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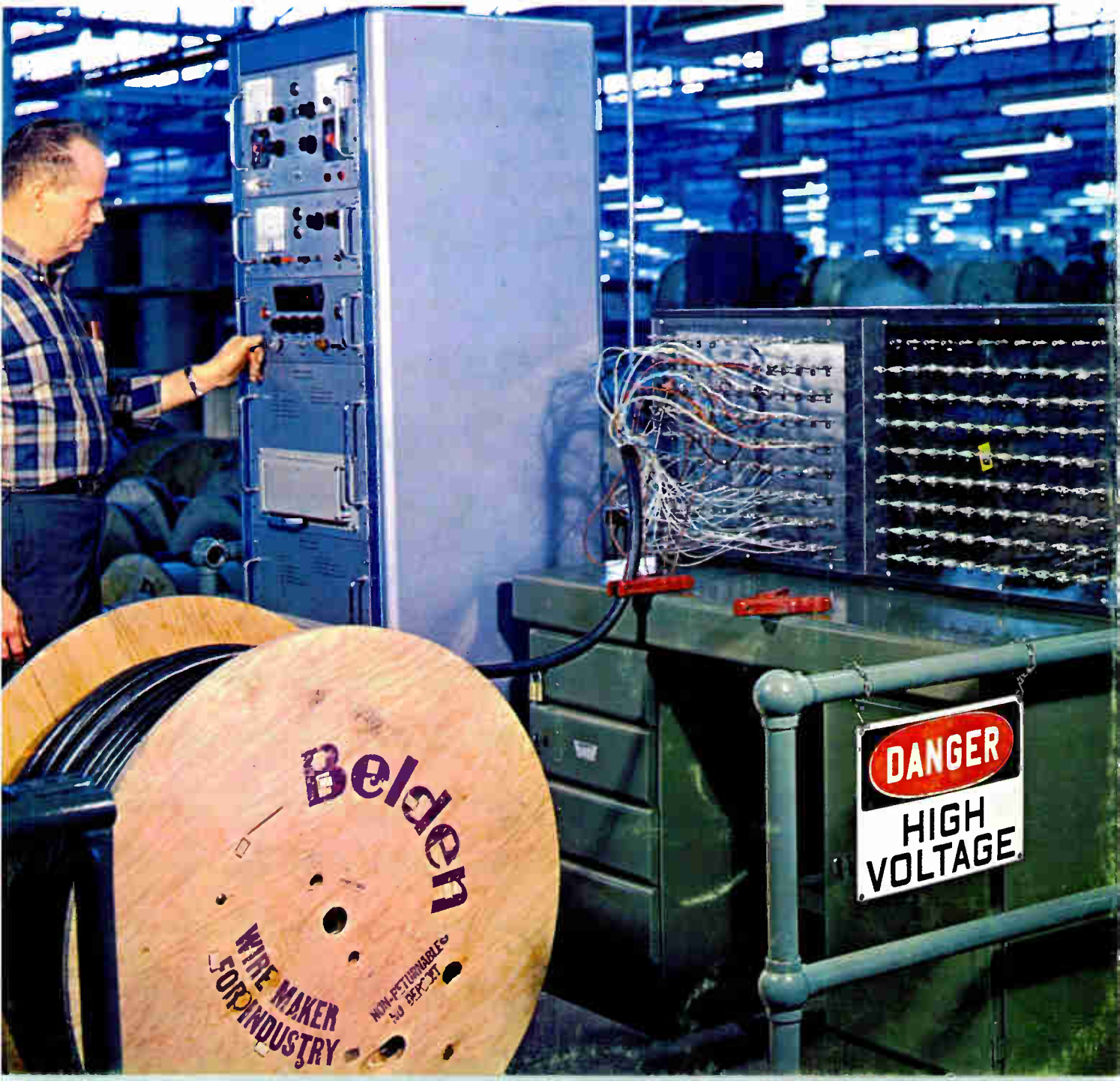
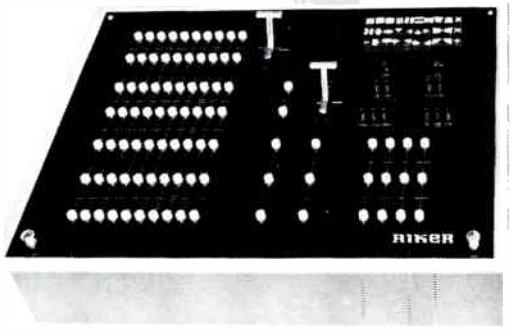
Broadcast Engineering

the technical journal of the broadcast-communications industry



Riker all solid state video switching equipment offers the broadcast industry the most flexible control systems available for selecting or mixing various video sources for transmission on the air. Switching speeds in the nanosecond range assure smooth, invisible transitions. Operating during the vertical interval, Riker switchers eliminate the difficulties inherent in random and relay switching systems. High performance in differential phase, gain and frequency response ensure excellent picture quality.

control



Riker manufactures the finest, most versatile and broadest line of solid state video instrumentation in the broadcast industry. The modular design concept of the equipment lets you build test capabilities as you need them. By adding modules as required, you can develop video analysis, simulation and control equipment exactly tailored to your particular application. It's the up-to-date, economical way to be on the air with the most advanced video equipment without the problems of technological obsolescence. From literally hundreds of different video products manufactured by the company, Riker engineers can help you design the optimum system to meet the most demanding requirements of your station.

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RIKER
PRODUCTS FOR VIDEO ANALYSIS, SIMULATION AND CONTROL

Circle Item 1 on Tech Data Card

ONE COMPANY

in the television broadcast industry offers a complete line of all-transistor instrumentation for video analysis, simulation & control

RIKER

Riker pioneered the development of solid state video test equipment for the continuous analysis of television broadcast signals.

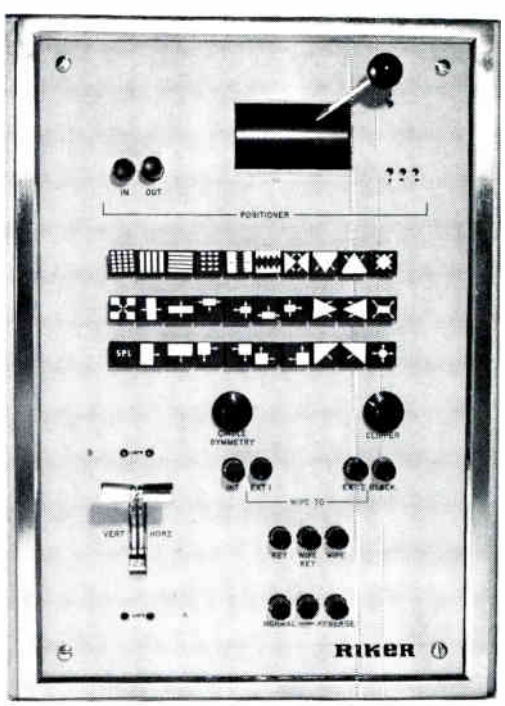
Built to the highest quality standards in the industry, Riker video test generators play a vital role in diagnosing signal quality of television transmission for all major networks and leading TV stations throughout the world.

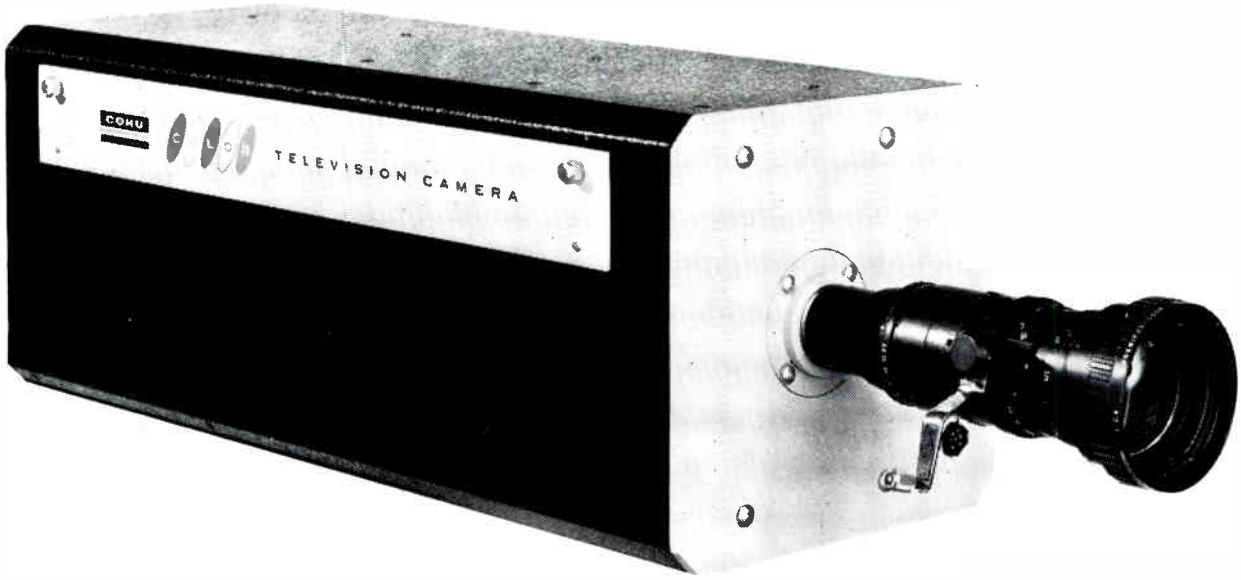
video analysis

Riker video simulation equipment provides the TV studio with a broad range of precision signal sources that generate highly stable pulse waveforms to evaluate and ensure quality video transmission, and to simulate unusual video effects. This product mix encompasses widely diverse instrumentation including such things as Sync Generators, Encoded Color Bar Generators, Chroma Keyers, Black Burst Generators, and Special Effects Generators, which produce electronically, montages, inserts, dissolves, wipes and a multiplicity of other unusual video effects.

Designed with all solid state circuits, these video signal sources provide TV broadcasters with highly accurate and stable equipment that contributes to overall transmission reliability and increases the flexibility of studio programming techniques.

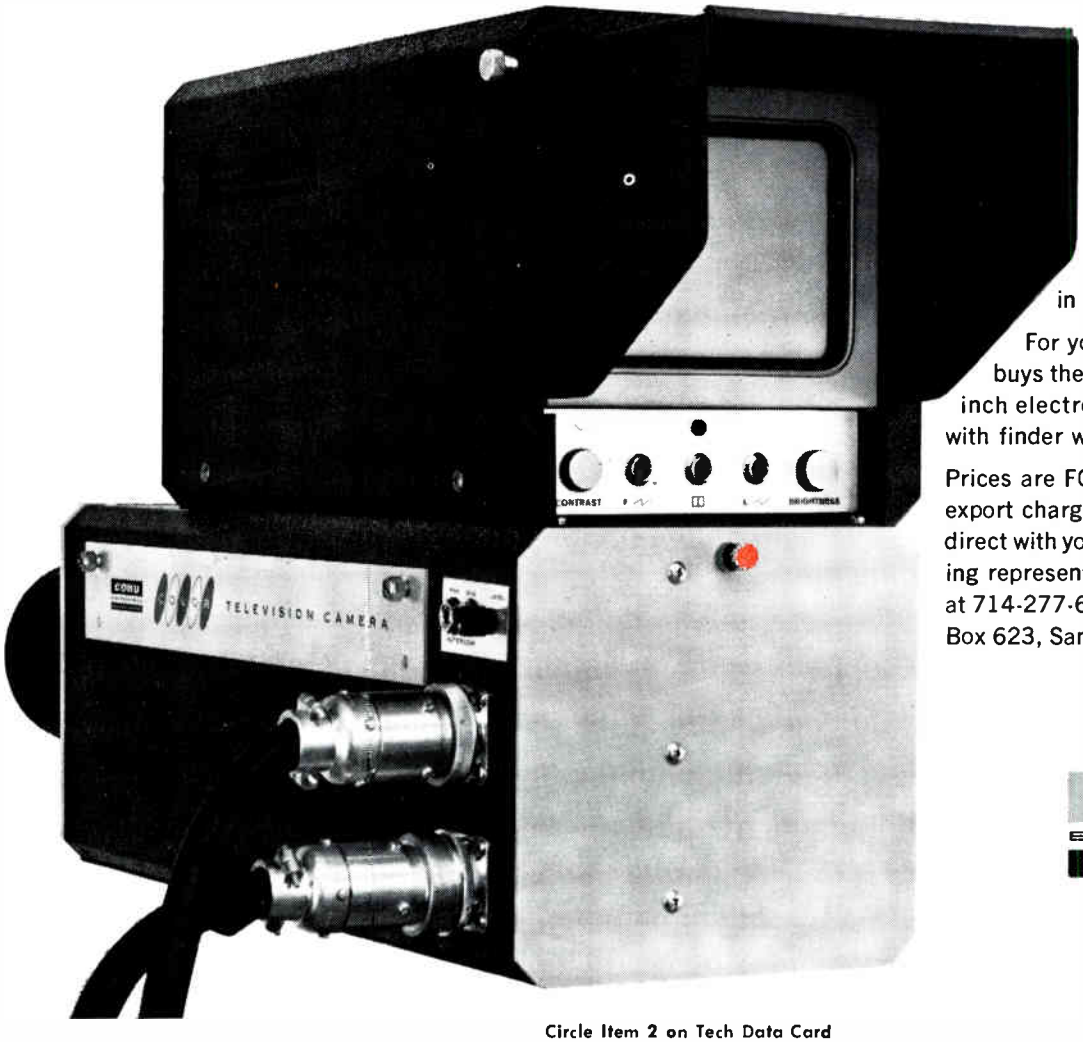
simulation





"Encoded COLOR camera chain for $30,000. But don't hold your breath for delivery...right?"

Wrong! Cohu delivers in 30 days.



You heard us right, friend. $30,000 buys our 1000 Series tri-vidicon camera – complete with solid-state camera control unit and NTSC video encoder. Less lens and cabling, of course. And we do deliver in thirty days.

For your mobile unit, $31,000 buys the same chain with our 6½-inch electronic viewfinder. Camera with finder weighs a mere 58 pounds.

Prices are FOB San Diego. Additional export charge. Place purchase orders direct with your nearest Cohu engineering representative. Or, call Bob Boulio at 714-277-6700.TWX 910-335-1244. Box 623, San Diego, California 92112.

COHU
ELECTRONICS, INC
SAN DIEGO DIVISION

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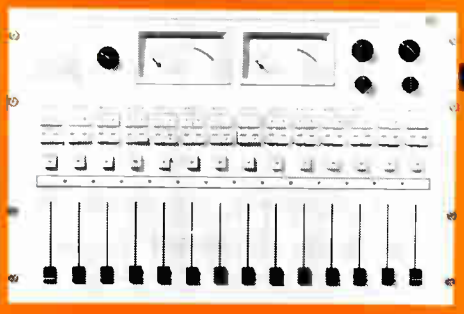
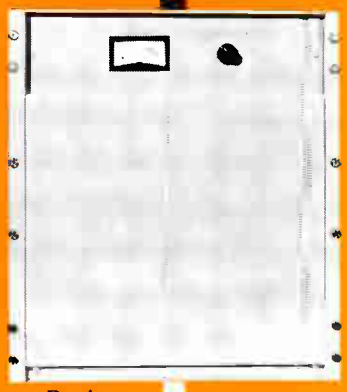


212T-1

212T-2

In 8 out of 10 cases one of these STANDARD consoles will meet CUSTOM console requirements



Rack Assembly

Before ordering a custom installation for your control room, check your requirements against these features of Collins' standard 212T-1 and 212T-2 Audio Control Consoles:

REMOTE CAPABILITY. Rack-mounted assembly containing amplifier cards can be located in an equipment room and linked by cable to the audio control panel in the studio. Sensitive audio wiring is concentrated in a card cage away from interference. Noiseless switching and audio level control are accomplished by photoconductive cells which employ a light beam to isolate control voltages from the audio circuits.

COMPONENT ACCESSIBILITY. Plug-in etched circuit card construction ends time-wasting troubleshooting. Attenuator, input switches, amplifiers, and amplifier output switches are replaced by simply taking one card out of the rack-mounted assembly and plugging in another card.

The 212T Audio Control Consoles consist basically of three units:

CONTROL PANELS. The control panel constitutes the difference between the two systems.

The 212T-1 control panel provides 28 inputs to 14 faders, 2 program output channels, and 2 10-watt monitor speaker outputs. The overall dimensions are 15¾" high by 24" wide.

The 212T-2 control panel has 32 inputs to 16 faders. The panel is divided into two sections: The fader operating controls are mounted on a panel 10½" high by 19" wide; the VU meters and monitoring controls are mounted on a panel 5¼" high by 19" wide.

RACK-MOUNTED ASSEMBLY. The assembly contains 16 preamplifier cards. Quantity and types of cards depend upon individual requirements. The assembly includes three program amplifier cards—one for cue and two for program channels. Two amplifiers are for speaker monitors; two switching cards select monitor inputs. The rack-mounted assemblies for the 212T-1 and 212T-2 are identical.

POWER SUPPLIES. Two power supplies are housed with the rack-mounted assembly. One power supply provides variable illumination for meters and push-button controls. Another provides powering for cards, attenuators, amplifiers, switches, and photoconductive cells.

Most studio audio requirements can be met by adapting the standard 212T-1 or 212T-2 Console through strapping options and minor wiring changes. Expansion and adaptation can be accomplished easily with additional space which the units provide for two extra preamplifier cards, two additional program amplifiers, and two unwired spare card receptacles.

For a copy of a new descriptive brochure on the 212T series, contact Broadcast Marketing, Collins Radio Company, Dallas, Texas 75207. Ph. (214) AD 5-9511.

COMMUNICATION / COMPUTATION / CONTROL

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Circle Item 3 on Tech Data Card

We'll do a month's work for you free!

Just send this page to CBS Laboratories, or call us collect at (203) 327-2000. We will send Audimax and Volumax to your station. If you want to send them home after 30 days, we'll even pay the freight. But if you want to make your station their permanent home, all you do is pay $665 for the Audimax and the same for the Volumax. Add $30 more if you need an FM Volumax.

At the end of that period, chances are you'll be so sold on Audimax and Volumax you will want to buy them.

And you should. After all, they can increase your program power 8 times.

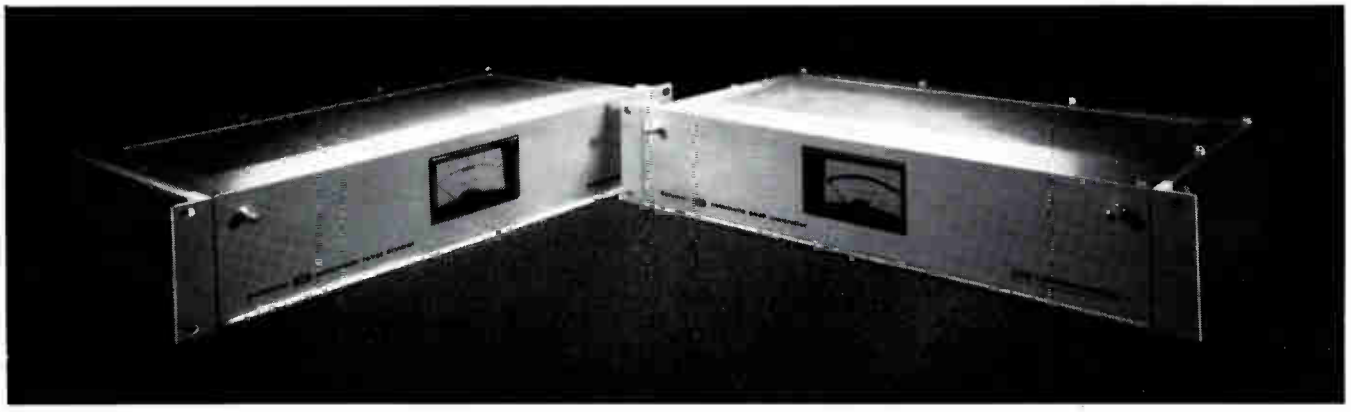
Solid state Audimax is an automatic level control years ahead of the ordinary AGC. By automatically controlling audio levels, it frees engineers, cuts costs, boosts your signal.

