendment should not be adopted, or should not be adopted in the form set forth herein, may file with the Commission on or before Feb. 19, 1960, written data, views, or arguments setting forth his comments. Comments in support of the proposed amendments may also be filed on or before the same date. Rebuttal comments may be filed within ten (10) days from the last day for filing of original comments. No additional comments may be filed unless (1) specifically requested by the Commission, or (2) good cause for the filing of such additional comments is established. The Commission will consider all such comments prior to taking final action in this matter, and if comments are submitted warranting oral argument, notice of the time and place of such oral argument will be given.

7. In accordance with the provisions of § 1.54 of the Commission's rules, an original and 14 copies of all statements, briefs, or comments shall be furnished the Commission.

Part I of the Commission rules is amended by adding a new § 1.76 which reads as follows:

§ 1.76 Availability of station logs and records for Commission inspection.

Station records and logs shall be made available for inspection or duplication at the request of the Commission or its representative. Such logs or records may be removed from the licensee's possession by a Commission representative or, upon request, shall be mailed by the licensee to the Commission by either registered mail, return receipt requested, or certified mail, return receipt requested. The return receipt shall be retained by the licensee as part of the station records until such records or logs are returned to the licensee. A receipt shall be furnished when the logs or records are removed from the licensee's possession by a Commission representative and this receipt shall be retained by the licensee as part of the station records until such records or logs are returned to the licensee. When the Commission has no further need for such records or logs, they shall be returned to the licensee. The provisions of this rule shall apply solely to those station logs and records which are required to be maintained by the Commission rules.

INTERIM POLICY ON VHF TELEVISION CHANNEL ASSIGNMENTS; TELEVISION ENGINEERING STANDARDS
Notice of Proposed Rule Making

1. The Commission herein invites comments on its proposal to:

(a) Consider applications for waivers of minimum television station separations in exceptional, individual cases meeting the criteria set out below; and

(b) Adopt revised rules and standards governing calculations of the service areas of television broadcast stations.

Interim policy on VHF channel assignments. 2. In a statement submitted to the Senate Committee on Interstate and Foreign Commerce on April 17, 1959, by the Chairman of the Commission, it was announced that the Commission is pursuing studies and negotiations needed to ascertain the practicability of four alternative approaches to basic revision of television allocations. Each of these four alternatives contemplates long-range reallocations which would require a period of years to carry out if it were found desirable and practicable to adopt it.

3. Recognizing the urgency of taking such action in the interim as would relieve the pressing scarcities of channel assignments needed to provide at least three competitive television services in

the major markets, the Commission announced also that, in view of the practical limitations on the utilization of UHF channels for this purpose, it would endeavor to make such increased use of VHF frequencies as could be justified in the light of the circumstances existing in particular markets. Because of the large number of persons affected, the Commission indicated that this need is pressing in the larger markets which have so far been unable to obtain three competitive television services.

4. Recognition was also given to the near exhaustion of possibilities for making VHF assignments in such markets which would meet the minimum separation requirements which were established in the rules in 1952, and have been adhered to since that time, with negligible exceptions. The Commission continues to regard the standard minimum separations as a necessary and important factor governing the utilization of television channels generally under the existing nationwide allocations scheme. Owing, however, to the urgency of relieving serious shortages, the Commission announced that it will consider, in appropriate cases, limited and specific exceptions to the existing minimum co-channel separation requirements.

5. We propose at this stage to consider short-spaced co-channel assignments only in circumstances in which such action is clearly warranted by the urgency of the need for providing additional VHF television outlets during the interim until final decisions can be reached on basic revision of the present television allocation plan. We have concluded, after carefully considering all the courses of action available during the present "interim" period that at this stage our consideration of short-spaced VHF television assignments can be considered usefully only in cases where the following conditions are present:

(a) The assignment would make possible a second or a third VHF television station in an important television market.

(b) The need for the additional service outweighs the need for any service lost as a result of additional interference to existing stations.

(c) The new VHF service would not have substantial adverse effect on established UHF television services.

(d) A new assignment would not require an excessive number of channel changes of existing stations.

6. It is proposed to require any new station assigned at a substandard co-channel separation to suppress radiation in the direction of the existing station to the extent necessary to ensure that such new station creates no more interference to the existing station than would be caused if both stations were operating at the standard minimum spacing permitted under § 3.610 of the rules, and with maximum antenna height and power. The method for calculating the required suppression of the new station's radiation is set out in paragraphs 17 and 18, hereinbelow.

7. New co-channel stations at substandard spacings will be required to comply with all requirements of the rules and standards applicable to television broadcast stations except the minimum co-channel spacings set out in § 3.610 of the rules. This means, for example, that new stations will be required to meet minimum adjacent channel spacings, which it is now proposed to reduce to 40 miles for all television broadcast stations. They will also be required to provide a signal of the prescribed minimum field intensity over the principal city provided for in the proposed rules revisions appended hereto.

8. Since short-spaced assignments will be considered only in the exceptional circumstances conforming with the criteria set out in paragraph 6 hereof, we do not propose to reduce the co-channel separations which are now provided for in § 3.610 of the rules, and which will remain generally applicable. Our proposal herein contemplates that consideration be given to short-spaced channel assign-

ments in individual cases either on the Commission's own motion or pursuant to petitions for amendment of the Table of Assignments in § 3.606 of the rules which are accompanied by requests for waiver of the standard minimum spacing requirements.