Volumax, also solid state, outmodes conventional peak limiters by controlling peaks automatically without side effects. By expanding effective coverage and improving reception, it brings in extra advertising revenue.

We can afford to give Audimax and Volumax away free. Because we know they're so good, most people can't afford to give them back.

PROFESSIONAL PRODUCTS

CBS LABORATORIES
Stamford, Connecticut A Division of Columbia Broadcasting Systems, Inc.



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the technical journal of the broadcast-communications industry

•Broadcast Engineering

Volume 9, No. 4 April, 1967

CONTENTS

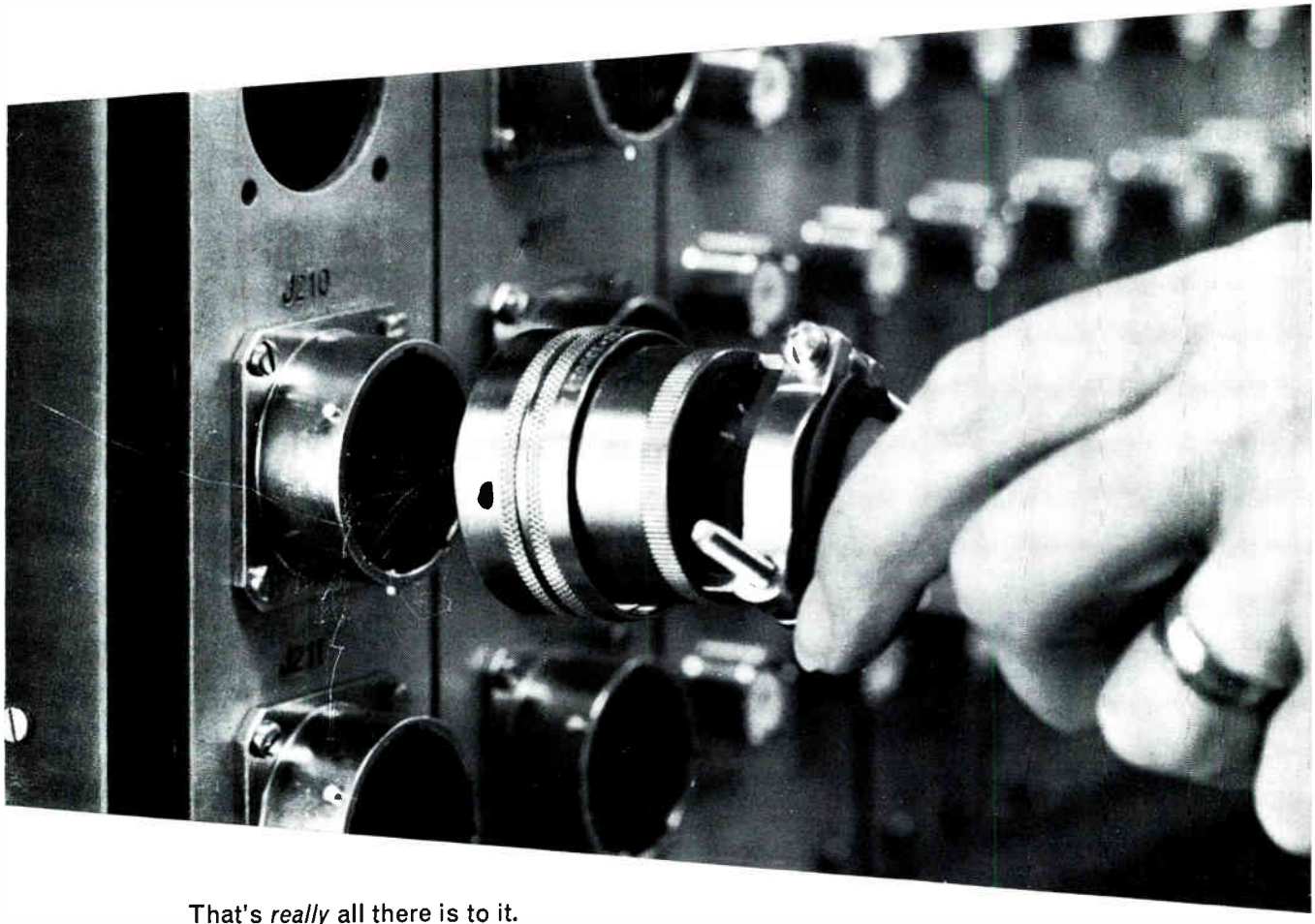
Features

Departments

Most of us are familiar with such products as camera cable after they are installed, but we seldom are aware of the processes involved in making the product. Like most major manufacturers, Belden Manufacturing Co. subjects its products to final tests. In our cover photo, a technician is adjusting an automatic sequential cable tester to perform final tests on a length of color-TV camera cable.

PLUG IT IN – USE IT!

THAT'S HOW EASY IT IS TO INSTALL CDC VIDEO TERMINAL EQUIPMENT



That's *really* all there is to it.
Everything else has been done at the factory.
The equipment was custom designed for you, in consultation with your station engineers. All cabling has been pre-formed. The equipment—or system—was completely checked out at the factory. Result—it starts functioning immediately, as naturally as though it had been there since the first day you went on the air.

You'll find that CDC equipment meets or exceeds the most stringent performance specifications. It's crafted in Canada by men who take pride in their work; sold and serviced in the United States by our own people. Switch to CDC video terminal equipment. Over 40 U.S. stations already have.

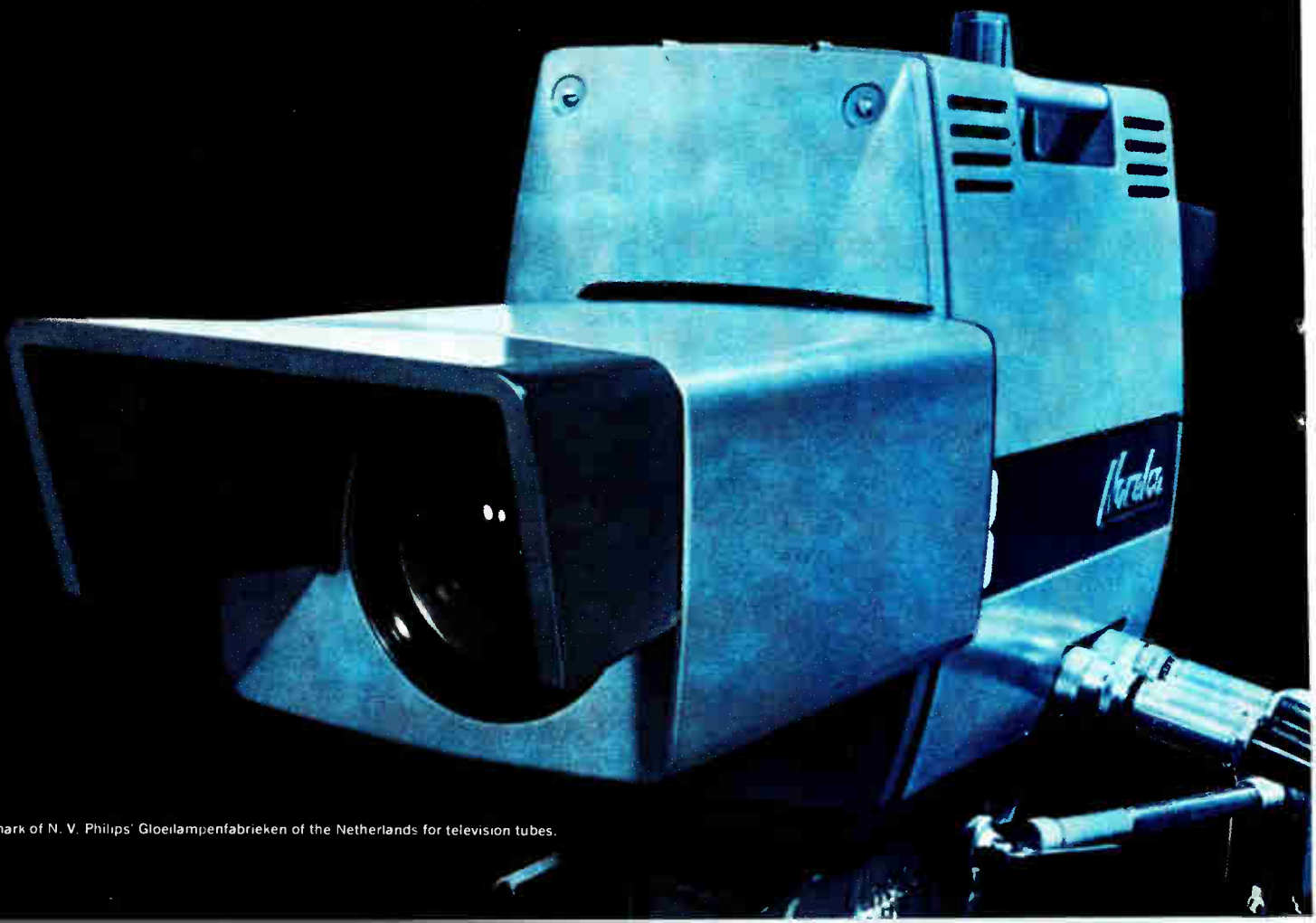
CENTRAL DYNAMICS CORPORATION
HEAD OFFICE: 903 Main St., Cambridge, Mass. 02139

Circle Item 5 on Tech Data Card

Two of the three major networks use Norelco cameras for their prime-time color shows.

If that doesn't convince you to buy a Norelco 3-tube Plumbicon* color camera,

take a trip on us.



*Trademark of N. V. Philips' Gloeilampenfabrieken of the Netherlands for television tubes.

This is an invitation to discover—at our expense—the practical, everyday reasons why you should now be using the new Norelco 3-tube Plumbicon rather than any other color TV camera on the market. Do this. Call, or write us direct. We'll schedule and pay for a trip to a station now using the Norelco 3-tube Plumbicon TV camera—subject to the availability of the station's time and technical personnel. They'll tell you and show you why they chose the new Norelco. You'll see it in program action. You'll learn for yourself—at no cost to yourself—why the Norelco Plumbicon TV camera is used for more programming than all other new generation makes.

Here's a partial list of stations now using the new Norelco

EAST

STATION	LOCATION
WJZ-TV	Baltimore, Md.
WNHC-TV	New Haven, Conn.
WNEW-TV	New York
REEVES SOUND STUDIO	New York
SPORTS NETWORK	Rutherford, New Jersey

SOUTH

WAGA-TV	Atlanta, Ga.
WJBF-TV	Augusta, Ga.
WCYB-TV	Bristol, Virginia/Tenn.
WKRG-TV	Mobile, Ala.
WSPA-TV	Spartanburg, S.C.
WBTV (Remote Unit)	Charlotte, N.C.

MIDWEST

WFIE-TV	Evansville, Indiana
WFRV-TV	Green Bay, Wisconsin
WISH-TV	Indianapolis, Indiana

WEST

KABC-TV	Los Angeles, California
KTTV	Los Angeles, California
KXTV	Sacramento, California
KPIX	San Francisco, California

When you visit one of these stations you'll be able to separate the facts from the fiction regarding color TV cameras. Facts and fiction like this:

FICTION: A 4-tube camera produces a sharper picture than a 3-tube color camera.

FACT: This concept is as obsolete as the 12-cylinder car. The Norelco 3-tube PC-70 Plumbicon Color Camera produces a sharper color and monochrome picture than *any* 4-tube camera. Reason: the first practical application of the unique "contours-out-of-green" principle provides both horizontal *and* vertical aperture correction. The contour signal produced from the green channel, is simply fed to all three channels.

RESULT: A startling increase in color and monochrome sharpness — on the home receiver—plus the same tolerance to misregistration that a fourth tube provides. All with one less tube, less maintenance, minimum operational make-ready time and trouble-free color matching.

FICTION: "Contours-out-of-green" creates an excessive noise problem.

FACT: Absolutely not. But some 4-tube cameras do have a noise problem. Check the "specs." You'll discover that these 4-tube models recommend a fixed gamma of 0.5. We provide continuously variable gamma and recommend an 0.45 operating point. This stretches blacks and gives you more detail in dark areas and shadows. A gamma of 0.5 hides noise by compressing blacks. Result: the 4-tube camera loses dark area detail and literally demands the use of flat lighting.

FICTION: By this time next year Norelco will be selling a four tube camera.

FACT: Definitely not. We made the best possible 4-tube camera but decided not to sell it. While using it to compare 3-tube vs. 4-tube, we discovered what every 4-tube manufacturer has since learned: 4-tube resolution is inherently less than 3-tube; that extra light split to the Y channel reduces the light to the RGB channels, causing noticeable lag. (Try moving a light object against a dark background with a camera using 4 photo conductor pick-up tubes. You'll see what we mean.)

FICTION: The Norelco PC-70 is made in Holland and won't be in full production for years.

FACT: The PC-70 camera is made by Norelco in Mt. Vernon, N. Y., where existing and constantly expanding facilities are meeting the demand for the most economical, easiest to use and maintain, color TV camera available today.

Other reasons to choose the Norelco PC-70:

A simple but remarkable 3-way beam split prism that eliminates the need for shading controls. (Because of their complicated beam split, many 4-tube models require as many as 16 shading controls.)

No magenta cast, a problem even some of the newest 4-tube cameras haven't solved.

Lens interchangeability.

No set-up operating controls in the camera head except for tube-focus and back-focus positions. Eliminates the need for a two-man set-up and for hectic on-the-set adjustments.

Now get all the reasons to choose the Norelco PC-70. Get them from the men behind the camera, Today, call our sales representative, Visual Electronics, or call us directly.

Norelco **STUDIO EQUIPMENT DIVISION**

NORTH AMERICAN PHILIPS COMPANY, INC.
900 South Columbus Avenue, Mount Vernon, New York 10550

Circle Item 6 on Tech Data Card

LETTERS to the editor

DEAR EDITOR:

With reference to my article, "A Low-Cost Stereo Conversion," (March 1967 BROADCAST ENGINEERING, page 82), I thought the following supplementary information might be of interest.

We have since converted one of our tape decks to stereo by using the extra electronics set which we had on hand. The audio switching is a duplication of the arrangement used with the turntables, except that the phase reversal was omitted.

We removed the knobs from the separate level controls on the electronics, locked the shafts in place, and added, on a separate panel, auxiliary ganged pots for record and playback level. These are connected into the amplifiers, in cascade with the original controls, with phone jacks and plugs arranged so that when the plugs going to the external controls are removed, the electronics set may be used by itself. If this arrangement is to be used for recording, it will be necessary to convert one set into a master and the other to a slave; if the two erase-bias oscillators are allowed to run unsynchronized, beats will be produced on the tape. The manufacturer supplied us with the necessary conversion information.

The phase-reversal relays for the turntables have been needed only rarely. If economy is important, they could probably be omitted, although they add only about $15 to the total cost.

The Commission's relatively new ruling requiring a check of pilot-carrier deviation at least once each day is met by using an oscilloscope to compare the pilot-carrier frequency with the frequency of a reference oscillator. This has the extra advantage that the crystal in the reference oscillator serves as a spare for the stereo generator.

We have been quite pleased with the system; since it was installed there have been no difficulties, and our stereo operation has proceeded quite smoothly.

DAVID L. YERZLEY
WVBR,
Ithaca, N.Y.

worried about Plumbicon® tube replacements?

The world's leading color TV camera manufacturers aren't worried. They know that sixty to seventy percent of the color TV cameras sold this year will use the Plumbicon tube. They are building these cameras and selling them with the guaranteed assurance that Plumbicon tube replacements are, and always will be immediately available.

We have franchised the electronics industry's largest industrial distributors to service your Plumbicon tube requirements. These include the very distributors you depend on, day in and day out.

The Amperex electro-optical manufacturing facility in Slatersville, Rhode Island is scheduled for full production this Fall. This new facility, the most advanced of its kind, will further contribute to supplying the growing requirements for the Plumbicon tube, the new standard of the television industry.

Write us today for the name of your nearest authorized Plumbicon tube distributor... and save yourself a lot of needless concern. Amperex Electronic Corporation, Distributor Sales Dept. Hicksville, N. Y. 11802.

Amperex

TOMORROW'S THINKING IN TODAY'S PRODUCTS

Circle Item 8 on Tech Data Card

REMOTE CONTROL FOR A 10-WATT FM STATION

By Charles D. Sears—*

The transmitter location dictated the design of a unique installation for this class of service.

Radio station WBDG is a 10-watt FM station broadcasting from Ben Davis High School, Indianapolis, Indiana. At first glance, the installation of such a station may seem straightforward, but some special problems arose which had to be solved before the station could be put on the air. The floor plan (Fig. 1) reveals that the transmitter is located in a room adjacent to the station but out of sight from the control room. FCC Rules and Regulations require that the transmitter be either next to the operator, or readily accessible and visible from the operating position. Since neither was the case here, authority to operate the transmitter by remote control was necessary; it was applied for, and granted about two weeks later.

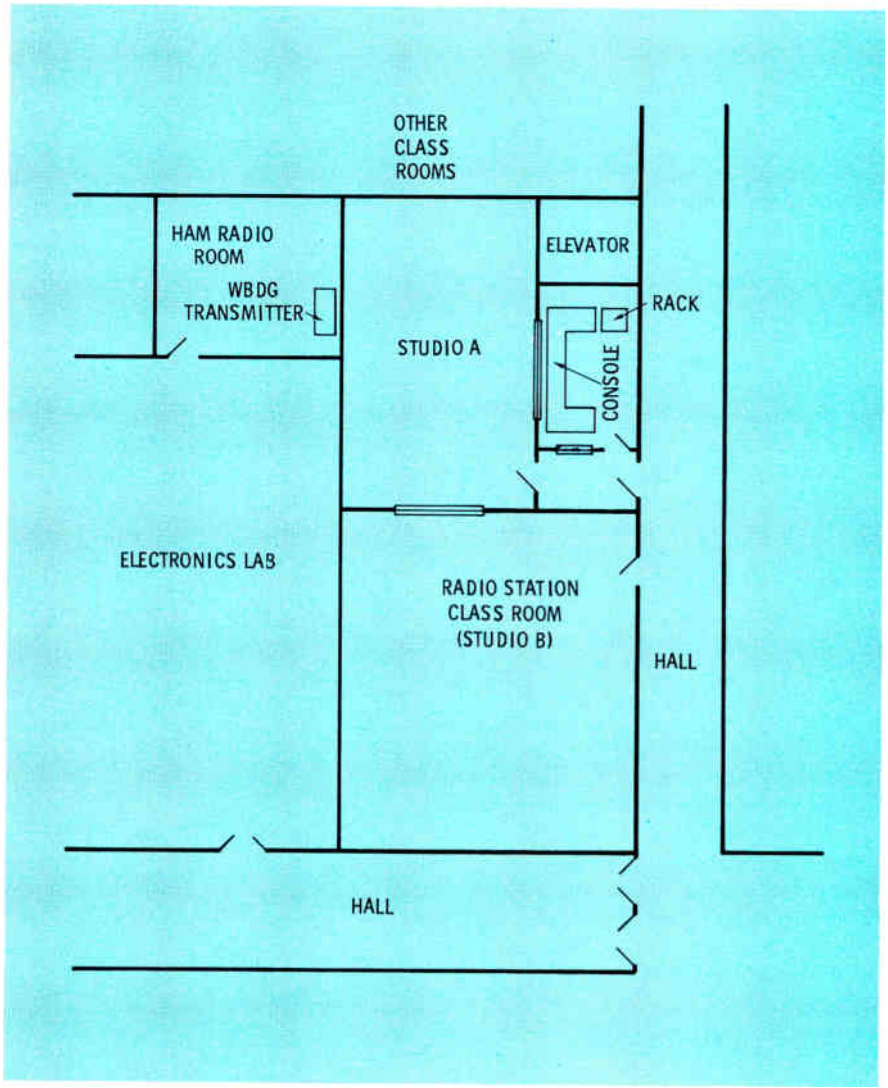


Fig. 1. Layout of school shows location of the remote-controlled transmitter.

Since the transmitter was in the same building as the control point and the budget was hard pressed, it was decided not to use a commercial remote-control unit. A unit, therefore, was designed and built to have full transmitter control with duplication of all necessary and required transmitter controls and meters. With this type of control, the meters read all the time (not just when called up, as in a commercial unit). This is, in a sense, an extension of the local controls.

The FCC does not require a 10-watt station to make meter readings. All that is necessary is that the transmitter be within tolerance. Because the school is teaching the operation of a broadcast station and the students need to be fully informed of requirements, it was deemed desirable to bring full control and metering to the control room. Also, with the meters present, it is easy to tell whether the transmitter is functioning normally.

Control Unit

The meters used were similar to those on the transmitter, but with different movement ranges. An appropriate multiplier was designed for each meter, and each was made adjustable so that the remote meters have ranges similar to the local meters (and can be adjusted for readings identical to those on the local meters). Shown in Figs. 2 and 3 is the meter panel which was installed in the rack next to the operator in the control room.

For this type of installation, the

*Chief Engineer, White River Radio Corp., Indianapolis, Indiana

FCC does not require a modulation meter. If a modulation indicator is not used, however, then a calibrated line VU meter must be installed. The WBDG transmitter is equipped with such an indicator, and the remote duplicate is in the line which feeds the transmitter.

The meter trimmers are accessible from the front of the remote-control panel through small holes. This permits calibration from the front with the meter in view. The holes were made small intentionally so that adjustment by the operators is not easy. Standard large screwdrivers, nail files, etc., cannot reach the controls.

Two runs of four-conductor shielded cable were used. One is for metering, and the other is for control. Because the metering is 320 volts above ground, this cable had to be selected carefully. A cable rated for 600 volts was chosen. The power metering was run with a separate shielded line. Shielded line was used for the program audio line in order to eliminate extraneous pickup.

The remote and local plate-current meters are in series. The 0.5-ohm shunt for the remote meter is installed at the transmitter end of the cable so that only a small amount of current is brought over to the remote meter. This permits the use of a 50-μa meter. The transmitter meter reads 300 ma full scale, so the scale of the remote meter had to be changed. The scale calibrations were not altered, but the numbers were modified to provide a 250-ma full-scale reading. With this arrangement, the calibrations are for the same amount of current per minor division (5 ma) as on the transmitter meter. The normal operating current for an output of 10 watts is 65 ma. The trimmer for this meter is a 10-turn, 2000-ohm unit.

Plate voltage is metered in the normal manner, with full voltage brought to the remote panel. Because of the low current requirement, there is neligible drop in the cable. A 1-megohm multiplier resistor was required. The next lowest standard value was chosen, and a variable control with a value greater than the difference between the required value and the chosen value of the multiplier was selected for the trimmer. A 500-μa meter for plate voltage was used; its scale required no modification for 500 volts full scale.

Remote indication of power is obtained through a separate, shielded cable. The meter movement is 50-μa full scale; its trimmer, a 10,000-ohm, ten-turn potentiometer, can be adjusted to give full-scale indication for approximately 200 μa. The probe in the transmitter is adjusted for a center-scale reading, and the trimmer is set for exactly the same reading as the transmitter meter. Normal reading for 100% output (10 watts) is center scale.

Control voltage is provided by a transformer in the remote panel. The 6.3-volt AC from this source is used for control of a relay in the transmitter AC line. A No. 47 lamp mounted on the panel is connected

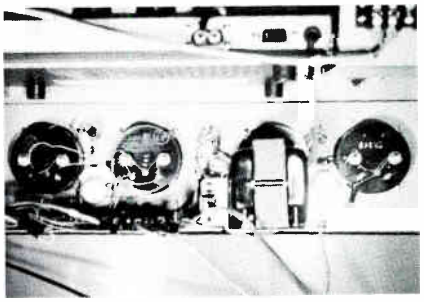


Fig. 2. Rear view of meter panel shows construction of control-room unit.

across the filament circuit of the transmitter, and lights only when the transmitter is turned on.

The meters and associated components are mounted on a standard 5-1/4-inch rack panel. To insure long transformer life, a unit much larger than necessary was selected. The larger-than-necessary transformer also allows for additional circuits that would be needed with a more powerful transmitter.

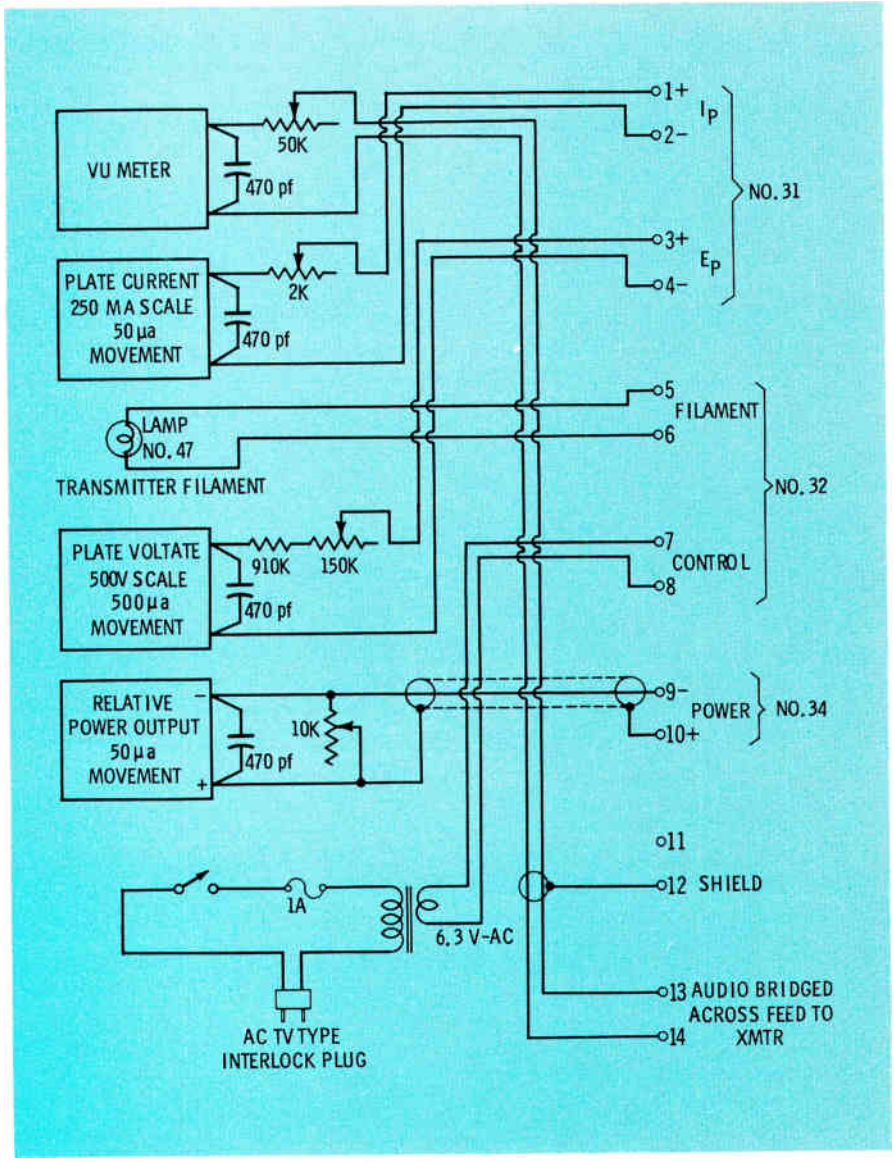


Fig. 3. Rack-mounted remote-control unit shows how meter adjustments are made.

Transmitter Unit

Most of the parts added to the transmitter were mounted on a blank panel provided directly below the exciter. Excepted were the speaker controls (mounted on the front panel), the RF pickup loop, and the ammeter shunt (mounted on the exciter barrier strip).

It is unusual to remote control this type of transmitter, and it was necessary to devise a method to obtain required metering and control. The power control is in the screen circuit of the final tube and is of the screwdriver type. The B+ is well regulated, so there is little variation in power output. Plate voltage in this transmitter comes on as soon as the tubes warm up, an arrangement that is satisfactory at this power level. After careful consideration of these factors, it was determined that remote control of this function was unnecessary.

Two pairs of AC terminals are provided in the transmitter, one for the crystal oven and the other for the remainder of the circuits. The crystal oven requires power at all times. For on-off control of the transmitter, a 6.3-VAC relay is inserted in the transmitter AC line. The relay is controlled from the remote panel. The crystal heater is connected directly to the AC source and remains on so long as the transmitter is plugged in. (See Fig. 4). A bypass switch (called Local-Remote Switch) is provided for the relay so that the transmitter can be controlled locally for maintenance, and in the event of control-unit failure. To keep people from accidently throwing it, the power switch is inside the transmitter cover. This switch must be left on at all times that remote operation is desired.

The plate-voltage metering circuit is connected directly to the final plate supply, on the supply side of the ammeter. The plate ammeter shunt is mounted on an insulator and placed on the barrier strip on the rear of the exciter; the leads are brought out to the external meter. The relative power meter is fed from a probe in the coaxial line. This RF pickup is similar to the one supplied with the transmitter. It is built in a small metal box which must be closed for proper indication. The probe is completely enclosed in the box, the diode extends through a hole, and the capacitor and resistor are mounted on the box.

The transmitter is supplied with the coaxial connector installed so that it projects through the top of the cabinet. This connector was moved inside the transmitter for two reasons: The connector cannot be accidentally disconnected; and the antenna feed goes through a box in the wall below the transmitter, so the line is brought up through

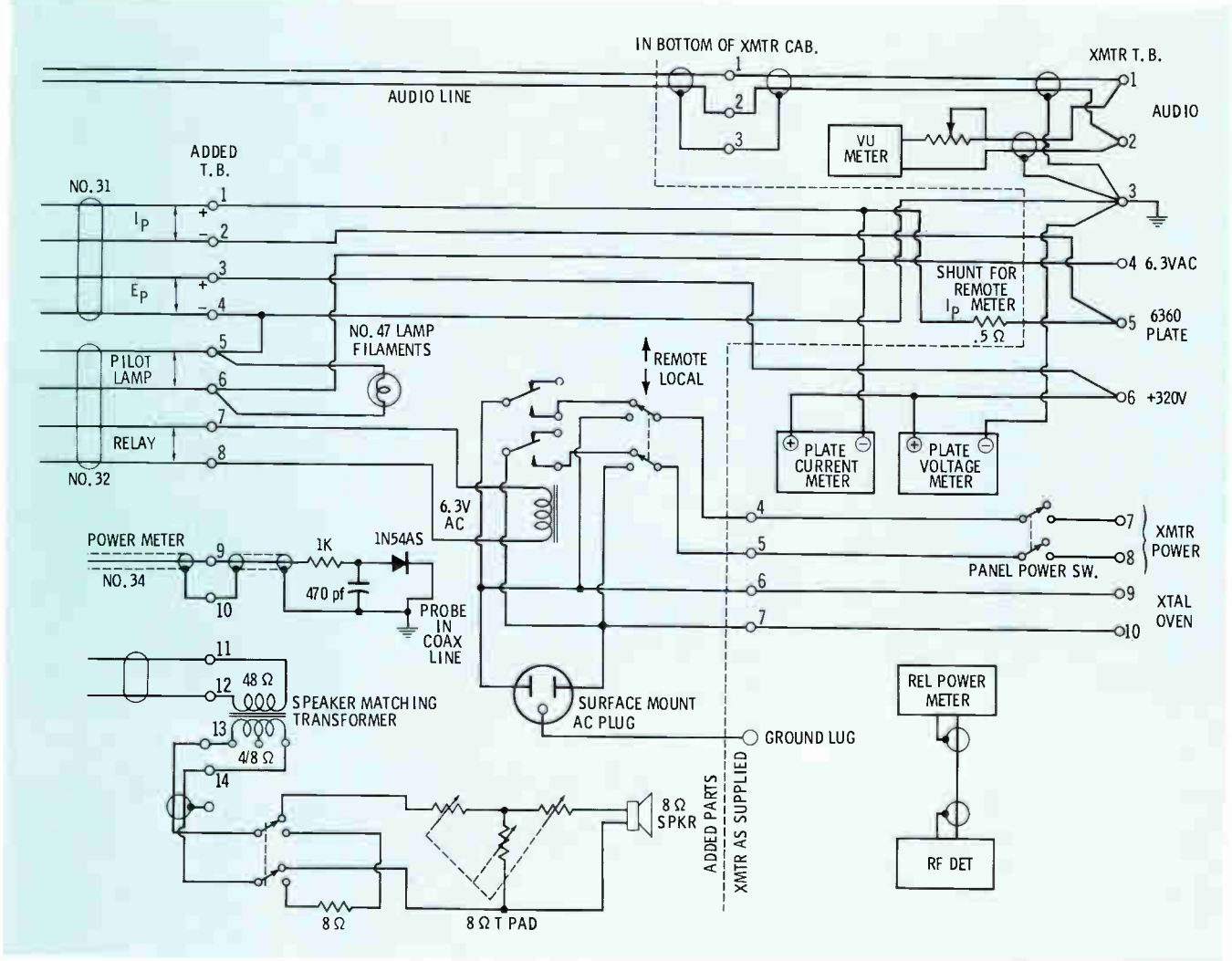


Fig. 4. Transmitter end of the remote-control installation indicates method for obtaining local control of the system.

the bottom. The AC line is permanently connected to a wall outlet. It can easily be disconnected from the transmitter, because an AC plug is mounted inside the rear of the cabinet and a line-type socket is on the end of the cable. This leaves the wall socket hot for test equipment. The next nearest hot outlet cannot be reached without an extension cord. This places the AC connector for the transmitter out of reach. The circuit breaker for this outlet is in another room. This disconnect feature is of value because the normal power input to the transmitter is on a barrier strip and easy to touch. When the plug is disconnected, the only voltage exposed is the 6.3-volt AC that goes to the control relay.

So that the off-the-air signal can be heard at the transmitter, an FM tuner was obtained. An output amplifier and matching transformer were added so that proper level could be obtained at the external monitor input terminals of the console. (See Figs. 3 and 5.) The tuner volume control was disconnected; level to the console is set by the internal control on the added amplifier. A VU meter added to the output of the tuner permits off-the-air modulation to be read. It is connected to the multiplex output of the tuner, which does not have de-emphasis, so that it approximates a regular FM modulation monitor. It has been compared against a commercial monitor and found to be reasonably close. This meter is intended to supplement the calibrated line VU meter, not to take its place.

If it is desired to rebroadcast a local FM station, the tuner can be set to the desired station and patched into a remote input on the console. An external antenna is not provided, so only local stations can be picked up.

Audio

Two turntables are mounted on a horseshoe desk, and a tape deck is mounted in the rack. A cable is provided for an extra tape deck to be placed on the desk when required. In this case, audio is obtained from the tape-deck-amplifier output, which is high impedance, and a plate-to-line transformer is provided in the cable. The console feeds a constant-level amplifier,

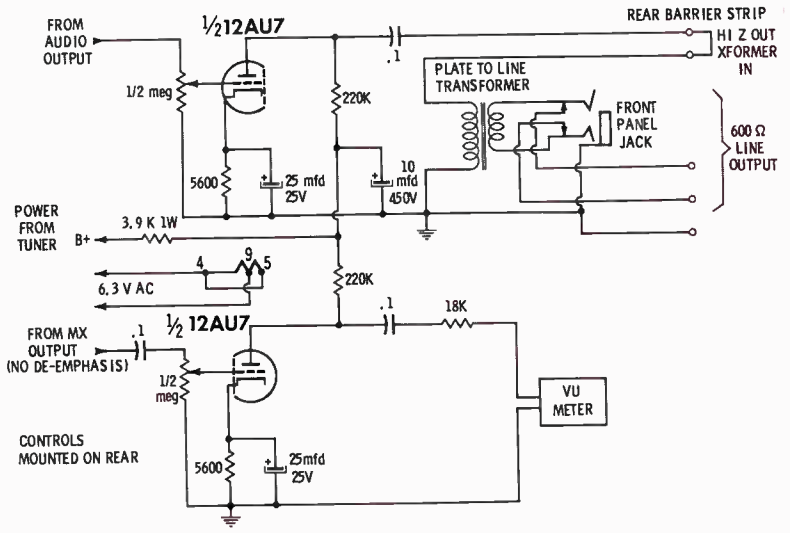


Fig. 5. FM tuner amplifier unit permits rebroadcast of other local programs.

which in turn feeds the transmitter.

There are microphone inputs in locations all over the school. In addition, the building is wired for closed-circuit TV, and the TV camera connectors also provide for a microphone to be plugged in at each camera socket. A cable, which normals to one of the microphone inputs on the console, comes from the patch panel of the main school PA system. Therefore, any microphone socket in the school can be patched through to the station for on-the-air use from almost any place in the school building.

The classroom (Studio B) is provided with microphone inputs so that programs can originate from there if desired. These lines do not normal to the console. Audio facilities of the station are shown in Fig. 6.

Conclusion

Like most 10-watt stations, WBDG is operated entirely by students, under supervision of an instructor who is present whenever the station is on the air. The remote-control system installed at the station permits those responsible for operation of the transmitter to observe its operation. ▲

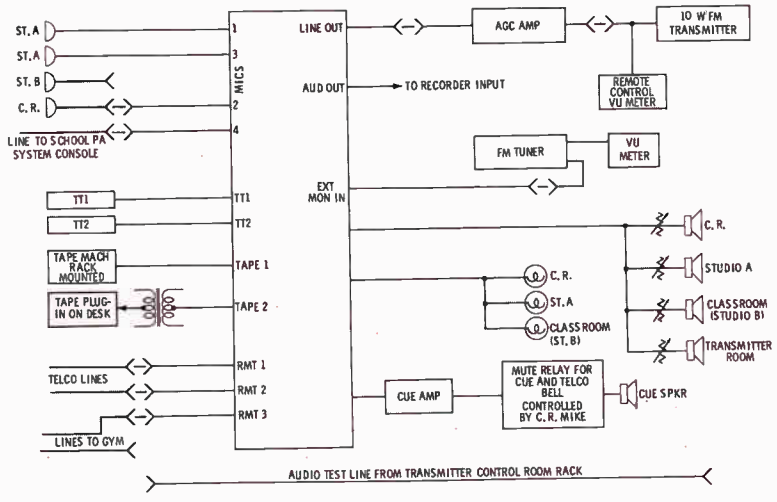


Fig. 6. Audio layout shows how station and school PA system are tied together.

AN AUTOMATICALLY SWITCHED AUDIO GENERATOR

*by A. Molchanovsky**—
This unit can add convenience to audio frequency-response measurements.

A need arose at the Israeli Broadcasting Authority for some means of making a quick and accurate check on gain and frequency response of audio chains, such as from a microphone input of a control desk to a recorded tape. Such a check before starting a studio recording would reveal immediately dirty recording heads, faulty control-desk channel units, incorrectly set filters, etc. The test should be simple, quick, and automatic, with the recording technician being required only to observe the final result.

To meet these requirements, it was decided to design an audio oscillator which performs the following functions:

1. The oscillator should be able to generate test frequencies of 30 Hz, 50 Hz, 200 Hz, 1 kHz, 3 kHz, 5 kHz, 10 kHz, 12 kHz, and 15 kHz. These frequencies were chosen because they are the standard check frequencies used by the maintenance technicians in our studios.
2. The oscillator should go through these frequencies automatically, holding each frequency for an interval of 1, 3, or 5 seconds as preset by the interval-timing switch.
3. An indicator lamp on the oscillator front panel should indicate the frequency being generated.
4. The output level of the oscillator should be constant for all test frequencies.
5. It should also be possible to generate any of the nine test frequencies by dialing a number from 1 to 9. The frequency of the oscillator should then remain unchanged until "0" is dialed.
6. The automatic change of frequency should be accomplished without clicks.
7. In order to make the unit as trouble-free as possible, all the switching should be done electronically without mechanical relays, rotary selectors, etc.
8. The unit should be completely transistorized.

*Development Engineer,
Israeli Broadcasting Authority

General Description

Of several approaches that were tried, the following was found most simple and foolproof. As shown in the block diagram of Fig. 1, a pulse generator supplies sharp positive pulses at intervals controlled by potentiometer R. These pulses feed a ring counter consisting of nine thyristors (silicon controlled rectifiers). At the beginning of the sequence, all the thyristors are nonconducting. The first pulse turns the first thyristor on, and pilot lamp M1 is lighted. The voltage that now appears across the pilot lamp is used as the DC supply for the first oscillator (30 Hz), and so a 30-Hz signal is fed to the mixing bar.