Revision of television engineering standards. 9. On March 16, 1959, the Television Allocations Study Organization (TASO) submitted a report to the Commission covering two and a half years of study of various factors related to the assignments of television broadcast channels on an engineered basis. The data obtained through this study makes it possible to refine some of the VHF technical data contained in our present rules. We are not prepared at this time to propose similar refinements of UHF standards in the rules.

10. The present rules of the Commission define two grades of service and specify a certain minimum value of signal strength which must be placed over the principal city in the area served. This grading is somewhat misleading since it is concerned merely with the probability of a specified percentage of the locations which are likely to receive a certain signal strength and is not directly concerned with the quality of such reception.

11. A more meaningful definition of television service is desirable and the TASO studies provide the basis for such a definition. On this basis we deem it appropriate to consider the service data of a television station as including the area over which it provides a signal of sufficient strength to produce an acceptable picture to average home television receiving installations in at least 50 per cent of the locations within the area for 90 per cent of the time or better. Comprehensive subjective viewing tests conducted by TASO showed that a picture relatively free of manmade electrical noise but with a discernible interference pattern from another television station, was considered acceptable by the average television viewer. We recognize that a more critical viewer might demand a picture free from noise and interference. However, such a strict definition of service would indicate a severely restricted service area and would not be realistic. Actual field strength measurements made in the vicinity of a large number of typical homes were compared with the viewers rating of picture quality in those homes.

12. It was found that on VHF channels the following median signal strengths would produce an acceptable picture as defined above in paragraph 11:[1]

Channels	*Channels*
2-6	7-13
40 dbu	50 dbu

The area encompassed by the above field strength contours taken from the ings to suppress radiation toward the existing station to the extent necessary to insure that the ratio of desired to undesired signal will not be less than 28 db (offset operation) at any point where such ratio would occur if the new and the existing station were operating with maximum facilities at the minimum spacing permitted in § 3.610 of the rules. In general, protection of the normal service range of an existing station on a line between the stations will provide protection in other directions as well but the new station must make this showing based on the particular facilities proposed. The value of 28 db was established on the basis of subjective viewing tests conducted prior to the adoption of the present TV allocation plan in 1952. (See paragraphs 97 and 98 of the Sixth Report and Order in Dockets 8736 *et al*). Similar subjective viewing tests conducted by TASO yielded almost identical results.[5]

19. TASO found that conventional TV receiving antennas have directive properties which provide as much as 6 db discrimination between desired and undesired signals. While this factor was not used in determining equivalent protection, it will provide additional protection for existing stations in some directions. In computing the protected service of existing stations the desired signal strength of the existing station is obtained from the F (50,50) curves and the strength of the interfering signal is obtained from the F (50,10) curves.

20. In determining service gains and losses resulting from the assignment of a new station at substandard co-channel spacings, the effect of service rendered by adjacent channel stations will be calculated on the basis of the TASO studies which show that service is rendered out to the point where the desired to undesired ratio is minus 24 db or less.

21. All interested persons are invited to file, on or before Feb. 19, 1960, comments supporting or opposing the proposals set out in this notice and in the Appendices hereto, or submitting any modifications or counterproposals the parties may wish to submit. Comments in reply thereto may be submitted by March 7, 1960. The Commission will consider all comments filed hereunder prior to taking final action in the matter: *Provided*, That, notwithstanding the provisions of § 1.213 of the rules, the Commission will not be limited solely to the comments filed in this proceeding.

22. The requisite statutory authority is contained in Sections 4 (i) and 303 of the Communications Act of 1934, as amended.

23. In accordance with the provisions of § 1.54 of the Commission's rules and regulations, an original and 14 copies of all statements, briefs, or comments shall be furnished the Commission.

[1]See Appendix B for a statement of the factors used to confirm the values.

[2]See Appendix C for a statement of the factors used in determining these values.

[3]See Report of the Ad Hoc Committee on TV Broadcasting, May 31, 1949. Volume I, Docket Nos. 8736, et al.

[4]In the computation of interference, between two time fading signals, a good approximation is available when the time fading of one is at least twice as large as that of the other. See reference F of the Ad Hoc Committee Report. Under such conditions the signal with the lesser fading may be assumed as constant as its median value. Thus, for co-channel interference the time fading of the desired signal is usually small enough to meet this criterion in relation to the fading of the interfering signal. In this case the desired signal may be assumed as constant at its time median value, so that 90 per cent service exists when the 10 per cent level of the interfering signal is equal to the permissible instantaneous interference level for the grade of service involved. Similarly, in the case of interference from noise the time fading of noise is assumed to be negligible, so that 90 per cent service exists when the 90 per cent desired signal is equal to the minimum required instantaneous signal level required for the grade of service involved.

[5]The TASO evaluation yielded a figure of 26 db.

[6]Dissenting statements of Commissioners Bartley and Lee filed as part of the original documents.

Appendix A

Proposed amendments to Part 3 of rules:

1. Amend § 3.610 (c) (1) to read as follows:

(c) Minimum assignment and station adjacent channel separations applicable to all zones:

(1)

Channels	*Channels*
2-13	14-83
40 miles	55 miles

2. Amend § 3.683 as follows:

(1) Change the title of this section to read as follows: "§ 3.683 *Field strength contours*."

(2) Change the term "Grade A" and "Grade B" to "Principal City Service" and "Normal Service", respectively wherever they appear in this section.

(3) Substitute the following for the present tabulation in paragraph (a):

	Principal City Service (dbu)	Normal Service (dbu)
Channels 2-6	80	40
Channels 7-13	85	50
Channels 14-83[1]	80	64

(4) In the last sentence of paragraph (a) change the term "F (50,50)" to "F (50,90)".

3. Amend § 3.684 as follows:

(1) Substitute the following for present paragraph (a):

(a) All predictions of coverage made pursuant to this paragraph shall be made without regard to interference and shall be made only on the basis of estimated field strengths obtained from the charts in § 3.699. The peak power of the visual signal is used in making predictions of coverage.

(2) In paragraph (c) substitute the following for the first two sentences in the present text: "In predicting the distance to the field strength contours, the F (50,90) field strength charts in § 3.699 shall be used. If the 90 per cent field strength is defined as that value exceeded for 90 per cent of the time, these F(50,90) charts give the estimated 90 per cent field strengths exceeded at 50 per cent of the locations in decibels above 1 microvolt per meter.[2]"

(3) In paragraph (c) substitute the terms "Principal City Service" and "Normal Service" for the terms "Grade A" and "Grade B" respectively, wherever they appear.

(4) In the first sentence of paragraph (e) delete the expression "Grade A and Grade B field intensity contours" and substitute therefor the expression "normal service contour".

4. Amend § 3.685 as follows:

(1) Substitute the following text for the present text of paragraph (a):

(a) The transmitter location shall be chosen so that, on the basis of the effective radiated power and antenna height above average terrain employed, the Principal City Service contour will encompass the entire principal community to be served.

(2) Delete the first sentence in paragraph (c).

(3) Substitute the following sentence for the second sentence in paragraph (c): "In considering applications proposing the use of questionable antenna locations the Commission may require site tests to be made."

5. Amend § 3.686 as follows:

(1) Delete the first sentence in paragraph (a).

(2) In paragraph (g) (1) substitute the term "Principal City and Normal Service Contours" for "Grade A and Grade B field intensity contours".

6. Insert new Propagation Curves.

[1]For the present F (50.50) chart may be used.
[2]For Channels 14-83 use is made of F(50,50) chart.

Appendix B

The following factors were used to determine the signal strength required to provide an acceptable picture at 50 per cent of the locations for 90 per cent of the time; defined as Normal Service.

	Channels [1]2-6	Channels [1]7-13
1. Picture quality	Passable	Passable
2. Thermal noise (dbu at 300 ohms)	7	7
3. Receiver noise figure (db)	7	8
4. Required visual peak to R.M.S. (noise ratio (db)	30	30
5. Receiving antenna transmission line loss (db)	2	3
6. Receiving antenna loss (db)	—3	—6
7. Dipole factor (db)	—3	8
8. Required local field (F(50, 90)) (dbu)	40	50

[1]The mean frequency used in computing the values used for Channels 2-6 is 71 Mc and for Channels 7-13, 195 Mc.

Explanatory Notes:

1. Taken from TASO data on subjective viewing tests.

2. This is the theoretical thermal noise which would be generated by a 300 ohm resistance at 300 degrees Kelvin over a 4 megacycle bandwidth.

3.. These noise figures are typical of an average television receiver found in use today.

4. The values listed were derived from analysis of the subjective data contained in the TASO Report.

5. The values listed correspond to the average for 5 year old transmission line when wet as reported by TASO.

6. These values are typical of those found by TASO.

7. These values take into account the average physical size of a halfwave dipole at the frequencies under consideration with respect to the signal strength in microvolts per meter and is determined by the formula—20 log 96.5/fMc.

Appendix C

The following factors were used to determine the strength of the signal which must be placed over the entire principal city, to provide an excellent picture at 90 per cent of the locations for 90 per cent of the time in the presence of man-made electrical noise at levels found in highly urbanized areas, if a reasonably good receiving antenna installation is employed. The value is sufficiently high to permit reception of an acceptable picture at many locations with an indoor antenna or on a lower quality receiver.

	Channels 2-6	Channels 7-13
1. Quasi-peak noise field relative to halfwave dipole (dbu)	49	46
2. Ratio of signal to quasi-peak noise required to produce an excellent picture (db)	24	24
3. Location probability factor (db)	7	10
4. Urban depression loss (db)	3	9
5. Operating receiving antenna loss referred to a halfway dipole (db)	—3	—4
Median field strength required for Principal City Service (F(50, 90)) (dbu)	80	85

Explanatory Notes:

1. Obtained from the Chart on page 763 of the handbook entitled "Reference Data for Radio Engineers," 4th Edition, published by International Telephone and Telegraph Corporation, corrected for a bandwidth of 4 megacycles.

2. It is assumed that a 24 db signal-to-noise ratio is necessary to render the noise interference inconspicuous in pictures representing average program material. This corresponds to a quasi-peak noise level of 6.25 per cent of the peak video level.