The second pulse from the pulse generator turns the second thyristor on, and the first one goes off. Now lamp M2 lights and the second oscillator (50 Hz) starts, and the 50-Hz signal is fed to the mixing bar. This process continues until the ninth thyristor is turned on. The next pulse turns the first thyristor on and the ninth off, and the complete sequence of tones is generated again. The connection of the dial to the circuit will be described later.

The Pulse Generator

A simple way to generate pulses is by using a unijunction-transistor sawtooth generator. The circuit, shown in Fig. 2, operates as follows: Capacitor C1 charges through resistor R1, and the voltage at point E (the emitter of the unijunction transistor) rises. When this voltage reaches a certain value, the junction becomes forward biased, and the transistor conducts heavily, discharging C1 and producing a sharp positive voltage pulse across R5. The interval between pulses depends on the time taken by C1 to charge to the firing voltage, and so can be controlled by changing the value of R1. Resistor R4 is used for temperature compensation.

The Thyristor Ring Counter

A thyristor is a silicon diode which does not conduct until a positive pulse is applied to its "gate" electrode. From that moment, the diode conducts, and the only way to make it become nonconducting again is to remove the supply voltage. Suppose thyristor X1 in Fig. 3 is conducting. Lamp M1 is lighted, and the anode of X1 (point A1) is at negative potential, since a conducting diode acts as a very low resistance. Thus diode D1 has its cathode at negative potential, and a positive pulse on the anode will cause conduction of D1. Since X2 to X9 are not conducting, their anodes, and consequently the cathodes of diodes D2 to D9, are at the full positive potential of 12 volts. Therefore a positive pulse of 5 volts appearing at point P finds only diode D1 open and so reaches the gate of X2. The pulse causes X2 to start conducting;

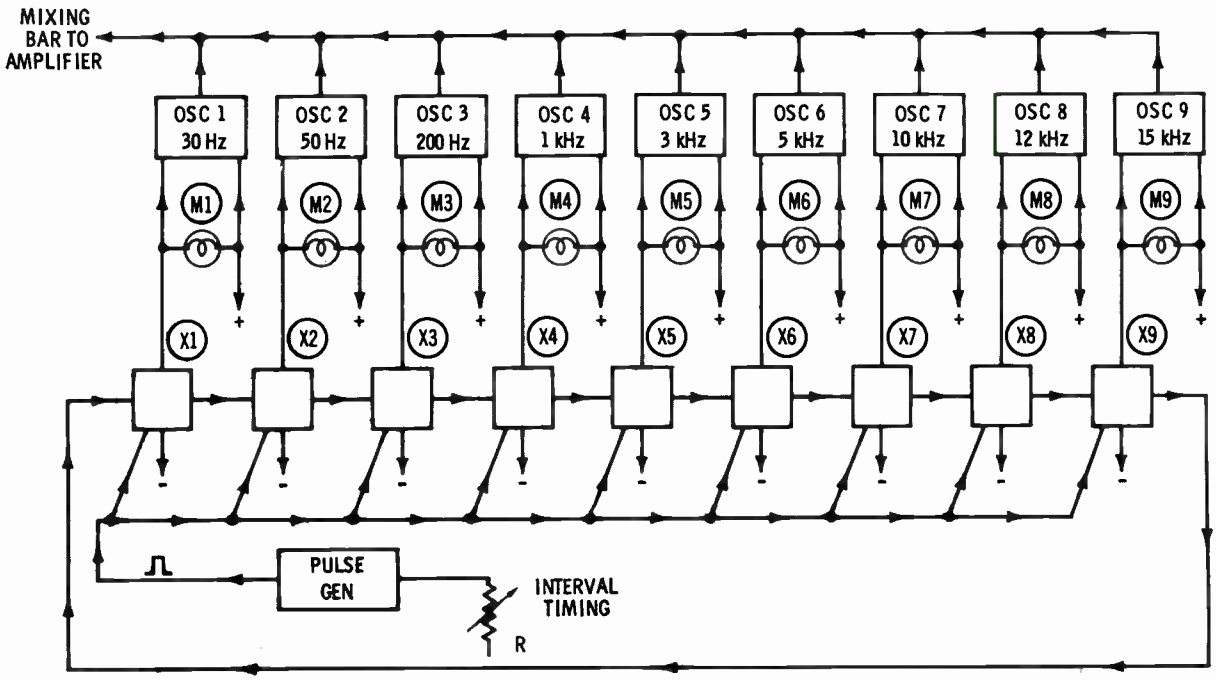


Fig. 1. Block diagram shows use of thyristors in a ring counter to operate the audio tone generators in sequence.

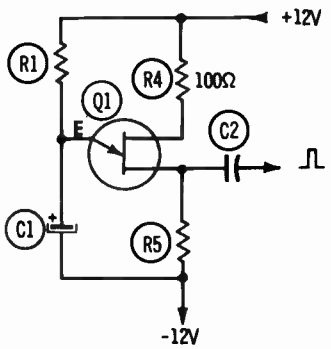
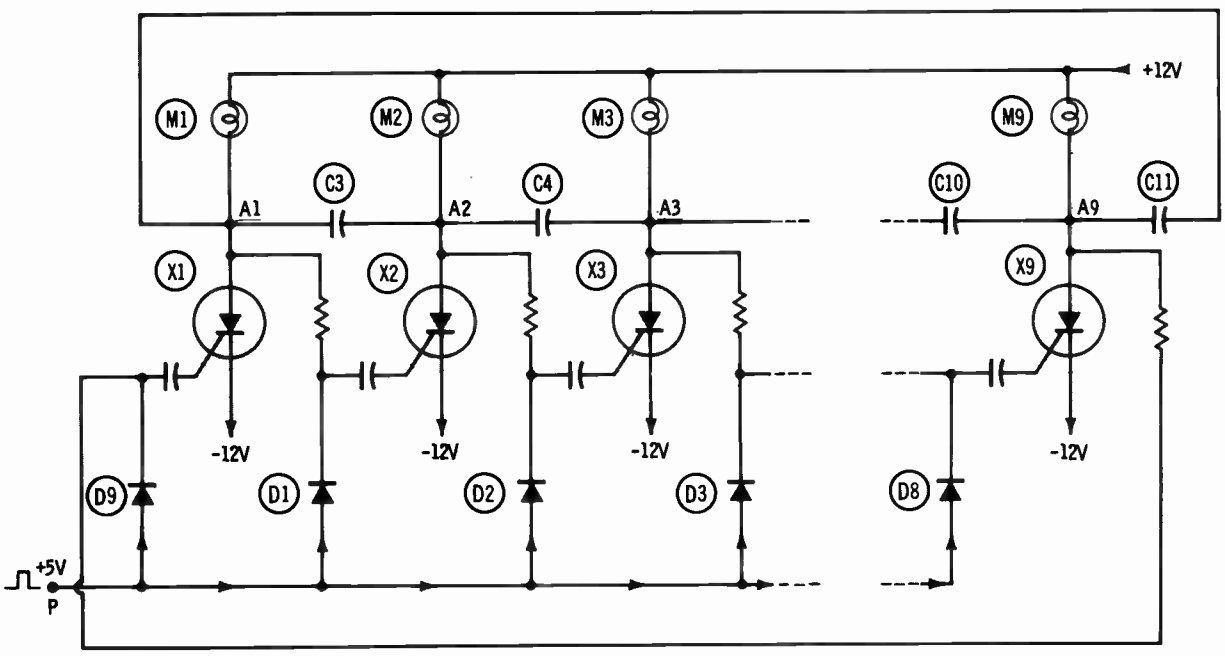


Fig. 2. Unijunction-transistor sawtooth oscillator generates timing pulses for control of ring-counter sequence.

Fig. 3. Partial schematic shows how stages of counter fire in sequence.



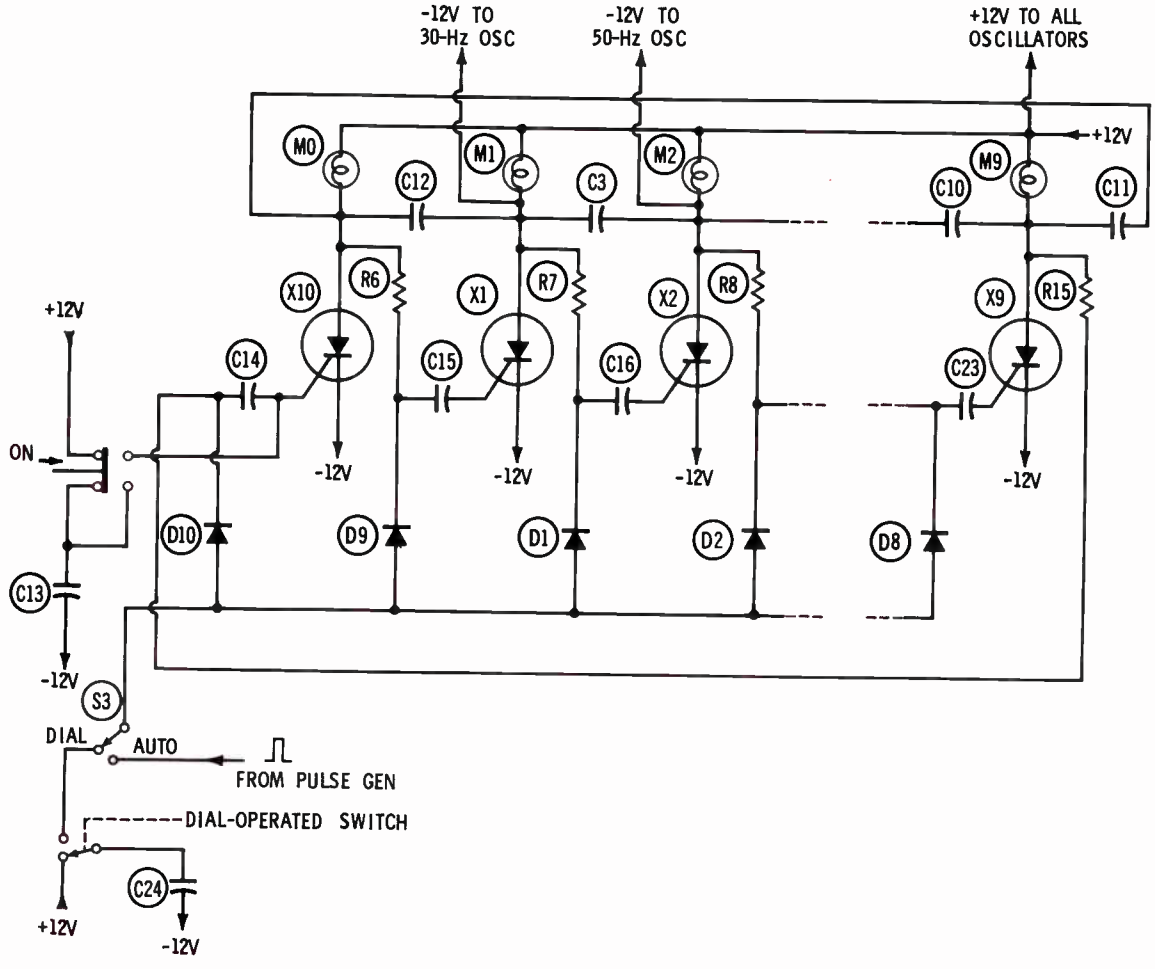
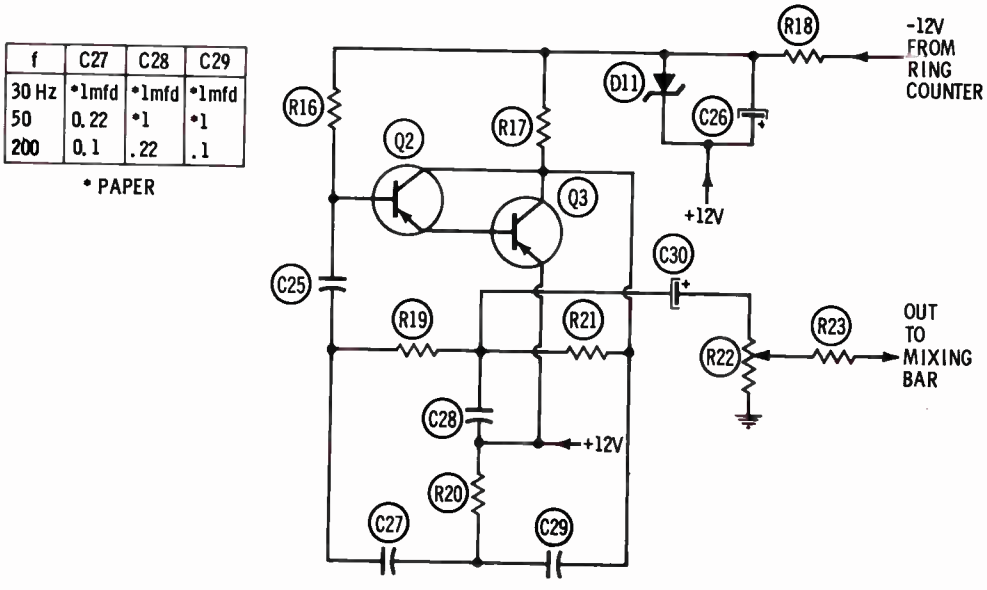


FIG. 4

Fig. 4. Schematic of ring counter with added thyristor stage and switch for placing circuit in readiness for pulses.



f	C27	C28	C29
30 Hz	*1mfd	*1mfd	*1mfd
50	0.22	*1	*1
200	0.1	.22	.1

* PAPER

Fig. 5. "Twin-tee" oscillator circuit with two transistors in Darlington connection is used for lower frequencies.

lamp M2 lights, and point A2 goes to ground through X2.

Now consider capacitor C3. Before the firing of X2, point A1 was at −12 volts and point A2 was at +12 volts. Therefore, C3 was charged to 12 volts, with the positive side at A2. As X2 fires, point A2 goes to −12 volts, and C3 is effectively across X1 with the negative side connected to A1 and the positive side through X2 to the cathode of X1. This places a negative voltage on the anode of X1 and cuts it off.

As the next pulse arrives, X3 goes into conduction and the charge on C4 causes X2 to go off. In this way, each pulse causes the lighted lamp to go off and the next lamp to go on. Since the anode of X9 is connected to the anode of X1 through C11, the process does not end as long as positive pulses continue to arrive. This is the reason the circuit is called a "ring" counter.

There remains the problem of starting this chain action. The preceding description started from the moment X1 was in conduction. However, the first thyristor cannot be turned on by the positive pulses, since at the beginning no thyristor conducts and therefore all the diodes D1 to D9 have their cathodes at +12 volts. The positive pulses cannot reach any of the gates, and all thyristors remain nonconducting.

To overcome this difficulty, a starting circuit including thyristor X10 is added (Fig. 4). This thyristor can be fired either by the positive pulses, if D10 is conducting, or by pressing the ON push-button and thus bypassing D10.

Now consider the complete circuit, as it appears in Fig. 4, before operation starts. Switch S3 (AUTOMATIC-DIAL) is in "Dial" position, and all the thyristors are nonconducting. Capacitor C13 is charged positively. Pressing the ON push-button causes C13 to discharge through the gate anode of X10, making it become conductive. This lights the pilot lamp labeled "0" to which no oscillator is connected. The circuit rests in this position and is ready to start going through the frequencies the moment switch S3 is placed in the "Automatic" position and pulses start arriving.

Since X10 is included in the chain but does not cause any frequency to be generated, there is now a time interval between the last frequency in the chain (15 kHz) and the first one (30 Hz). This was found to be advantageous since it clearly marks the end of the frequency run.

The Oscillators

Any oscillator circuit could be used provided its amplitude and frequency are stable and it is operated from a 10-volt supply. For the lowest frequencies (30, 50, and 200 Hz), a twin-tee oscillator circuit (Fig. 5) was chosen. Two transistors are used (Darlington connection) for more positive oscillation so that selection of transistors is not necessary. The higher frequencies are generated by Colpitts oscillators (Fig. 6).

The DC supply for each oscillator comes from its associated pilot lamp and is regulated by a 10-volt zener diode. The networks R18-C26 and R29-C34 eliminate clicks, since the voltage builds up gradually. However, the time constant is short enough that this effect is not noticeable.

The outputs of all the oscillators are mixed through potentiometers, thus making it possible to set all the outputs at exactly the same level. At the output of the mixing bar, any amplifier can be used provided its input impedance is not less than 10,000 ohms so as not to load the oscillators excessively.

The Dial Circuit

Consider again the circuit in Fig. 4. Suppose the ON push-button has been operated and X10 is conduct-

f	C31	C32	C33
1K	*2mfd	*2mfd	.1mfd
3K	0.12	*1	.01
5K	0.066	0.1	.01
10K	0.02	0.03	.01
12K	0.02	0.02	.01
15K	0.01	0.01	.01

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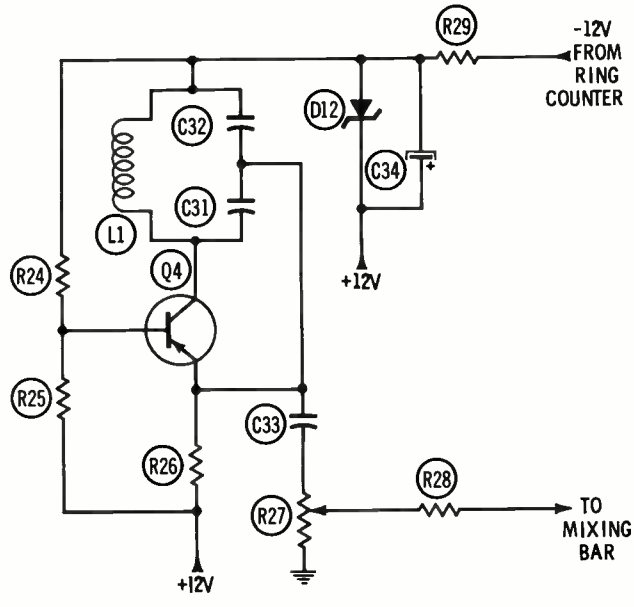


Fig. 6. Colpitts oscillator configuration with single transistor is employed to generate the higher test frequencies.

ing. Now it is desired to generate the frequency of 1 kHz (for example) by dialing number 4 (fourth oscillator). It is necessary to supply 4 positive pulses through S3. This is done by the dial contacts, which charge the 600-pf capacitor and then discharge it through S3 as many times as the number dialed.

The only remaining problem is to "clear" the counter when a new number is being dialed. For instance, if the 200-Hz frequency (number 3) is dialed after the 1-kHz frequency (number 4), the 3 positive pulses would advance the count to 7, and the frequency of 10 kHz would be generated. Therefore, it is necessary to return to "0" before the positive pulses start. This is done automatically by a switch added to the dial mechanism, as shown in Figs. 7 and 8. This switch performs two functions. When the dial is turned clockwise at the beginning of dialing, the switch is operated, and the supply to the ring counter is cut off, thus making all the thyristors nonconducting and so clearing the count. At the same time, C24 is charged to 12 volts. As soon as the finger is lifted from the dial and it starts turning counterclockwise, the switch returns to its rest position, and C24 fires the "0" thyristor (X10) just as the ON push-button does. Now the positive pulses which start arriving from the turning dial can operate the counter.

Conclusion

An overall diagram of the audio oscillator, including the power supply, is shown in Fig 9. The chassis layout is completely noncritical, except that transistors Q5 and Q6 should be mounted so that the chassis serves as a heat sink. A photograph of the original unit is shown in Fig. 10.

The audio oscillator described here should provide the builder with a convenient and useful piece of test equipment. In addition, the ideas behind these circuits can be put to use in many applications where automatic electronic switching is preferred to the usual mechanical methods. ▲

For Parts List, Turn to page 22.