3. From T.R.R. 2.4.16, October 22, 1956.

4. Reduction due to signal loss in built up areas.

5. The typical urban receiving antenna is less effective than a similar antenna operated in rural areas. Consequently, this value is somewhat less than the typical gains for receiving antennas reported by TASO.

CONELRAD ATTENTION SIGNAL
Transmission Standards

1. Notice is hereby given of Rule Making in the above-entitled matter.

2. The Commission has before it for consideration a recommendation that there be established specific transmission specifications for the CONELRAD Attention Signal. The Office of Civil and Defense Mobilization, in a letter dated August 4, 1958, requested that action be initiated looking toward the establishment of such standards so that an alert receiver could be developed that could be mass produced and still meet OCDM requirements.

3. Executive Order 10312, which provides for emergency control over stations engaged in radio transmission, contains a provision, among others, that

plans be prepared and implemented whereby radio stations may be silenced or required to be operated in a manner consistent with the needs of national security and defense. The authority to prepare and put into effect such plans is delegated to the Commission under Section 1 of Executive Order 10312. An operating and alerting plan for broadcast stations was approved November 11, 1952. On April 8, 1953, CONELRAD Rules for broadcast stations, and the CONELRAD Manual, BC-3, For Broadcast Stations were adopted by the Commission. Section 3.919 of these rules states that "the CONELRAD Manual is the document containing the detailed description of how broadcast stations will be alerted and operated in the CONELRAD system. The Manual will be subject to modification from time to time as experience indicates."

4. Section 3.932 of the Commission Rules states that immediately upon the receipt of a CONELRAD Radio Alert, all standard, FM, and TV broadcast stations will follow the prescribed procedure and transmit an approved sign off message as set forth in the CONELRAD Manual for Broadcast Stations, then remove the transmitter from the air.

5. The CONELRAD Attention Signal, as now set forth in the CONELRAD BC-3 Manual, is activated by broadcast stations in the following manner:

(a) Discontinue normal program.

(b) Cut the transmitter carrier for approximately 5 seconds (Sound carrier only for TV stations).

(c) Return carrier to the air for approximately 5 seconds.

(d) Cut the transmitter carrier for approximately 5 seconds (Sound carrier only for TV stations).

(e) Return carrier to the air.

(f) Broadcast 1,000 cycles (approx.) steady state tone for 15 seconds..

The CONELRAD Attention Signal consists of steps (b) through (f). There are no other specifications.

6. When the Commission's staff and the industry formulated the composition of the original CONELRAD Attention Signal there were numerous considerations involved. One of the most important of which was the utilization of the 1,000-cycle per second tone. Some of the factors considered at that time were as follows:

(a) 1000 cycles per second is a standard test signal which can be generated without complex equipment or circuitry at low cost.

(b) It is an audible (annoying) signal and could be used to attract the listener's attention.

(c) Provides for the optimum transfer of radiated energy into the sidebands.

(d) Provides a more useful signal in fringe areas above prevailing ambient noise levels.

By utilizing the (bracket standard) sequence of two carrier breaks and 15-seconds of 1000 cycle tone, a wide latitude in the production of "muted" CONELRAD Radio Alert receivers was made available to the receiver manufacturer in the free competitive market. This "bracket standard" provided on one hand, for complex circuitry with interlocking of the elements (two carrier breaks and 1000 cycle tone) to provide a maximum of freedom to false alarms at one extreme and on the other hand, simple circuitry utilizing the carrier break principle with minimum freedom from false alarms at the other extreme.

7. A CONELRAD Attention Signal Study Committee was appointed to study and report on possible standards for the Attention Signal. The Committee after holding several meetings and reviewing the background leading to the development of the CONELRAD Attention Signal, reached the conclusion that the composition of the present signal would be retained. However, this committee agreed that the project should be referred to the National Industry Advisory Committee for further study and recommendations of specific transmission tolerances.

8. The National Industry Advisory Committee determined that:

(a) The establishment of specific and relative tight tolerances on the CONELRAD Attention Signal would not increase the cost of receivers for general public use.

(b) The basic radio receiver for public use need not be elaborate and its final cost would be determined by the desired freedom from false alarm.

(c) The establishment of specific tolerances on the CONELRAD Attention Signal would aid in the design of the more elaborate and more foolproof type of receiver required for OCDM use.

It was further determined that, inasmuch as transmitters could be turned off and on in a relatively short time, close tolerances can be applied to the Attention Signal. It was indicated that the control of the Attention Signal must be accomplished by an automatic control device. The committee agreed that the burden of cost should be placed with the transmitter rather than the receiver because of the relative ease of control at this point. It was further revealed that a coding equipment might be procured by individual broadcasters for approximately $150.00 per unit. Thus this would indicate that the economics are definitely in favor of a relatively small expenditure at the transmitter in place of considerable complexity for each and every alert receiver that might be sold in the future.

9. The Commission has been encouraging the development of pre-attack and post-attack State Defense Networks by the various State Industry Advisory Committees. These emergency networks are formed by off-the-air relay between FM broadcast stations, with program material being intercepted off-the-air by standard broadcast stations. These State Defense Networks are alerted for Emergency Weather Warnings by utilizing FM receivers equipped with CONELRAD Attention Signal devices. In this connection, the Broadcast Services Committee of the NIAC has been requested to prepare suitable promotional material for use by all broadcast stations, encouraging the general public to purchase combination AM-FM CONELRAD Radio Alert receivers for receipt of Emergency Weather Warnings and the CONELRAD Radio Alert in the event of enemy attack. The broadcast industry has indicated active support of this activity, since it has a direct bearing upon increasing AM-FM receiver circulation for the broadcaster.

10. At the October 22, 1959, meeting of the NIAC, the Chairman of the Electronics Industry Committee indicated that the receiver manufacturing industry was waiting upon adoption of the proposed technical transmission tolerances prior to production of AM-FM CONELRAD Radio Alert receivers for sale to the general public.

11. In view of the above, it is proposed to amend the CONELRAD Manual BC-3 so as to establish the following transmission tolerance specifications for the CONELRAD Attention Signal.

TRANSMISSION STANDARDS

Carrier off: 5 Sec. ±0.25 Sec.
Carrier on: 5 Sec. ±0.25 Sec.
Carrier off: 5 Sec. ±0.25 Sec.
Carrier on: Tone on within 1 Sec.
Duration of tone: 15 Sec. ±1.0 Sec.
Tone frequency: 1000 cycles±0.2%. 5% distortion at the oscillator.
Percentage modulation: 75%.

12. The National Industry Advisory Committee report did not recommend the utilization, by broadcast stations, of an automatic push button device which when activated would automatically cause the transmitter to send the CONELRAD Attention Signal having the above tolerances. However, the report of the Electronics Industry Committee contains a statement that the control of the Attention Signal must be accomplished by an automatic control device, two of which are available. A statement was made at the NIAC meeting that the Commission should consider, as a part of the criteria for permission to remote control broadcast transmitters, the inclusion of "automatic" equipment to transmit the CONELRAD Attention Signal. All stations, as pointed out previously, whether remote controlled or otherwise, are pres-

ently required to transmit the CONELRAD Attention Signal and CONELRAD Radio Alert Message upon receipt of notification of the CONELRAD Radio Alert. In view of the decrease in the length of the attack warning time that has developed, it is believed that automation should be carried one step further in that an additional device would take over immediately after the Attention Signal was sent and transmit the approved CONELRAD Alert Message together with a short civil defense message and then remove the transmitter from the air. For those stations holding a National Defense Emergency Authorization, a further adaption of the automatic device would cause the CONELRAD transmitter to be activated and made ready for transmission of National, State and local emergency information. The present Notice of Proposed Rule Making applies specifically to the standards for the Attention Signal. Parties filing comments are requested to direct their attention to the need for and desirability of an amendment of the BC-3 to provide for the use of automatic push button devices to accomplish one or more of the following operations:

(a) Transmit the CONELRAD Attention Signal.

(b) Transmit the CONELRAD Radio Alert Message, the local civil defense message and then remove the transmitter from the air.

(c) Place the CONELRAD transmitter in operation ready to transmit emergency information.

13. There are presently 86 key standard broadcast stations operating on a 24-hour basis at the request of the Commission. These stations provide the backbone of the alerting system. All licensees of the Commission are required to install means to receive the CONELRAD Radio Alert. In the majority of cases a broadcast station is monitored by the other services in order to receive an Alert. In addition the general public would receive an alert from broadcast stations. The CONELRAD Attention Signal may also be used to alert the public to Emergency Weather Warning information in accordance with section 3.933 of the Commission's Rules. Several State Industry Advisory Committees have, or are in the process of establishing Emergency (FM) Defense Networks. Advantage is being taken of the reliable solid FM coverage which does not change much with the time of day or with atmospheric conditions. The development of an AM-FM broadcast alert receiver will provide an effective means of alerting the general public during normal non-listening hours.

14. The proposed amendments herein above described are issued pursuant to the authority contained in sections 1, 4 (i) and 303 (e) and (r) of the Communications Act of 1934, as amended, and section 4 of Executive Order 10312.

15. Any interested person who is of the opinion that the proposed amendment should not be adopted, or should not be adopted in the form set forth herein may file with the Commission on or before February 8, 1960, written data, views or arguments setting forth his comments. Comments in support of the proposed amendment may also be filed on or before the same date. Comments in reply to the original comments may be filed within thirty days from the last day for filing said original data, views or arguments. No additional comments may be filed unless (1) specifically requested by the Commission or (2) good cause for the filing of such additional comments is established. The Commission will consider all such comments prior to taking final action in this matter, and if comments are submitted warranting oral argument, notice of the time and place of such oral argument will be given.

16. In accordance with the provisions of § 1.54 of the Commission's rules and regulations, an original and fourteen copies of all statements, briefs, or comments filed shall be furnished the Commission.

Industry News

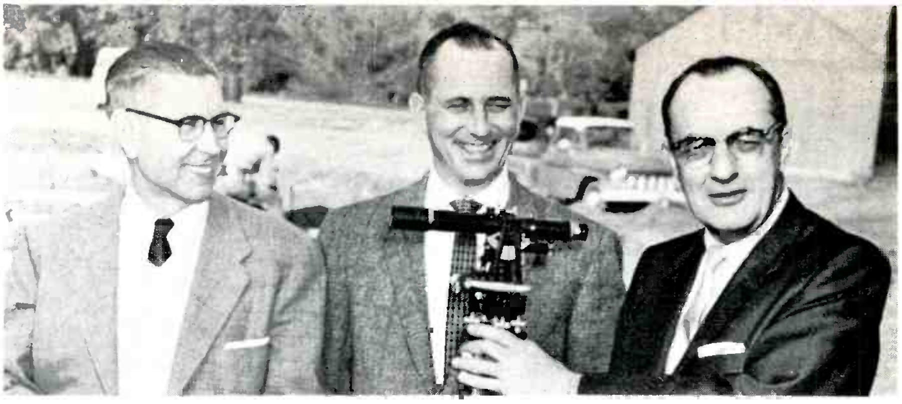
Electro-Plex Merges With Nuclear Electronics Corp.