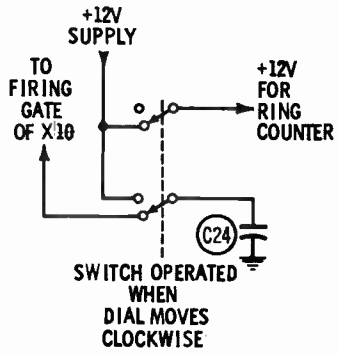
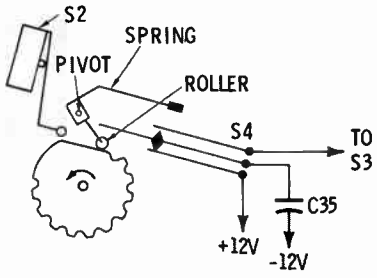


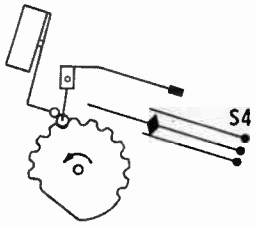
Fig. 7. Switch added to dial resets counter each time number is dialed.

Fig. 8. Mechanical action of dial reset switch shown in sequence of four steps.



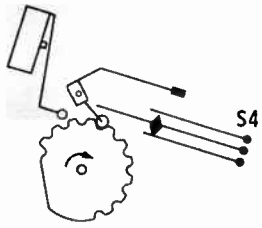
(A)

Normal resting position. This is part of the mechanism behind the dial. The switch is in normal (off) position. The toothwheel rotates together with the dial.



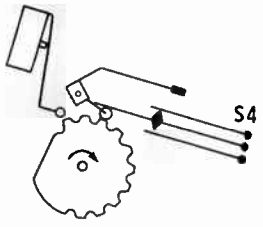
(B)

No. 4 is dialed. As the finger turns the dial, the first tooth takes the roller to the left, and the roller arm actuates the switch. The roller remains in this position until the finger reaches the stop. In this position, the roller is behind the fourth tooth, and the switch is still operated. The ring counter becomes cleared.



(C)

The finger is lifted and the dial starts returning to its rest position. The roller is taken back by the tooth-wheel, which is now turning clockwise. The switch is disengaged and returns to "off" position. As yet switch S4 is not operated and no voltage pulses are generated.



(D)

The wheel continues turning clockwise, and now each tooth lifts the roller and so operates S4. Four voltage pulses are generated.

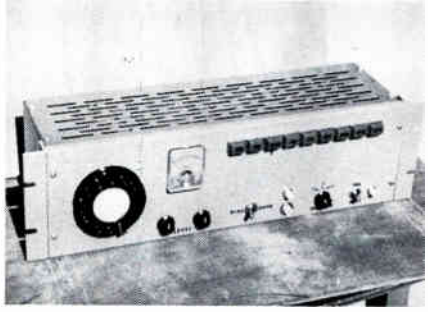
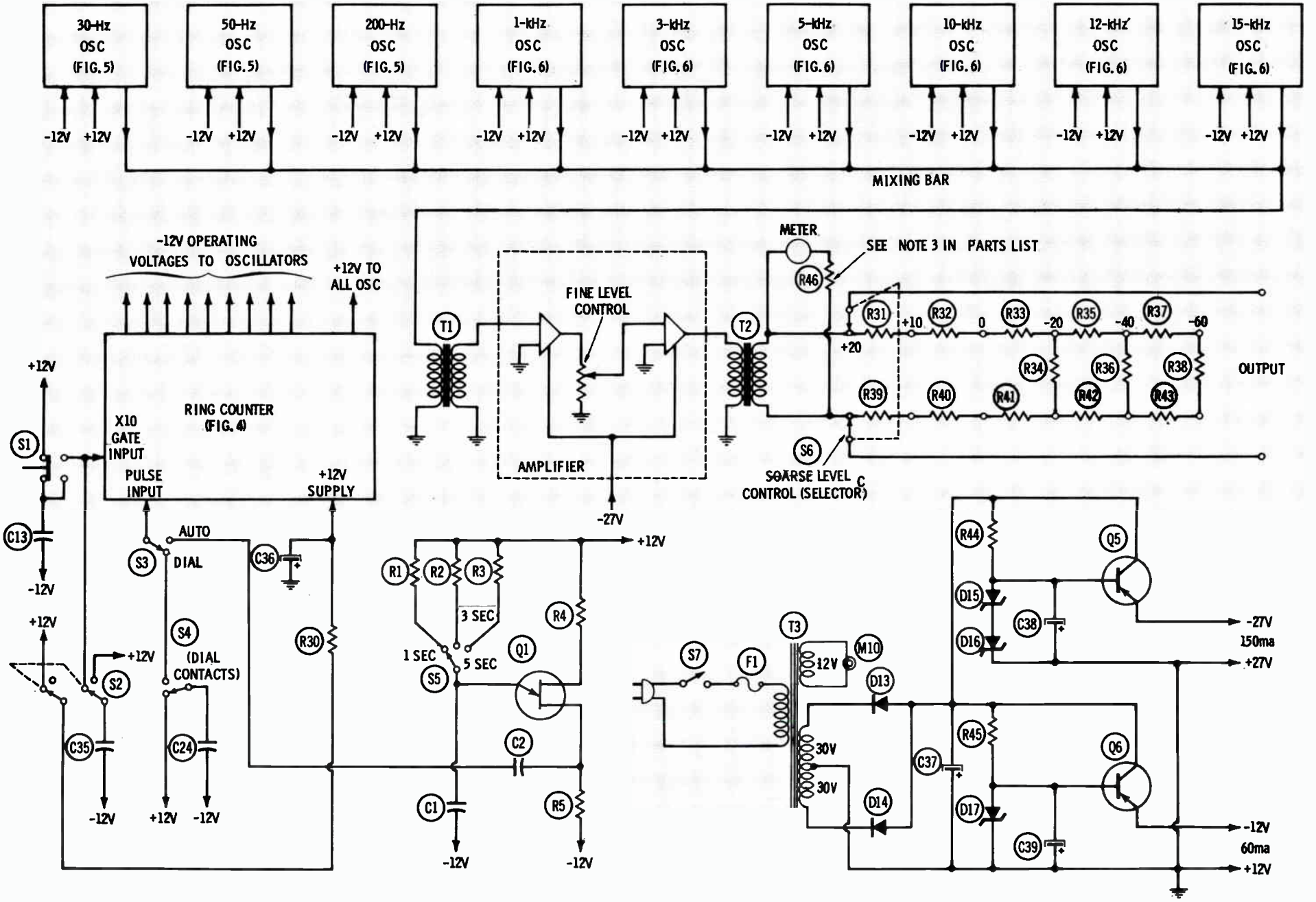


Fig. 9. Diagram at right shows overall design of automatic audio generator.

Fig. 10. View of completed audio oscillator as it was built by the author.


30-Hz OSC (FIG. 5)
50-Hz OSC (FIG. 5)
200-Hz OSC (FIG. 5)
1-kHz OSC (FIG. 6)
3-kHz OSC (FIG. 6)
5-kHz OSC (FIG. 6)
10-kHz OSC (FIG. 6)
12-kHz OSC (FIG. 6)
15-kHz OSC (FIG. 6)
-12V
+12V
MIXING BAR
-12V OPERATING VOLTAGES TO OSCILLATORS
+12V TO ALL OSC
METER
SEE NOTE 3 IN PARTS LIST
R46
FINE LEVEL CONTROL
T1
T2
R31
R32
R33
R35
R37
+10
0
-20
-40
-60
+20
R34
R36
R38
R39
R40
R41
R42
R43
OUTPUT
S6
SOARSE LEVEL CONTROL (SELECTOR)
AMPLIFIER
-27V
RING COUNTER (FIG. 4)
X10 GATE INPUT
PULSE INPUT
+12V SUPPLY
S1
C13
S3
AUTO
DIAL
C36
R30
S4
(DIAL CONTACTS)
S2
C35
C24
R1
R2
R3
3 SEC
1 SEC
5 SEC
S5
Q1
R4
C2
C1
R5
S7
F1
T3
12V
M10
D13
30V
30V
D14
C37
R44
Q5
D15
D16
C38
-27V
150ma
+27V
R45
Q6
D17
C39
-12V
60ma
+12V

PARTS LIST FOR AUTOMATICALLY SWITCHED AUDIO GENERATOR

R1	100K	R32, 40	39Ω
R2	220K	R33, 35, 37, 41, 42, 43	15Ω
R3	330K	R34	4Ω
R4	100Ω	R36, 38	3.3Ω
R5	20Ω	R44	2.2K
R6-15, 23, 25, 28	10K	R46	(NOTE 3)
R16	100K (NOTE 1)	C1	32 mfd, 16 V
R17	1K	C2, 13-23	.001 mfd
R18	200Ω	C3-12	.47 mfd
R19, 21	15K	C24, 35	600 pf
R20	1K (NOTE 2)	C25	.1 mfd
R22, 27	25K trimmer potentiometer	C26	100 mfd, 16 V
		C27, 28, 29	See Fig. 5
R24	33K	C30, 34	10 mfd, 16 V
R26, 45	4.7K	C31, 32, 33	See Fig. 6
R29	330Ω	C36	125 mfd, 16 V
R30	10Ω	C37, 38	1000mfd, 50 V
R31, 39	120Ω	C39	1000mfd, 25 V

Q1	Unijunction transistor, 2N2647
Q2, 3, 4	Silicon PNP transistors, 2N2927 (NOTE 4)
Q5, 6	Transistors, 2N555
D1-10	Diodes, 1N898
D11, 12	10-V zener diodes, 1N1523
D13, 14	Rectifier diodes, 1N1096
D15, 17	12-V zener diodes, 1N1524
D16	15-V zener diode, 1N1525
X1-10	Thyristors, 2N1595A
S1	Two-pole changeover nonlocking pushbutton
S2	DPDT miniature switch
S3	SPDT switch
S5	Single-pole, three-position switch
S6	Two-pole, six-position switch
S7	SPST switch
M0-10	12-V, 50-ma pilot lamps
L1	25-mh coil
F1	0.5-amp fuse
T1	1:1 isolation transformer
T2	Output transformer suitable for amplifier
T3	Power transformer: 60 V, C.T., 250 ma; 12 V, 50 ma
Meter	AC meter with dB scale
Amplifier	Any transistor amplifier capable of delivering +20 dBm into 300 ohms and having gain of at least 50 dB

NOTES:

1. This value can be changed slightly to obtain optimum oscillation level and waveform.
2. By changing this value slightly, the oscillator frequency can be adjusted.
3. This resistance value depends on the sensitivity of the meter used. Choose a value which gives a reading of 0 dB on the meter when the output from the amplifier is +20 dBm.
4. Transistor type not critical. Almost any PNP transistor, silicon or germanium, may be used. Silicon was chosen for better stability.
5. All resistors are ½-watt.

NORTH AMERICAN REGIONAL BROADCASTING AGREEMENT

Editor's Note: Use of the standard broadcast band in the North American region is regulated by this treaty among Canada, Cuba, the Dominican Republic, the United Kingdom (Bahama Islands and Jamaica), and the United States. (For the separate treaty between Mexico and the United States, see BROADCAST ENGINEERING, July 1966, page 21.) The North American Regional Broadcasting Agreement (1950) was signed in 1950 and ratified by the United States Senate in 1960.

The portions of the NARBA text that follow are reproduced verbatim. Annex 1, dealing with relations between governments, and Annex 3, the initial station assignment list, have been omitted. For convenience, several of the figures contained in the NARBA have been included in simplified form; others have been included by reference only.

PART I
PURPOSE AND SCOPE OF AGREEMENT

1. *Purpose of Agreement*
   The purpose of this Agreement is to establish fair and equitable principles governing, and to regulate, the common use of the broadcasting band in the North American Region so that each country within the Region may make the most effective technical use thereof with the minimum of interference between broadcasting stations.
2. *North American Region*
   For the purposes of this Agreement, the North American Region shall consist of the following countries: Bahama Islands and Jamaica, Canada, Cuba, Dominican Republic, Haiti, Mexico and the United States of America (including Alaska, Puerto Rico and the Virgin Islands).
3. *Contracting Government*
   For the purposes of this Agreement, the term "Contracting Government" means a Government of a country in the North American Region which shall have signed and ratified, or which shall have adhered to, this Agreement.
4. *Broadcasting Band*
   For the purposes of this Agreement, the term "broadcasting band" means the band of medium frequencies defined in the Broadcasting Regulations contained in Annex 2.
5. *Sovereign Rights of Countries*
   While fully recognizing the sovereign right of each country in the field of broadcasting, the Contracting Governments also recognize that, until technical developments reach a state permitting the elimination of radio interference of an international character, a regional agreement between them is necessary in order to promote and maintain standardization and to minimize interference.
6. *Regional Character of Agreement*
   This Agreement is a regional agreement within the meaning of Article 41 of the International Telecommunication Convention, Atlantic City (1947), and Article 29 of the Inter-American Radio Communications Convention, Habana (1937). In conformity with these Articles, each provision of this Agreement is subject to the provisions of said Conventions and of the Radio Regulations annexed to the International Telecommunication Convention.
7. *Annexes to this Agreement*
   The following annexes complete and form an integral part of this Agreement:
   (a) General Regulations contained in Annex 1,
   (b) Broadcasting Regulations, together with the Appendices, contained in Annex 2, and
   (c) Initial Broadcasting Station Assignment List contained in Annex 3.

PART II
DEFINITIONS

For the purposes of this Agreement:

1. *Broadcasting Station*
   The term "broadcasting station" means a station authorized to operate in the broadcasting band whose transmissions are to be received directly by the general public.
2. *Broadcasting Channel*
   The term "broadcasting channel" means the band of frequencies occupied by the carrier and two side bands of a signal of a broadcasting station with the carrier frequency at the center. Each broadcasting channel shall be designated by its assigned carrier frequency.
3. *Objectionable Interference*
   The term "objectionable interference" means interference to the signals of a broadcasting station in one country caused by the signals of one or more broadcasting stations in another or other countries, in excess of that permitted in this Agreement.
4. *Ground Wave Signal*
   The term "ground wave signal" means the radiated signal which is propagated close to the surface of the earth and which has not been reflected back from the ionosphere.
5. *Sky Wave Signal*
   The term "sky wave signal" means the radiated signal which has been reflected back from the ionosphere.
6. *Existing Broadcasting Stations*
   The term "existing broadcasting stations" means, as of the date of signing this Agreement, all broadcasting stations whose assignments are listed in the Initial Broadcasting Station Assignment List in Annex 3, or, at any given time thereafter, the broadcasting stations enumerated in said list as supplemented or modified by new broadcasting station assignments and changes in, or deletions of, broadcasting station assignments made in accordance with the terms of this Agreement.
7. *Clear Channel*
   The term "clear channel" means a broadcasting channel to which are assigned primarily one or more Class I stations, so protected from interference as to render broadcasting service over extensive areas by means of sky wave signals as well as ground wave signals. The following broadcasting channels are designated clear channels: 540, 640, 650, 660, 670, 680, 690, 700, 710, 720, 730, 740, 750, 760, 770, 780, 800, 810, 820, 830, 840, 850, 860, 870, 880, 890, 900, 940, 990, 1000, 1010, 1020, 1030, 1040, 1050, 1060, 1070, 1080, 1090, 1100, 1110, 1120, 1130, 1140, 1160, 1170, 1180, 1190, 1200, 1210, 1220, 1500, 1510, 1520, 1530, 1540, 1550, 1560, 1570, 1580 kc/s.
8. *Regional Channel*
   The term "regional channel" means a broadcasting channel to which are assigned several broadcasting stations so protected from interference as to render broadcasting service over considerable areas by means of ground wave signals and on which channel no protection from interference is generally given to service obtained from sky wave signals, except as specifically provided in Tables III and IV of Appendix A of Annex 2. The following broadcasting channels are designated regional channels: 550, 560, 570, 580, 590, 600, 610, 620, 630, 790, 910, 920, 930, 950, 960, 970, 980, 1150, 1250, 1260, 1270, 1280, 1290, 1300, 1310, 1320, 1330, 1350, 1360, 1370, 1380, 1390, 1410, 1420, 1430, 1440, 1460, 1470, 1480, 1590, 1600 kc/s.
9. *Local Channel*
   The term "local channel" means a broadcasting channel

to which are assigned many broadcasting stations so protected from interference as to render broadcasting service over limited areas by means of ground wave signals and on which channel no protection from interference is given to service obtained from sky wave signals. The following broadcasting channels are designated local channels: 1230, 1240, 1340, 1400, 1450, 1490 kc/s.

PART III
PROCEDURES

A. *Conferences*

1. *Classes of Conferences*

Two classes of Conferences relating to this Agreement may be held:

(a) Plenipotentiary and (b) Administrative.

2. *Plenipotentiary Conferences*

(a) The next Plenipotentiary Conference shall meet not later than four years after the entry into force of this Agreement, at a time and place to be fixed by agreement of a majority of the Governments of the countries in the North American Region. The time of the next Plenipotentiary Conference may, however, be postponed, or the place may be changed, by agreement of a majority of the said Governments.

(b) A Plenipotentiary Conference may revise the Agreement.

3. *Administrative Conferences*

(a) An Administrative Conference shall meet at least once prior to the next Plenipotentiary Conference at a time and place to be fixed by agreement of a majority of the Contracting Governments, and thereafter at a time and place to be fixed in the same manner. The time and place may be changed by agreement of a majority of the Contracting Governments.

(b) An Administrative Conference, within the limits of this Agreement, may:

1) Revise Annex 2. However, Appendix A of said Annex, which must be accepted by all Contracting Governments, may be revised only at a Plenipotentiary Conference unless the Contracting Governments unanimously agree that such revision may be undertaken at an Administrative Conference.

2) Deal with all matters of an administrative nature or with other matters in accordance with any directive given by a Plenipotentiary Conference.

4. *Date and Place of Conferences, Invitation and Circulation of Proposals*

(a) Within the limitations of this Agreement, the host Government for a Conference shall fix the exact date and place of the Conference.

(b) Invitation to conferences and the circulation of proposals shall be in accordance with the provisions of Annex 1.

5. *Rules of Internal Procedure of Conferences*

Each conference shall be governed by the Rules of Internal Procedure set forth in Annex 1, with such modifications as it deems necessary for its own meetings.

B. *Revision of Technical Matters in Broadcasting Regulations*

In addition to the procedures for revising Annex 2, herein above provided, said Annex may be revised, with respect to technical matters and standards of good engineering practice, by means of a supplement, prepared by technicians appointed by the Contracting Governments, which is unanimously approved by such Governments. This may be accomplished as set forth in paragraph 2 of Section E of Annex 2.

C. *Cooperation of the Governments in the Work of Research and Exchange of Information*

The Contracting Governments bind themselves to gather properly proven data, and to make studies thereon, and to exchange information which will assist said Governments in complying with the technical provisions of this Agreement.

D. *Rights and Obligations with Respect to Existing Broadcasting Stations*

With respect to existing broadcasting stations, each Contracting Government shall have the rights and obligations established for it by this Agreement, especially the preservation of priorities and the protection from interference, specified herein. In making assignments of new broadcasting stations, or changes in or deletions of assignments of existing broadcasting stations, and with respect to the operation of broadcasting stations, each Contracting Government shall comply with the provisions of this Agreement.

E. *Methods of Determining the Presence, Degree or Absence, of Objectionable Interference*

1. The presence, degree, or absence, of objectionable interference on the same or adjacent broadcasting channels shall be determined by one of the following methods:

(a) by reference to the propagation curves in Appendices E and I of Annex 2, or

(b) by actual field intensity measurements or recordings.

2. The field intensity measurements or recordings shall be made with mutually acceptable apparatus, duly calibrated, and shall be carried out by technicians designated by the interested Governments. Such field intensity measurements shall be made in the manner, and for the periods of time, agreed upon by the Governments concerned. The Contracting Governments shall facilitate the making of the measurements by requiring the broadcasting stations involved to suspend operation or to operate in the manner such Governments deem necessary.

F. *Notification*

1. *Performance of the Notification Exchange Function*

Notifications concerning broadcasting station assignments and changes in or deletions of such assignments, objections thereto, and other communications made pursuant to the provisions of this Section F, shall be sent for purposes of exchange to the Agency or Government which, in accordance with Section F of Annex 2, performs the notification exchange function.

2. *Notifications of New Broadcasting Station Assignments or of Changes in Existing Broadcasting Station Assignments*

In making any notifications of a new broadcasting station assignment, or of a change in an existing broadcasting station assignment, the Government shall supply the basic information, which is essential to constitute a notification. The basic information shall be accompanied or followed as soon thereafter as possible, but in no case more than sixty days thereafter, by supplementary information.

(a) *New Broadcasting Station Assignments*

(1) *Basic Information.* Basic information shall consist of the following: frequency; class of station; location by city and province or state; power; time designation; whether a directional antenna is to be used and the time during which it will be used (DA-1, DA-2, DA-N or DA-D); the date of expected commencement of operation.

(2) *Supplementary Information.* Supplementary information shall consist of the following: call sign; geographical location of the midpoint of the antenna system in degrees and minutes of latitude and longitude; and,

(i) for a directional antenna system, its electrical and physical dimensions, the horizontal radiation pattern for day operation, and the horizontal and vertical radiation patterns for night operation (the vertical patterns to be supplied only for directions in which protection is required for stations in other countries);

(ii) for omnidirectional antennas, the electrical and physical dimensions (including those of the ground system, etc.)* and the horizontal unattenuated radiated field

*It is assumed that omnidirectional antennas will be guyed or self-supporting insulated towers, located on the ground with a buried radial ground system. Where the antenna system deviates from this, (for example: is located on a building; is a type T or inverted L; is shunt fed; is sectionalized or top loaded) full particulars, including a sketch if necessary for clarity, shall be submitted.

at one statute mile (or its international equivalent in kilometers) for one kilowatt of input power to the antenna.

(b) *Changes in Broadcasting Station Assignments*

(1) *Basic Information.* The basic information shall consist of the nature of the change, together with the date of expected consummation thereof, and any revision of the basic information previously supplied necessary to make it conform to the change.

(2) *Supplementary Information.* The supplementary information shall consist of any revision of the supplementary information previously supplied necessary to make it conform to the change.

3. *Notifications of Deletions of Broadcasting Station Assignments*

Notifications of deletions of broadcasting station assignments shall consist of sufficient information to identify the station assignment deleted, including call sign, location, frequency and power, together with the date on which the station has ceased, or is expected to cease operation.

4. *Notifications of Commencement or Cessation of Operation of, and Consummation of Changes in, Broadcasting Stations*

The exact date of commencent or cessation of operation of a broadcasting station, or of consummuation of a change in a broadcasting station, shall be notified.

5. *Initial Broadcasting Station Assignment List*

(a) The Initial Broadcasting Station Assignment List is contained in Annex 3. The list sets forth those broadcasting station assignments which have heretofore been duly notified in accordance with the terms of the first North American Regional Broadcasting Agreement and the North American Regional Broadcasting Interim Agreement (Modus Vivendi) up to and including March 28, 1949, as supplemented and modified by new broadcasting station assignments and changes in, and deletions of, broadcasting station assignments which have been incorporated in said Annex. Annex 3 contains the following information with respect to the assignments listed therein: name of the country; frequency; call sign, if assigned; class of station; location by city and province or state; power; time designation; whether a directional antenna is used or to be used; and, where appropriate, details of protection from interference accorded to and received from broadcasting stations in other countries.

(b) New broadcasting station assignments and changes in broadcasting station assignments, together with the information relating to them incorporated in the Initial Broadcasting Station Assignment List in Annex 3, shall be deemed to be duly notified and accepted by the Contracting Governments on the date of the signing of this Agreement. Objections relating to said assignments shall be limited to the additional information required in connection with said assignments and in accordance with paragraph 5. (c) of this Section F.

(c) So far as possible, within sixty days after the date of signing this Agreement or at any time thereafter, but in no event later than thirty days after the date of deposit of their respective instruments of ratification or adherence, the Governments shall supply, with respect to their broadcasting station assignments contained in Annex 3, all the basic and supplementary information specified in paragraph 2 above, which has not been included in said Annex or which has not previously been supplied in notifications made prior to the date of signing this Agreement.

(d) So far as possible, within a period of sixty days after receiving the additional information supplied in accordance with the preceding subparagraph (c), but in no event later than sixty days after the date of entry into force of this Agreement, any Government may advise the Government supplying the additional information of objections it may have to the effect that, in the light of such additional information, the operation of a broadcasting station for which an assignment is listed in Annex 3 will not be in compliance with all the pertinent provisions of this Agreement.

(e) No Government shall be required to make changes in any broadcasting station as shown in the Initial Broadcasting Station Assignment List, supplemented by the additional information submitted in accordance with subparagraph (c) above, with respect to which any objection has been resolved because of interference it may cause in excess of the amount specified in Annex 2, except and to the extent that such changes are necessary in said broadcasting stations to meet the requirements in the notes to Annex 3.

6. *Supplementary Broadcasting Station Assignment List*

(a) The Supplementary Broadcasting Station Assignment List shall consist of such assignments of new broadcasting stations, changes and deletions in broadcasting station assignments as shall have been authorized by each Contracting Government during the period between the date of signing this Agreement and the date of its entry into force, provided that they comply with the following requirements:

(1) Such new broadcasting station assignments, changes and deletions shall have been duly notified to the Governments of the other countries in the North American Region as provided in paragraphs 1, 2 and 3 of Section F, and

(2) Such assignments, changes and deletions shall comply in all other respects with the pertinent terms of this Agreement.

(b) The Government of any other country in the North American Region may advise the Government making the notifications referred to in the preceding subparagraph (a) (1) of this paragraph of any objection it may have thereto under the terms of this Agreement. Said objections shall be made not later than sixty days after the date of entry into force of this Agreement. However, every effort shall be made to submit said objections prior to that date and in the manner and within the time limits hereinafter specified with respect to objections to subsequent notifications.

(c) Within one hundred and twenty days after the date of entry into force of this Agreement, the Agency or Government performing the notification exchange function shall prepare and distribute a copy of the Supplementary Broadcasting Station Assignment List to the Governments of all the countries in the North American Region, together with information indicating which notifications in the Initial and Supplementary Broadcasting Station Assignment Lists are still the subject of unresolved objections.

7. *Subsequent Notifications*

(a) After the date of entry into force of this Agreement and throughout the period in which it shall remain in effect, each Contracting Government shall notify the other Contracting Governments of all new broadcasting station assignments, and all changes in or deletions of existing broadcasting station assignments in accordance with paragraphs 1, 2 and 3 of this Section F.

(b) To be valid, each such notification must be such that the new broadcasting station, change or deletion proposed therein is in accordance with this Agreement.

(c) Each Contracting Government may, within thirty days after the date of receipt of such notification, advise the Government making the notification of any objection it may have thereto under the terms of this Agreement.

(d) In case the supplementary information does not accompany the basic information and such sup-

plementary information is received within the period specified in paragraph 2 of this Section F, the period during which objection may be made shall be extended to thirty days after the date of receipt of such supplementary information.

(e) Failure of any Contracting Government to object to a notification within the period specified above shall be deemed to be an acceptance by that Government of such notification.

(f) The date of priority of a notification shall be determined by the date of receipt, by the Agency or Government performing the notification exchange function, of the basic information constituting the notification, provided the supplementary information with respect to such notification is also submitted within the period specified therefore in paragraph 2 of this Section F. As between two or more notifications proceeding from different Governments, priority in the date of receipt thereof by the Agency or Government performing the notification exchange function shall govern.

8. *Cessation of Effect of Notification*

(a) A broadcasting station assignment in the Initial Broadcasting Station Assignment List shall cease to have any validity if the additional information required by paragraph 5. (c) of this Section F is not supplied within the specified time and all rights with respect to such assignment shall cease.

(b) Any other notification of a new broadcasting station assignment or of a change in an existing broadcasting station assignment shall cease to have any effect if, within the period specified in paragraph 2 of this Section F, the supplementary information shall not have been supplied.

(c) Any notification, including a notification contained in the Initial or Supplementary Broadcasting Station Assignment List, with respect to which basic and supplementary information has been supplied in the form set forth in paragraph 2 of this Section F within the time limits specified in this Agreement shall cease to have any effect if within two years after the date when the supplementary information is received, the new broadcasting station shall not have actually commenced operation or if the change shall not have actually been consummated. In special cases arising from unusual circumstances, the effect of such a notification may be extended for successive periods of six months upon notice to all other Contracting Governments within the period of effectiveness of the notification in question. Said notice must include the details of the circumstances which the notifying Government may consider to justify such extension.

(d) Except as may be otherwise specifically provided in this Agreement, changes in power, antenna characteristics or location of an existing broadcasting station may be made at any time, provided protection to all existing broadcasting stations at the time of the change is in accordance with the provisions of Appendix B of Annex 2, provided however, that it shall not be obligatory to provide greater protection than that previously accepted and in force immediately preceding the change.

Any notification of change in an existing broadcasting station which involves a change in frequency is in effect a deletion of the previous assignment (except as provided for in paragraph 8 (e) of this Section F) and the simultaneous notification of a new assignment, which notification shall be accorded only such priority as would result from the notification of a new broadcasting station assignment.

(e) Any notification of a deletion of an existing broadcasting station assignment shall be deemed to be an abandonment by the notifying Government of any rights it may have with respect to such assignment unless, simultaneously with notification of the deletion, due notification of a new broadcasting station assignment on the same frequency be made which is, in effect, a substitution for the deleted assignment and does not result in interference to existing broadcasting stations in other countries in excess of that previously caused by the broadcasting station whose assignment is deleted.

9. *Regional Notifications*

The regional notifications made in accordance with the provisions of this Agreement shall be made independently of and in addition to those which, under current practice, are sent to the International Telecommunication Union.

G. *Settlement of Differences*

Contracting Governments may settle their differences on questions relating to the interpretation or execution of this Agreement through diplomatic channels or by any other method mutually agreed upon. If no such method of settlement is adopted, the difference shall, upon request of any party thereto, be submitted for settlement in accordance with the procedure estabieshed in Part II of Annex 1.

H. *Ratification, Adherence and Execution*

1. *Ratification*

(a) This Agreement shall be subject to ratification by each of the signatory Governments.

(b) Each instrument of ratification shall be deposited, as soon as possible, in the archives of the Government of Canada. The said Government shall, through diplomatic channels, notify the other Contracting and Signatory Governments, the Secretary General of the International Telecommunication Union, and the Agency or Government performing the notification exchange function, of the deposit of each instrument of ratification as soon as it is received, and shall forward to each of them an authentic copy of each such instrument.

2. *Adherence*

(a) The Government of any country in the North American Region not a signatory of this Agreement, may adhere to it at any time, and shall thereupon become a Contracting Government.

(b) Each instrument of adherence shall be deposited in the archives of the Government of Canada. The said Government shall, through diplomatic channels, promptly notify the other Contracting and Signatory Governments, the Secretary General of the International Telecommunication Union, and the Agency or Government performing the notification exchange function, of the deposit of each instrument of adherence and shall forward to each of them an authentic copy of each such instrument.

3. *Execution*

The Contracting Governments undertake to abide by the provisions of this Agreement and to take the necessary measures to impose the observance of the said provisions upon the private and other operating agencies recognized or authorized by them to establish and operate broadcasting stations within their respective countries.

I. *Entry into Force, Term and Denunciation of the Agreement*

1. *Entry into Force*

(a) This Agreement shall enter into force when it shall have been ratified or adhered to by the Governments of at least three of the following four countries: Canada, Cuba, Mexico and the United States of America. The date of entry into force of this Agreement shall be the fifteenth day after the date on which the third of such instruments of ratification or adherence shall have been deposited.*

(b) This Agreement shall be valid only as between such Governments as shall have deposited their instruments of ratification or adherence.

2. *Term*

This Agreement shall remain in effect for a period of five years after the date of its entry into force. Nevertheless, if, upon the expiration of the said period, a new agreement shall not have entered into force, this Agreement shall remain in full force and effect until the date of entry into force of a new agreement.

*Entered into force April 19, 1960. Department of State, Press Release No. 201 (April 20, 1960).

3. *Denunciation*

Each Contracting Government shall have the right to denounce this Agreement by an instrument of denunciation addressed through diplomatic channels to the Government of Canada. The Government of Canada shall announce the denunciations through diplomatic channels to all the other Contracting and Signatory Governments, the Secretary General of the International Telecommunication Union, and the Agency or Government performing the notification exchange function. The denunciation shall take effect one year after the date on which the instrument of denunciation is received by the Government of Canada at which time the Government denouncing the Agreement shall cease to be a Contracting Government. This Agreement shall remain in force between the Contracting Governments.

IN WITNESS WHEREOF, the respective plenipotentiaries have signed this Agreement, in the English, Spanish and French languages, in a single copy which shall be deposited in the archives of the Government of Canada. The texts in each language shall be equally valid. An authentic copy thereof shall be forwarded by the Government of Canada to the Government of each country in the North American Region, to the Secretary General of the International Telecommunication Union and to the Agency performing the notification exchange function.

Done at Washington, D. C., this fifteenth day of November, 1950.

ANNEX 2
BROADCASTING REGULATIONS

A. *Definitions*

For the purposes of this Agreement:

1. *Broadcasting Band*

The term "broadcasting band" means the band of frequencies extending from 535 to 1605 kc/s. The Contracting Governments agree that this band of frequencies shall be allocated exclusively to broadcasting in the North American Region.

2. *Power*

The term "power," when used with reference to a broadcasting station, means the unmodulated radio frequency power, expressed in watts or kilowatts, supplied to the antenna system.

3. *Radiated Field Intensity*

The radiated field intensity in a specified direction is the unattenuated field expressed in millivolts per meter at one statute mile (or its international equivalent in kilometers).

4. *10% (or 50%) Night-time Sky Wave Field Intensity*

The term "10% (or 50%) night-time sky wave field intensity" means values as computed from the 10% and 50% curves of Appendix E, taking into account the radiated field intensity in the pertinent directions.

5. *Spurious Radiations*

Spurious radiations from a broadcasting transmitter are the radio frequency harmonics, audio frequency harmonics, or any other emission or modulation products which are not necessary in order to render the desired broadcasting service and may result in the generation of steady state or transient components capable of producing harmful interference.

6. *Day-time and Night-time Operation*

(a) Day-time operation in general means operation between the times of local sunrise and local sunset at the transmitter location of the station; however, in particular cases other hours for day-time operation may be established, either in the present Agreement or in bilateral agreements, between the respective Contracting Governments, taking into account the location of the station it is intended to protect.

(b) Night-time operation is operation at any other time.

(c) The times of sunrise and sunset, to the nearest quarter hour, on the fifteenth day of a calendar month shall be considered to be the times of sunrise and sunset for all the days of that month.

7. *Synchronous Operation*

Synchronous operation is the operation of two or more broadcasting stations, broadcasting the same program simultaneously on the same assigned frequency with an actual carrier frequency difference of not more than 0.1 cycle per second.

B. *Operation of Broadcasting Stations*

1. *Assignment of Carrier Frequencies*

The carrier frequencies assigned to broadcasting stations shall begin at 540 kc/s and be in successive steps of 10 kc/s to and including 1600 kc/s. No intermediate frequency shall be assigned as the carrier frequency of any broadcasting station.

2. *Band-Width of Emissions*

The band-width of emissions is not fixed, provided that objectionable interference is not caused.

3. *Frequency Tolerance and Stability*

The operating frequency of each broadcasting station shall be maintained to within 20 cycles per second of the assigned frequency and shall not vary perceptibly over short periods of time under all conditions of operation.

4. *Elimination of Spurious Radiations*

In the event harmful interference results from spurious radiation, the Government of the country in which the station causing such interference is located shall adopt the necessary technical measures for its elimination.

5. *Determination of Power*

The power of a station shall be determined by taking the product of the square of the current at the point of input to the antenna system and the total resistance at that point.

6. *Modulation*

The form of modulation for broadcasting stations is amplitude modulation of an unsuppressed carrier of constant amplitude yielding two symmetrical side bands.

C. *Classes of Broadcasting Stations*

1. *Class I Station*

A Class I station is a broadcasting station designed to provide broadcasting service over extensive areas by both ground wave and sky wave signals.

(a) *Class I-A Station*

A Class I-A station is a Class I station operating on a clear channel with respect to which channel a Contracting Government has a priority listed in Table I of Appendix A. The power is generally 50 kW or more. Permissible interference from another station on the same channel in another country is determined at the boundary of the country in which the Class I-A station is located in accordance with Appendix B, except as may otherwise be specifically provided in the Annexes to this Agreement.

(b) *Class I-B Station*

A Class I-B station is a Class I station operating on a clear channel with the station priority specified in Table II of Appendix A. The power is 10, 25 or 50 kW. Permissible interference from another station on the same channel in another country is determined at a specified field intensity contour of the Class I-B station in accordance with Appendix B, except as may otherwise be specifically provided in the Annexes to this Agreement.

(c) *Class I-C Station*

A Class I-C station is a Class I station operating on a clear or regional channel with the station priority specified in Table III of Appendix A. The power is 10, 15, 25 or 50 kW as specified in Annex 3. It operates so as to render broadcasting service by means of both sky wave and ground wave signals. Permissible interference from another station on the same channel in another country is determined at a geographical limit specified in Appendix B, except as may otherwise be specifically provided in this Agreement.

(d) *Class I-D Station*

A Class I-D station is a Class I station operating on a clear or regional channel with the station priority specified in Table IV of Appendix A. The power is 10, 15 or 25 kW as specified in Annex 3. It operates so as to render broadcasting service by means of both sky wave and ground wave signals.

Permissible interference from another station on the same channel in another country is determined at a geographical limit specified in Appendix B, except as may otherwise be specifically provided in this Agreement.

2. *Class II Station*

A Class II station is a broadcasting station, other than a Class I station, operating on a clear channel and designed for broadcasting service by means of ground wave signals only. The power is 0.25, 0.5, 1, 2.5, 5, 10, 15, 25 or 50 kW. Permissible interference from another station on the same channel in another country is determined at a ground wave field intensity contour, in accordance with Appendix B.

3. *Class III Station*

A Class III station is a broadcasting station operating on a regional channel and designed for broadcasting service by means of ground wave signals only. The power is 0.5, 1, 2.5 or 5 kW*. Permissible interference from another station on the same channel in another country is determined at a ground wave field intensity contour, in accordance with Appendix B.

4. *Class IV Station*

A Class IV station is a broadcasting station operating generally on a local channel and designed for broadcasting service by means of ground wave signals only. The power is 0.1 or 0.25 kW.** Permissible interference from other stations on the same local channel in another country is determined at a ground wave field intensity contour, in accordance with Appendix B.

D. *Allocation of Broadcasting Stations to Broadcasting Channels*

1. *Clear Channels*

(a) Each clear channel shall be used with due regard to the priority in use as set forth in Appendix A.

(b) Class II stations, in addition to those listed in Annex 3, may be assigned to clear channels in accordance with the notification procedure prescribed by this Agreement, and in accordance with the provisions of this Annex and of Annex 3.

2. *Regional Channels*

(a) Generally, only Class III stations may be assigned to regional channels.

(b) Class I-C and I-D stations may be assigned to specified regional channels in accordance with the priorities established in Tables III and IV of Appendix A.

(c) Where the assignment of a Class III station is impracticable, Class IV stations may be assigned to regional channels, provided that no objectionable interference is caused to existing stations.

(d) Each country may use all regional channels subject to the power limitations and the standards for prevention of objectionable interference set forth in this Agreement.

3. *Local Channels*

(a) Only Class IV stations may be assigned to local channels.

(b) Each country may use all local channels subject to the power limitations and the standards for prevention of objectionable interference set forth in this Agreement.

E. *Investigation of Interference, Coordination of Studies of Propagation Phenomena, and Cooperation for the Solution of Technical Problems*

1. *Investigation of Interference*

When a Contracting Government has reason to believe that interference greater than that permitted by the Agreement is being caused to any broadcasting station under its jurisdiction as the result of the operation of a broadcasting station under the jurisdiction of another Contracting Government, it may request the latter to investigate the situation. On receipt of such a request, the Government to which it is addressed shall order the carrying out of such an investigation, the results of which will be communicated to the Government making the request.

*In certain cases listed in Annex 3, Class III stations are established in Cuba with power of 10 kW.

**In certain cases listed in Annex 3, Class IV stations are established in Cuba with power of 0.5 kW and 1 kW.

2. *Research and Consultative Activities*

(a) The Contracting Governments shall consult with each other and prepare and exchange informational reports which will facilitate the effective technical use of the broadcasting band. For this purpose, they shall carry out and coordinate technical research relating to broadcasting.