W. H. Collins

Nuclear Electronics Corp. has acquired the Electro - Plex Corp., it was announced by John E. Wagenseller, Nuclear president. Electro-Plex will operate as a separate division. Nuclear will engage in the research, deengage actively in the research, development, and manufacture of specially integrated FM Multiplex receiving equipment, as well as the FM broadcast station instruments. William Collins, founder and president of Electro-Plex, will continue to head the Electro-Plex Div. Mr. Collins stated that the additional engineering and manufacturing facilities of Nuclear will enable Electro-Plex to provide a greater service to the FM broadcasting industry and background music operators.

Bauer Electronics Forms New Corporation

Fritz Bauer, pioneer AM transmitter manufacturer, has announced the formation of the Bauer Electronics Corp. with headquarters in Burlingame, Calif. Mr. Bauer is president and principal stockholder of the new firm. Paul Gregg, formerly with Gates Radio Co., has been named sales manager. The firm will manufacture broadcast equipment. Two new AM transmitters will be introduced early in 1960. Offices are located at 1011 Industrial Way, Burlingame, Calif.



Participants in ground-breaking ceremonies for new plant of Conrac, Inc., at 19313 E. Foothill Blvd., Glendora, are (left to right) Charles A. Nichols, engineering manager; Charles Dickman, Fleetwood sales manager; and W. J. Moreland, president and board chairman.

Construction of the new ultramodern Conrac, Inc., plant at 19313 E. Foothill Blvd. in Glendora got under way recently with W. J. Moreland, Conrac president and board chairman, wielding the ceremonial shovel for the occasion.

The new plant, with total floor space of 35,000 sq. ft., will be 50 per cent larger than Conrac's previous building which was destroyed by fire last summer. Scheduled for May 15 completion, the new facility will increase production capacity nearly four times above the old plant, Moreland said.

"Facilities will be especially geared to production of Conrac's Fleetwood custom television receivers for the home, and video monitors used in television broadcast stations and industrial closed-circuit TV," he said.

Television Test Signals

A. Prose Walker, manager of engineering for the NAB, emphasizes that the finalization of Docket 11986 concerning the use of television test and reference signals only specifies the area within the vertical interval during which test signals may be transmitted under conditions which would preclude significant picture degradation. The transmission of test signals is permissive, not mandatory, and the types of test signals are not specified. The National Association of Broadcasters participated in the work of the EIA Committee which formulated the report to the FCC.

PAM/FM Stereo

There have been inquiries for additional information on the PAM/FM stereo system which was described in the December issue of BROADCAST ENGINEERING. The mathematical analysis of the system is available and a complete copy of the article including the mathematical treatment can be obtained by writing to Broadcast Engineering, 1014 Wyandotte St., Kansas City 5, Mo.

Mr. Vincent Skee, who translated the original article, states that the system can be better understood by using the concept of gating in describing the function of the adapter at both the transmitter and receiver.

Tower Lamp Voltages

Frank J. Little, Jr., of Hughey & Phillips, Inc., points out that the FAA Standards for Marking and Lighting Obstructions to Air Navigation require that the rated voltage of the tower lamps used should correspond to or be within 3 per cent higher than the average voltage across the lamp during the normal hours of operation. With 110 volts at the socket of a 130-volt lamp, the lumen output will be about 55 per cent of that specified by the FAA as satisfactory for the warning light. A recent "Technical Hint" suggested the use of 130-volt lamps for various applications because of the longer life obtained when operated at 115 volts. The Federal Aviation Agency standards, however, rule out this application for tower obstruction lighting.

Product News

NEW SPEECH INPUT CONSOLE

A medium-sized speech input console has been introduced by Collins Radio Co. The single channel console, Model 212G-1, will mix 9 of the 13 inputs. It features plug-in modules and can be expanded. Maximum number of channels possible, when supplied with a full complement of plug-in modules, is six low level inputs, two medium level inputs, one remote or net input, one program channel, one monitor channel and one cueing channel. Maximum gain is 100 db, output level from the program line is 18 dbm and from the monitor 39 dbm. Frequency response is plus or minus 1.5 db from 50 to 15,000 cycles. Only two tube types are used in the console.

MATCHED MICROPHONES FOR STEREO

Four models of microphones will be packaged in pairs by Electro-Voice, Inc., for use on stereo pickups. The paired microphones will be balanced within close tolerances ensuring that no significant difference exists between the two mikes. Included in the program for paired packaging are E-V Models 623, 630, 636, and 664.

THIRD CONVERTOR AVAILABLE FOR ZOOMAR LENSES

Television Zoomar Co. has announced the development of a third convertor for their Super Universal Zoomar Lens. The third convertor will enable the lens to zoom from 12 inches to 72 inches. With the convertor a camera located on a grandstand can zoom from a cover scene to a head and shoulder shot of an athlete. Several networks have been experimenting with the convertor and plan to use it for the national political conventions next summer. TV Zoomar Co. has announced that more than 500 Zoomar Lenses are in use by networks and television stations.

LOW NOISE VHF PREAMPLIFIER

Community Engineering Corp
Box 824, State College, Pa.

Designed for use in the 50 to 200 mc range, the Model 1001 VHF Preamplifier has a noise figure of better than 3 db at 85 mc and 4.5 db at 200 mc with a nominal gain of 30 db. Unit is fixed tuned to required frequency, bandwidth is 10 megacycles. Input and output impedance is 50 ohms.

CROWN 714 C STEREO RECORDER

The Crown 714 C, Stereo X, records and plays 4-track stereo, plays 2-track stereo, and is capable of recording and playing monaural. The 714 C 4-track recording performance surpasses traditional professional standards of former years, according to Crown. Features include three speeds, three motors, accepts 10-inch reels, four microphone inputs, rack mount, and automatic stop. Frequency response at 15 ips is 50 to 28,000 cps within 2 db, at 7½ ips it is 40 to 17,000 and at 3¾ ips it is 30 to 9,000 cps.

GATES ANNOUNCES NEW FM TRANSMITTER

A new 10,000 watt FM transmitter, Model FM-10A, has been announced by Gates Radio Co. The transmitter features a new method of tuning a single ended VHF amplifier called varialine tuning. A portion of a parallel plate transmission line is made variable to capacity tune the line to operating frequency. Neither mica nor vacuum capacitors are needed in the tank circuit increasing the efficiency of the circuit. The exciter employs a phase shift modulator with pulse timing techniques and may be adapted to single or dual channel multiplexing on a plug-in basis.

NEW SOUND CATALOG

A greatly expanded sound catalog has been issued by Electro-Voice, Inc. Full technical specifications and features are included on the full line of microphones and speakers. Charts are included to aid in choosing the most appropriate microphone or speaker for each specific application. Copies of the catalog, known as Commercial Sound Catalog No. 32, may be obtained by writing Electro-Voice, Inc., Buchanan, Mich.

NEW THREE SPEED TURNTABLE

Gates Radio Co. has announced a new three-speed, 12-inch professional transcription turntable. In the operation of this new turntable, the drive is against a solid inner hub, away from the usable playing surface of the platter. A 600-rpm hysteresis synchronous motor is used. The turntable will come up to speed at 33⅓ rpm in ⅙ turn, with noise rated at —45 rpm, at 45 rpm the turntable starts in ¼ turn with noise or rumble at —40 db. The CB-77 chassis size is 16 inches x 16 inches.

Four Stations to Use AM Stereo Broadcast Equipment

FULL-RANGE stereo broadcasts over a single AM transmitter are soon to be a regular program feature of four internationally known radio stations equipped with the new All-AM Stereo Adapter system developed and manufactured by Kahn Research Laboratories, Inc., Freeport, N. Y. They include CJAD in Montreal, the major high power station in Mexico City and two leading stations in Venezuela.

As far as it is known, they are the first stations to purchase AM stereo broadcast equipment. According to Kahn Research Laboratories, who are also the developer and manufacturer of Compatible Single-Sideband and Symmetra-Peak, the decision to broadcast stereo at this time was based upon the system's unique ability to achieve immediate and widespread public participation. Kahn Adapters make this possible because the programs (1) have the desired mass appeal of an AM system and (2) they can be received on two standard AM receivers found in the majority of homes. Thus, the public has nothing to buy and the broadcaster, now competing for listeners with the stereo phonograph, is assured of holding a large and commercially vital audience. Completely balanced monaural reception is also provided when only one receiver is used.

When installed on standard AM transmitters, the Kahn Model STR-59-1A Stereo Adapter system develops a full carrier and two independent sidebands which can be independently modulated by the two stereo channels. The resulting envelope wave has the same spectrum requirements as conventional AM. It is also theoretically free from inherent distortion and in actual practice approximately one-half per cent total harmonic distortion is added. Installations can be made on any standard high-level, low-level or Doherty system in a matter of a few hours without engineering modifications of the transmitter.

True Stereo Reception on Two Standard Receivers

This new type envelope wave permits independent upper and lower sidebands to be demodulated by standard AM detectors. Therefore, true stereophonic reception, which is not to be confused with a stereo effect, can be achieved by simply placing two standard AM receivers approximately six to eight feet apart and tuning each receiver to the respective upper and lower sideband.

It is expected that inexpensive receivers with single-control tuning, dual audio channels, and other improvements designed to utilize the system's optimum isolation features will be introduced later by various receiver manufacturers.

Compatible Monaural Reception On One Standard Receiver

Compatible monaural reception of stereo programs is accomplished by tuning a standard receiver to the carrier in the usual AM manner. Both stereo channels can then be received with perfect program balance.