(b) The Contracting Governments, in matters pertaining to this Section E, shall consult with each other and exchange the information, proposals and reports through their respective agencies or Departments having jurisdiction over technical matters of radio broadcasting. Such agencies or Departments shall communicate their points of view to the corresponding Technical agencies or Departments of all the interested Contracting Governments within the shortest practicable time.

(c) When they deem it appropriate, the Contracting Governments shall prepare and circulate proposals for the revision of the technical standards of these Broadcasting Regulations.

(d) At the suggestion of any one of the Contracting Governments, meetings of the technicians of such Governments may be held, at times and places mutually agreed upon, to discuss proposals for the preparation of the Supplement referred to in Section B of Part III of the Agreement and for the coordination of technical research on radio broadcasting.

3. *Standards of Good Engineering Practice*

In making field intensity measurements or in carrying out research within their respective countries, each Contracting Government shall be guided by the generally accepted standards of good engineering practice and shall make use of adequate and duly calibrated apparatus.

F. *The Notification Exchange Function*

1. *Agency or Government Performing the Notification Exchange Function*

The notification exchange function referred to in Section F of Part III of the Agreement shall be performed by the Inter-American Radio Office (OIR), hereinafter referred to as the Agency, so long as that organization is in a position to perform this function. If, at any time, the Agency shall not be in a position to perform this function, the host Government of the OIR is requested to perform provisionally, in the same manner, said notification exchange function on a cost reimbursement basis, until such time as a different decision may be reached by a conference of the Contracting Governments.

2. *Use of Registered Mail*

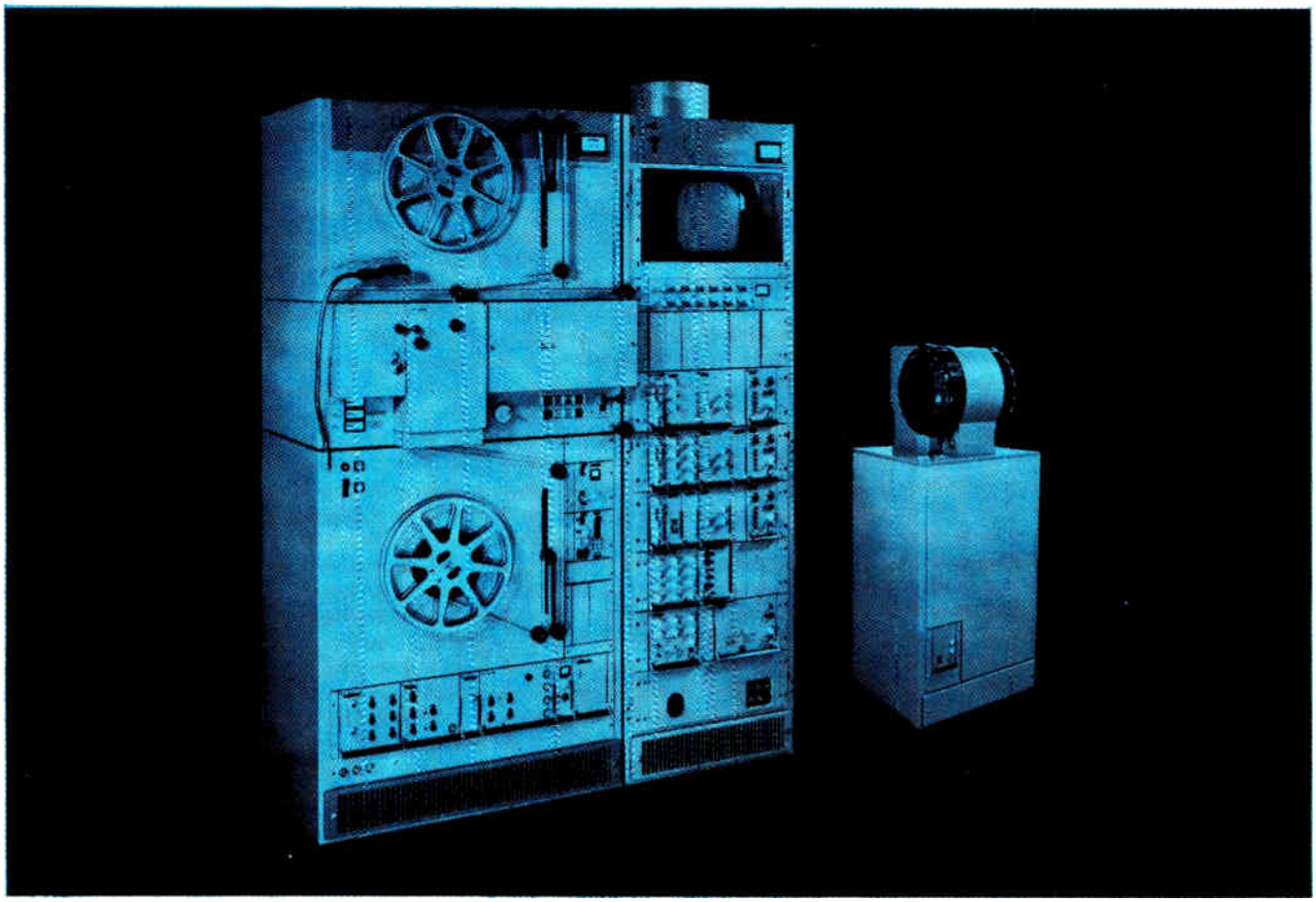
All notifications, objections, and other communications (all of which are hereinafter referred to as communications) made pursuant to Section F of Part III of the Agreement, as well as those made pursuant to this Section F, shall be transmitted by registered mail.

3. *Files and Records of the Agency*

The Agency shall file in an appropriate manner all such communications received and copies of communications transmitted. It shall establish and maintain an accurate, up to date, and detailed system of registration records with respect to all such communications. Such records shall include a serial number based on the order of receipt, the date of such receipt, the registered mail number, the name of the Government or country sending the communication, a brief description of its nature and contents, the date on which the Agency acknowledged receipt to the sending Government, the date or dates on which the Agency transmitted the communication to other Governments, and appropriate cross-references to notifications, objections, or other communications related to the communication thus recorded. All communications sent by the Agency shall be recorded in the same manner.

4. *Acknowledgement of Receipt and Transmittal of Communications*

Not later than on the next business day after the receipt of any such communication, the Agency shall



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(a) advise the sending Government by letter of such receipt, the date and hour thereof, the serial number assigned thereto, and such other information as may be necessary to identify the communication in the records and files of the Agency, and

(b) transmit a copy of such communication, when it deals with notifications or objections thereto, to each of the Governments of the North American Region, and in other cases only to the interested Contracting Governments. In each case a copy of the Agency's acknowledgement of receipt to the sending Government shall be attached.

APPENDIX A
TABLES OF PRIORITIES

TABLE I* CLASS I-A PRIORITIES

Channel kc/s	Country having I-A Priority
540	Canada
640	USA
650	USA
660	USA
670	USA
690	Canada
700	USA
720	USA
730	Mexico
740	Canada
750	USA
760	USA
770	USA
780	USA
800	Mexico
820	USA
830	USA
840	USA
860	Canada
870	USA
880	USA
890	USA
900	Mexico
990	Canada
1010	Canada
1020	USA
1030	USA
1040	USA
1050	Mexico
1100	USA
1120	USA
1160	USA
1180	USA
1200	USA
1210	USA
1220	Mexico
1540	Bahamas
1570	Mexico
1580	Canada

NOTE The protections to be accorded to channels listed herein are those specified in Appendix B except as otherwise specified in this Agreement. The existing assignments on the channels listed herein may be changed and additional assignments on such channels may be made by the country having the Class I-A priority, provided that the Class I and II stations in other countries on such channels listed in Annex 3 are accorded the protection for such Class I and II stations specified in this Agreement and provided that requirements of this Agreement with respect to protection of stations on adjacent channels are met.

*The Mexican priorities indicated are those which existed under the North American Regional Broadcasting Agreement, Habana (1937), and the North American Regional Broadcasting Interim Agreement (Modus Vivendi), Washington, D.C., (1946), and are included in this document as a matter of information only, in the absence of Mexico as a Government signatory to this Agreement.

TABLE II* CLASS I-B PRIORITIES

Channel kc/s	Station	Country having I-B Priorities	Antenna	Schedule	Notes
640	S. John's Nfld.	Canada	ND	U	1)
680	S. Francisco, Calif.	USA	ND	U	
710	New York, N. Y.	USA	DA	U	
	Seattle, Wash.	USA	DA	U	
810	S. Francisco, Calif.	USA	DA	U	
	Schenectady, N.Y.	USA	ND	U	
850	Denver, Colo.	USA	ND	U	
940	Montreal, Que.	Canada	ND	U	
	Mexico, D.F.	Mexico		U	
1000	Mexico, D.F.	Mexico	DA	U	
	Chicago, Ill.	USA	DA	U	
	Seattle, Wash.	USA	DA	U	
1010	Habana	Cuba	DA	U	
1060	Mexico, D.F.	Mexico	DA	U	
	Philadelphia, Pa.	USA	DA	U	
1070	Sackville, N.B.	Canada	ND	U	2)
	Los Angeles, Calif.	USA	ND	U	
1080	Hartford, Conn.	USA	DA	U	
	Dallas, Texas	USA	DA	U	
1090	Rosarito, B. Cfa.	Mexico	DA	U	
	Arkansas	USA	DA	U	3)
	Baltimore, Md.	USA	DA	U	
1110	Omaha, Neb.	USA	DA	U	
	Charlotte, N.C.	USA	DA	U	
1130	Vancouver, B.C.	Canada	DA	U	
	Shreveport, La	USA	DA	U	
	New York, N.Y.	USA	DA	U	
1140	Nuevo Laredo, Tam.	Mexico	DA	U	
	Richmond, Va.	USA	DA	U	
1170	Tulsa, Okla.	USA	DA	U	
	Wheeling, W. Va.	USA	DA	U	
1190	Guadalajara, Jal.	Mexico	DA	U	
	Fort Wayne, Ind.	USA	DA	U	
	Portland, Ore.	USA	DA	U	
1500	Washington, D.C.	USA	DA	U	
	S. Paul, Minn.	USA	DA	U	
1510	Nashville, Tenn.	USA	DA	U	
	Spokane, Wash.	USA	DA	U	
1520	Buffalo, N.Y.	USA	DA	U	
	Oklahoma City, Okla.	USA	DA	U	
1530	Sacramento, Calif.	USA	DA	U	
	Cincinnati, Ohio	USA	DA	U	4)
1540	Waterloo, Ia.	USA	DA	U	
1550	Windsor, Ont.	Canada	DA	U	
	Mexico, D.F.	Mexico		U	
1560	Las Villas	Cuba	DA	U	
	New York, N.Y.	USA	DA	U	5)
	Bakersfield, Calif.	USA	DA	U	

*The Mexican priorities indicated are those which existed under the North American Regional Broadcasting Agreement, Habana (1937), and the North American Regional Broadcasting Interim Agreement (Modus Vivendi), Washington, D.C., (1946) and are included in this document, as a matter of information only, in the absence of Mexico as a Government signatory to this Agreement.

Notes: 1) In agreeing to the Class I-B priority for a station in Newfoundland on 640 kc/s, the United States of America reserves the right for full use of the Class I-A priority on this broadcasting channel for a station on the Pacific Coast.

2) The Canadian Class I-B assignment on 1070 kc/s is subject to excessive local receiver oscillator interference due to nearby assignments on 610 kc/s and 630 kc/s. The existence of this problem is recognized and it is agreed that Canada and the United States will negotiate bilaterally for a possible change in frequency for this assignment.

3) Exact city to be subsequently notified by the United States of America. Interference to Habana is not to exceed that permissible under past Class I-B notification.

4) Directional antenna is to be used after local sunset at Sacramento, Calif.

5) The radiation toward Las Villas from the Class I-B station in New York City is not to exceed the equivalent of 10 kW from an omnidirectional antenna. Radiation from the Las Villas Class I-B station toward the service area of the Class I-B station in New York City is not to exceed the equivalent of 1 kW from an omnidirectional antenna.

TABLE III CLASS I-C PRIORITIES

Channel kc/s	Station	Country having I-C Priorities	Antenna	Schedule	Notes
550	Habana	Cuba	DA	U	
620	Ciudad Trujillo	Rep. Dom.	ND	U	
640	S. Clara, L.V.	Cuba	DA	U	
690	Habana	Cuba	DA	U	
860	Habana	Cuba	DA	U	

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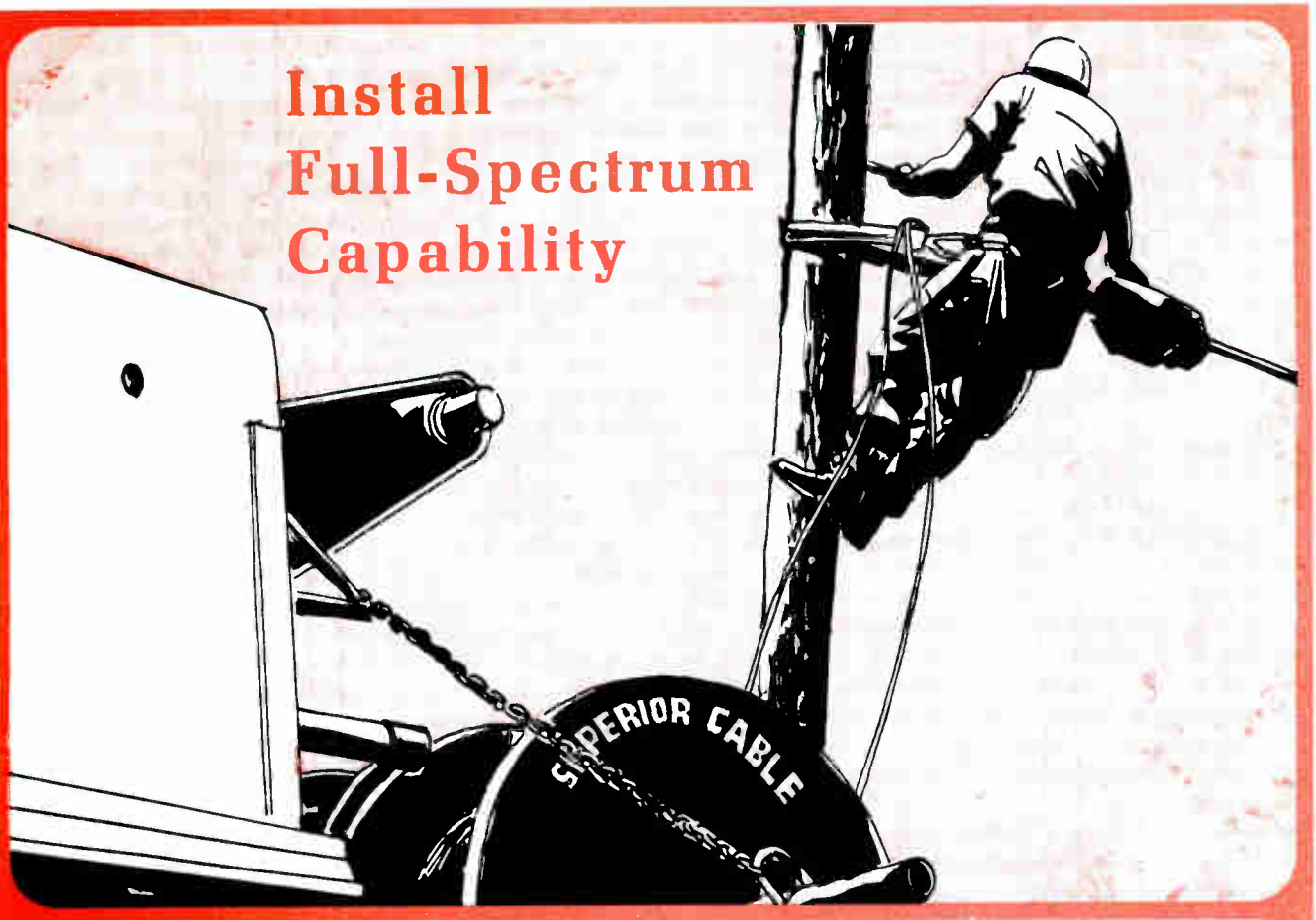

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TABLE IV CLASS I-D PRIORITIES

Channel kc/s	Station	Country having I-D Priorities	Antenna	Schedule	Notes
570	S. Clara, L.V.	Cuba	DA	U	
590	Habana	Cuba	DA	U	
630	Habana	Cuba	DA	U	
740	Holguin, Ote.	Cuba	DA	U	
920	Camaguey, Cam.	Cuba	DA	U	
950	Habana	Cuba	DA	U	
980	Habana	Cuba	DA	U	

APPENDIX B
PROTECTION RULES FOR CO-CHANNEL BROADCASTING STATIONS

General Rules for protection from objectionable co-channel interference. (Special provisions, if any, are contained in Tables I, II, III and IV of Appendix A and in Annex 3.)

A. *General Table*

(See below.)

B. *Stations Near Boundaries*

Where the signal intensity contour at which the permissible interfering signal is determined extends beyond the boundary of the country in which the broadcasting station is located, that section of the boundary within the said contour shall be considered as the location of the said contour.

C. *Separate Determination of Interferences*

In the case of day-time ground wave interference to all classes of broadcasting stations and in the case of night-time sky wave interference to Class I stations, the permissible interference specified applies separately to each interfering signal, and the presence of interference from existing broadcasting stations in excess of the amount specified will not reduce the requirements for limitation of interference from proposed assignments in other countries.

APPENDIX C
PROTECTION RULES FOR ADJACENT CHANNEL BROADCASTING STATIONS

1. Permissible interference to a desired ground wave signal produced by the interfering ground wave signal of a broadcasting station in another country is determined at the 500 μV/m ground wave contour (or at that section of the boundary of the country where the signal exceeds 500 μV/m) on the basis of the following ratios:

Channel separation between stations	Ratio of desired ground wave signal to interfering ground wave signal
10 kc/s	2:1
20 kc/s	1:30

2. Ordinarily adjacent channel sky wave interference is not considered. However, if any Contracting Government contemplates changes which would increase substantially the adjacent channel sky wave interference in the country of another Contracting Government, such proposed changes shall be the subject of bilateral negotiations between the Contracting Governments concerned, before the changes are implemented.
3. For the international application of this Agreement, no broadcasting station will be assigned for operation with less than 40 kc/s separation from a broadcasting station in another country if the area enclosed by the 25 mV/m ground wave contours of the two broadcasting stations overlap.

General Table (Appendix B)

Class of Station	Class of Channel	Boundary or Signal intensity contour at which interfering signal is determined (1)		Permissible interfering signal	
		Day	Night	Day	Night (2)
I-A	Clear	Boundary of Country having priority		5 μV/m	25 μV/m (3)
I-B	Clear	100 μV/m	500 μV/m 50% sky wave contour	5 μV/m	25 μV/m
I-C	Clear or Regional	200 μV/m	Boundary of Country having priority	10 μV/m	25 μV/m
I-D	Clear or Regional	500 μV/m	Boundary of Country having priority	25 μV/m	50 μV/m
II	Clear	500 μV/m (5)	(4) (5)	25 μV/m (5)	(4) (5)
III	Regional	500 μV/m	(4)	25 μV/m	(4)
IV	Regional	500 μV/m	(7)	25 μV/m	(7)
IV	Local	500 μV/m	(6)	25 μV/m	(6)

Notes:

(1) No broadcasting station need be protected from interference at any point outside the boundary of the country in which such broadcasting station is located.

(2) 10% sky wave field intensity.

(3) In addition to the requirement concerning the permissible interfering signal within the boundary of the country having Class I-A priority, no Class II station in another country is to be assigned for night-time operation within 650 miles of said boundary.

(4) The permissible interfering signal to Class II or Class III stations is based on the existing interference level from all co-channel stations in accordance with Appendix G, Paragraph 3. However, no interfering signal will be considered objectionable if the resulting RSS 10% sky wave signal interference, calculated in accordance with the rule contained in Appendix G, is not greater than 125 μV/m.

(5) Class II stations are not protected from Class I-A stations on the same channel, except as may otherwise be established in Annex 3.