Improved Audio Fidelity

Improved audio fidelity in each of the stereo channels is entirely a function of receiver bandwidth. Since design economy requires that most receivers employ narrowband IF amplifiers, the great majority have a total passband of only 5 or 6 kc. When conventional AM transmissions are employed, receivers must be tuned so that the carrier is centered in the IF passband. Therefore, only one-half or between 2.5 and 3 kc, constitutes the actual fidelity of these receivers. With AM stereo reception, however, each set is tuned slightly off-carrier so that the carrier appears on one side of the IF passband. Thus, almost the entire 5 or 6 kc IF bandwidth of each receiver can be utilized, resulting in a marked improvement in audio fidelity, approaching that of FM.

Classified

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

EQUIPMENT FOR SALE

TV VIDEO MONITORS—8Mc., Metal cabinets starting at $189.00. Never before so much monitor for so little cost. 30 different models, 8" thru 24". Miratel, Inc., 1083 Dionne St., St. Paul, Minn. 2-60 11t

G. E. Limiting Amplifier model BA-5-A with instruction book. $200. KWKW, Pasadena, Calif. 2-60 1t

TEFLON COAXIAL TRANSMISSION LINE 1⅝", 51 ohm. Unused. Suitable for AM, FM, VHF-TV, Communication Systems, and some Microwave frequencies. RETMA flanges. Write: Sacramento Research Labs., 3421-58th Street, Sacramento 20, Calif. 2-60 6t

WANTED

WANTED: TV experienced technician-engineers. First Class FCC license required. Large market TV operation — studio, control, maintenance, transmitter work. Give age, experience, qualifications. Station WVUE-TV, 1418 Cleveland Ave., New Orleans, La. 2-60 1t

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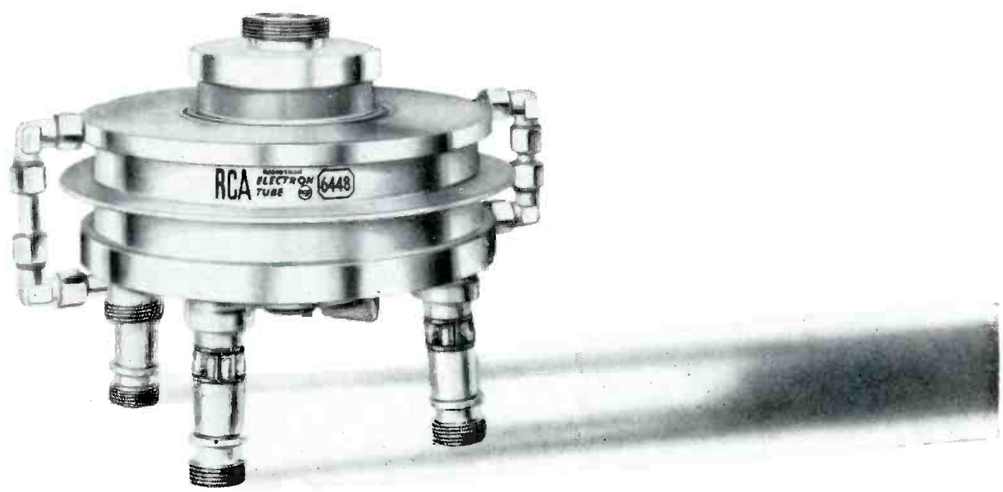
C. E. Smith
WKOW-TV
Madison, Wisconsin

CHIEF ENGINEER'S REPORT ON RCA-6448

12,000 "TROUBLE-FREE" HOURS ON CHANNEL 27... AND NO LET-DOWN IN SIGHT!



Read what Chief Engineer C. E. Smith of WKOW-TV in Madison, Wisconsin, has to say about the RCA-6448 beam power tube:

"One of our RCA-6448's has clocked 12,000 hours of service in our visual power amplifier. Another just passed the 10,500 hour mark in our aural power amplifier. Both tubes are still delivering top performance. Long tube life like this is a big item in keeping transmitter operating expenses down."

Many UHF-TV stations all over the country have discovered that proper care of their RCA-6448's often pays off in *extended service far beyond normal tube life expectancy*. Result: reduced transmitter maintenance and downtime, more hours of service per tube dollar.

Contact your RCA Electron Tube Distributor whenever you need tubes for broadcasting and telecasting operations. He also carries a complete line of high-quality RCA Sound Tape for your convenience.

RADIO CORPORATION OF AMERICA
Electron Tube Division **Harrison, N. J.**

ANOTHER WAY RCA SERVES THE BROADCASTING INDUSTRY THROUGH ELECTRONICS

HOW TO GET MORE HOURS FROM AN RCA-6448

- Use only high-quality water to fill the water system initially and make provision for continuous regeneration of the system water. (A suitable method is given in the RCA-6448 technical bulletin.) Be liberal with water flow through tube ducts.
- Make certain that electronic protective devices are functioning properly.
- "Break-in" new tube in accordance with instructions in the RCA-6448 technical bulletin.
- Raise filament voltage gradually (prevents undue thermal stresses in the filament). Run both filament sections at same voltage—obtained from well-regulated supply.
- Operate filament at lowest voltage practical for adequate emission (not less than 1.25V per section). During standbys of up to 2 hours reduce filament voltage to 80% of normal value. For longer periods, turn off filament power.
- Avoid stresses at ceramic seals—especially when tightening or removing water fittings.
- Operate spare tubes periodically.
- Keep all tube surfaces CLEAN—to avoid leakage and voltage breakdown.