(6) Class IV stations on local channels are protected from sky wave interference at night only by means of the required day-time separation, and the limitation of the maximum power.

(7) The permissible interfering signal to Class IV stations on regional channels is based on the existing interference level from all co-channel stations in accordance with Appendix G, Section 3. However, no interfering signal will be considered objectionable if the resulting RSS 10% sky wave signal interference, calculated in accordance with the rule contained in Appendix G, is not greater than 200 μV/m.

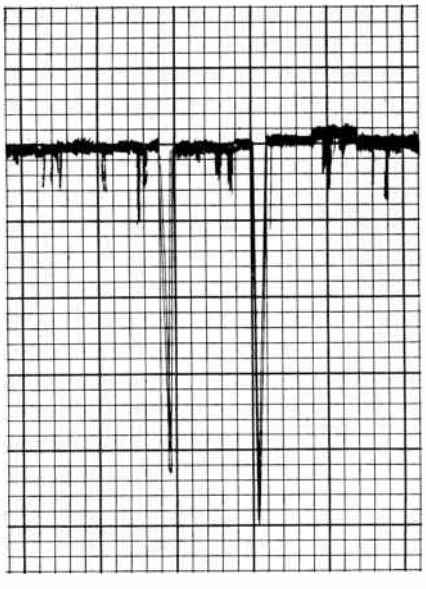
Some plain talk from Kodak about tape:

Uniform magnetic sensitivity

(or the lack thereof)

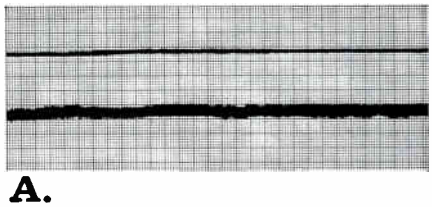
Uniformity for a tape is like kissing babies for a politician. Without it, you're hardly in the running. We take uniformity in all of tape's characteristics very seriously at Kodak. Maybe it's all those years of putting silver emulsions on film that's made us so dedicated to the idea. Uniformity in terms of magnetic sensitivity is one of the most important measures of a tape's performance. Non-uniformity can result in all sorts of bad things like level shifts, instantaneous dropouts, periodic non-uniformity, output variations, distortion, and variations from strip to strip.

Testing for all these possible flaws on a tape is a simple procedure in the lab. Standard industry practice is to record a long wavelength signal (37.5 mil) at a constant input level. The signal from the playback amplifier is then filtered and the output at particular critical wavelengths is permanently charted by a high-speed pen recorder which registers variations on a chart. Instantaneous dropouts caused by foreign matter on the tape surface, for example, would look like this:

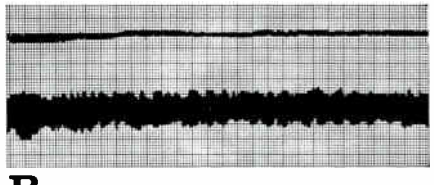


The long and the short of it

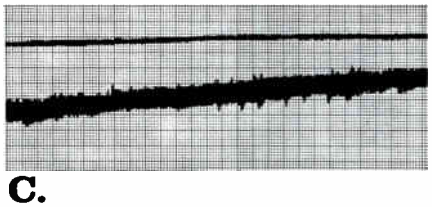
The low frequency procedure gives a good picture of variations in oxide thickness. We take it one step further . . . also test for short wavelength—1.0 mil. This helps evaluate surface smoothness and tape-to-head contact. Taken together, they aid in evaluating the level of lubrication, slitting, and oxide binder characteristics. The smoother the lines, the more uniform the magnetic sensitivity. Guess which graph below is KODAK Sound Recording Tape (the other two graphs represent quite reputable brands of other manufacture):



A.



B.



C.

What looks good sounds good

Congratulations if you picked brand A, Kodak tape. It is notably more uniform . . . doesn't vary more than ¼ db within the reel . . . no more than ½ db from reel to reel.

You benefit as follows:

1. *Within-reel uniformity.*

(a) Less instantaneous and short term amplitude modulation of the signal, which results in a cleaner signal on playback.

(b) Reduced drift gives less variation in frequency response.

(c) Better uniformity across the strip width (no lengthwise coating lines) results in a more nearly balanced output for stereo recordings.

2. *Reel-to-reel uniformity.*

(a) Better coating uniformity gives a more uniform low-frequency sensitivity. This allows splicing of sections of tape from one reel with tape from other reels without obvious signal level changes.

(b) Better coating uniformity also results in a minimum change in optimum bias which allows the professional to establish an operating bias nearer the optimum bias.

KODAK Sound Recording Tapes are available at most camera, department, and electronic stores. New 24-page comprehensive "Plain Talk" booklet covers all the important aspects of tape performance, and is free on request. Write: Department 940, Eastman Kodak Company, Rochester, N.Y. 14650.

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APPENDIX D
STANDARDS OF GOOD ENGINEERING PRACTICE

The Contracting Governments agree unanimously that texts for standards of good engineering practice covering the subjects listed immediately following this paragraph, and such others as may be required and which are not included in other parts of this Agreement, should be formulated and adopted for inclusion in this Appendix D and they agree to take steps promptly to formulate and adopt such standards in accordance with the provisions of this Agreement, particularly in Part III, Section B and Section E of this Annex.

1. determination of distances from broadcasting stations to their ground wave contours by field intensity measurements;
2. determination of ground conductivity by field intensity measurements;
3. determination of the presence and degree or absence, of objectionable interference by field intensity measurements or recordings.

APPENDIX E
10% AND 50% SKY WAVE CURVES
Sky Wave Range for Frequencies
540 kc/s to 1600 kc/s

Explanatory Introduction

The curves in this Appendix E, entitled 10% and 50% Sky Wave Curves, are based on a statistical analysis of a limited number of field intensity measurements made over a 3 month period during the spring of 1935. Field intensity values of sky wave signals were recorded over transmission paths varying from 100 to 2500 miles from clear channel stations operating with omnidirectional antennas and powers ranging from 10 to 50 kW. The analysis of the recorded data that resulted in the graphs shown was such that, in the use of the curves, no weight can be given to such factors as frequency, latitude effect, directional effects (i.e. north-south, east-west, etc.), seasonal and annual sun spot variation, possibility of more than one reflection, and other factors affecting sky wave propagation not specifically referred to in the instructions for their use.

In view of the above, it is recognized that the quantitative values of sky wave signal indicated by the graphs are approximations and in general are not expected to agree closely with results which may be obtained by measurements of signals of individual stations over specific paths and periods of time.

Nevertheless, these graphs have the virtue of having provided a satisfactory basis for international rules and standards governing the allocation of broadcasting stations over an extensive period of time. The assignments made under these rules have been carefully evaluated in the light of the considerably extended fund of information and knowledge concerning sky wave propagation characteristics now available, and, while it is possible to predict with much more accuracy the results that may be expected in terms of service and interference, these results do not indicate a need for sweeping changes in the allocation rules and standards. On the contrary, sweeping changes are undesirable. The sky wave graphs and the allocation rules and standards have been found to produce, in general, an acceptable and desirable result and are, therefore, to continue in effect for purposes of international allocation of broadcasting stations as contemplated in this Agreement.

Editor's Note: Appendix E includes a graph which corresponds to Figure 1a, Section 73.190, FCC Rules and Regulations.

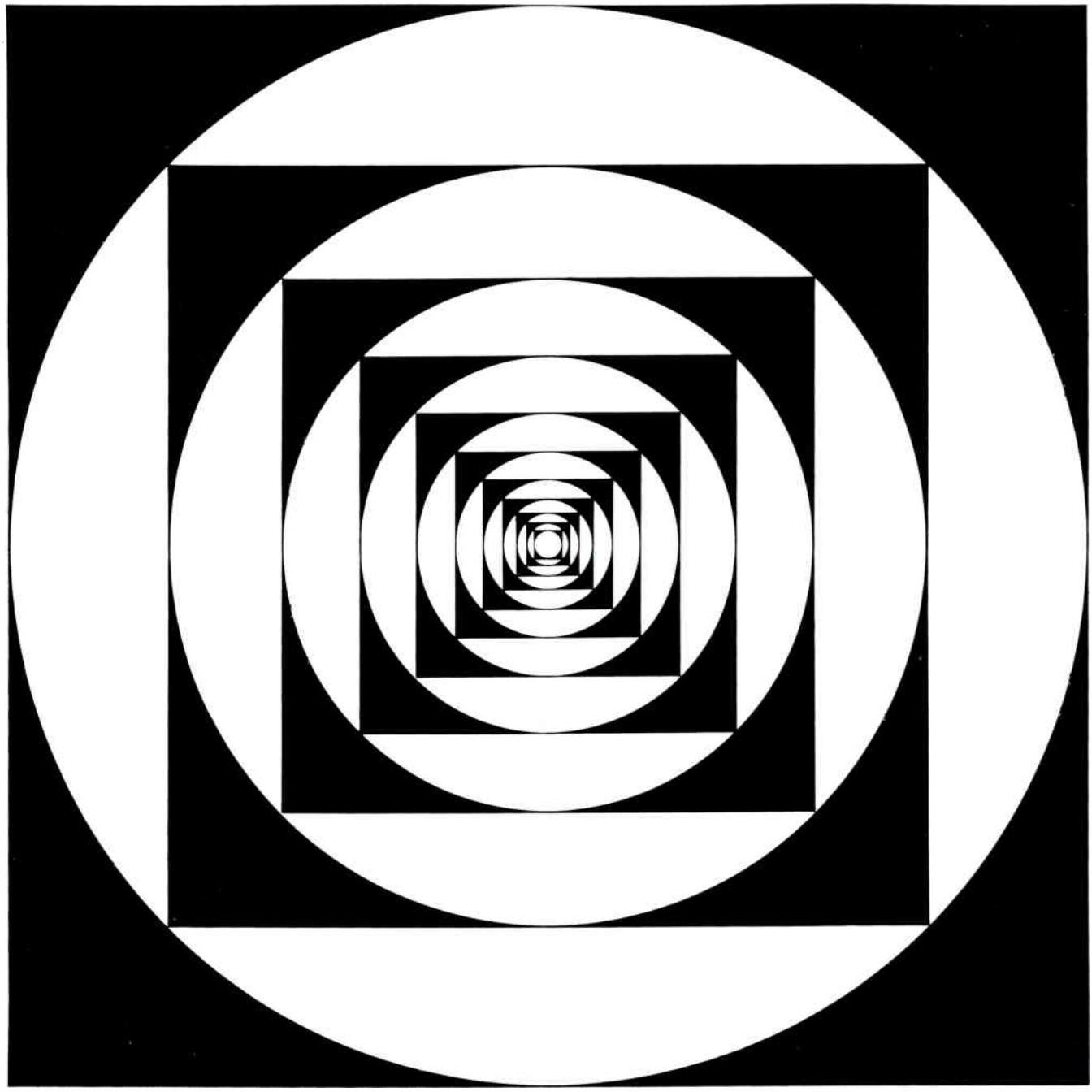
APPENDIX F

Editor's Note: Appendix F consists of a graph which corresponds to the solid curves of Figure 6a, Section 73.190, FCC Rules and Regulations. NARBA curves 1, 2, and 3 correspond to FCC curves 1, 4, and 5, respectively.

APPENDIX G
METHODS OF CALCULATION OF GROUND WAVE AND SKY WAVE SIGNALS AND INTERFERENCE

1. *Antenna Performance*

For the purpose of notification and for calculating the presence and degree of objectionable interference, in the absence of actual measurements or other more precise information indicating higher radiation values, broadcasting



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about the new 78V.

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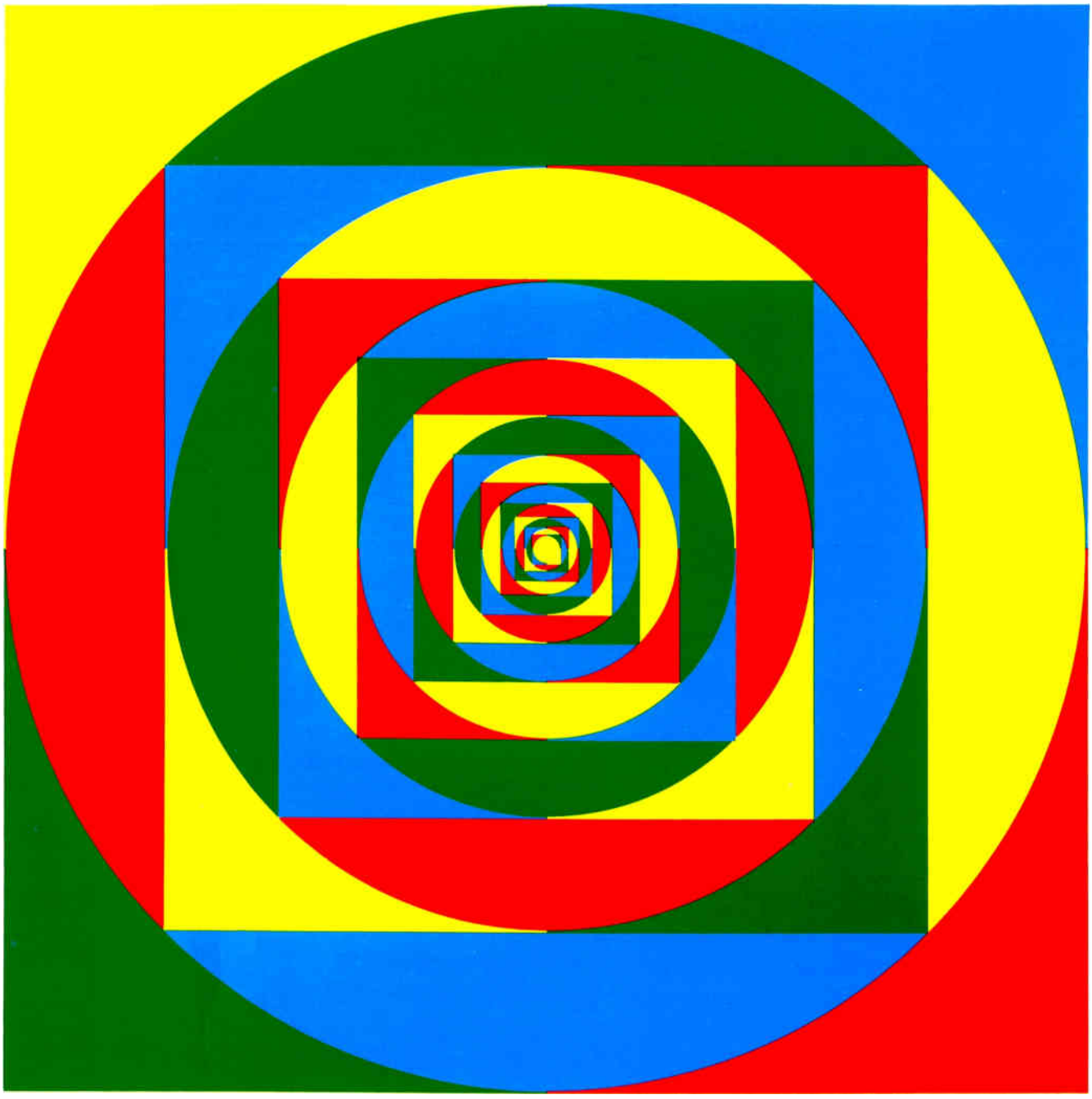

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And it will perform with less drop-outs, reel after reel, long after other video tapes have failed.

The new 78V has higher signal-to-noise ratio and greater frequency response: better video, better sound.

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stations of the several classes using omnidirectional antennas shall be assumed to produce a minimum radiated unattenuated field, for one kilowatt of input power to the antenna as follows:

Class of Broadcasting Station	At One Statute Mile
I	225 mV/m
II and III	175 mV/m
IV	150 mV/m

In considering the performance of an antenna for the purpose of calculating the presence and degree of objectionable interference, due cognizance shall be taken of the pattern of the horizontal radiation for day-time operation and of the patterns of the horizontal and vertical radiations for night-time operation in the pertinent directions.

2. *Calculation of Ground Wave Signal Intensity*
Determination of Distances from Broadcasting Stations to their Field Intensity Contours

(a) The distances from a broadcasting station in actual operation to its ground wave contours may be determined by measurement. These measurements must be made in accordance with the standards of good engineering practice adopted by the Contracting Governments. In case of proposed operation, these distances may be calculated by use of the 20 graphs of Appendix I. These graphs are based upon an unattenuated field intensity of 100 mV/m at one mile and indicate the attenuated field intensities to be expected at varying distances from the transmitter for all frequencies in the broadcasting band and for ground conductivities from 1 to 5000 $\times 10^{-14}$ e.m.u.

(b) The conductivity of a given terrain should be determined, where feasible, by measurements of broadcast signals traversing the terrain, in accordance with the standards of good engineering practice adopted by the Contracting Governments. In other cases, conductivity values may be taken from the map of ground conductivities in Appendix H. This map shows the conductivity values throughout the populated areas of the North American Region by general areas of reasonably uniform conductivity. In areas of limited size, or over a particular path, the conductivity may vary widely from the value given.

(c) Where several values of conductivity are presumed to occur along a single propagation path, an acceptable estimate of the distance to a given contour may be made by using the "Equivalent Distance" method in conjunction with the graphs in Appendix I. This method assumes that a radio wave traversing a non-homogeneous path will follow for each homogeneous interval a curve for a homogeneous earth of that conductivity but that, on passing from one homogeneous interval to another, the effective distance from the transmitter will change abruptly to a value which will maintain continuity in the field intensity. For example, suppose the non-homogeneous path is made up of the following:

$\sigma_1 = 20 \times 10^{-14}$ e.m.u.
from 0 to 20 miles
$\sigma_2 = 5 \times 10^{-14}$ e.m.u.
from 20 to 50 miles
$\sigma_3 = 8 \times 10^{-14}$ e.m.u.
from 50 to 70 miles

Assuming 100 mV/m unattenuated field intensity at 1 mile on a frequency of 1000 kc/s, let it be required to find first, the 0.5 mV/m contour, and second, the field intensity at 70 miles from the transmitter.

There are various ways in which the details of the computation may be carried out. The attached sketches illustrate the graphical construction of a composite propagation curve using, in this instance, a loglinear representation.

With respect to the 0.5 mV/m contour: From the curves for a homogenous earth, the field intensity at 20 miles with a conductivity of 20 is 3.25 mV/m. On conductivity 5, the field intensity of 3.25 mV/m is produced at 11.4 miles. Thus, the equivalent distance from the antenna at which the conductivity becomes 5 is 11.4 miles or 8.6 miles less than the actual distance. Following the 5 curve, the field intensity of 0.5 mV/m is found at 27.8 miles equivalent distance; so the actual distance to the 0.5 mV/m contour is 27.8 + 8.6 = 36.4 miles.

With respect to the field intensity at 70 miles from the transmitter; the 5 curve is followed for 30 miles to 41.4 miles. The field intensity at this point is 0.195 mV/m. This field intensity is produced on the 8 curve at 54.5 miles equivalent distance, or 4.5 miles farther than the actual distance. The field intensity at 70 miles will be found on the 8 curve at an equivalent distance of 74.5 miles. This value is 0.092 mV/m.

3. *Calculation of Sky Wave Signal Intensity*

(a) *General Description of Method*

(1) Appendix E, "10% and 50% Sky Wave Curves," shows the sky wave signal intensity as a function of distance from a transmitting antenna with a radiated field of 100 mV/m at the pertinent angle for the distance. The pertinent angle θ is the angle described by the curves of Appendix F.

(2) To determine the 50% field at any distance requires, therefore, determination of the radiation at the pertinent angle θ. The pertinent angle θ for 50% values is taken from curve 1 of Appendix F. The ratio of the value of radiated field at that value of angle θ, to 100 mV/m then is used as the multiplying factor for the value of the field read from the 50% curve of Appendix E.

(3) Curves 2 and 3 of Appendix F are used in connection with the determination of the 10% sky wave signal and describe the limits of the pertinent angle for this 10% field. The radiation within these pertinent angles is determined and the highest value indicated is used in computing interference.

(4) Sky wave interference to a broadcasting station from broadcasting stations in synchronous operation shall be calculated as if the synchronous stations were in independent operation.

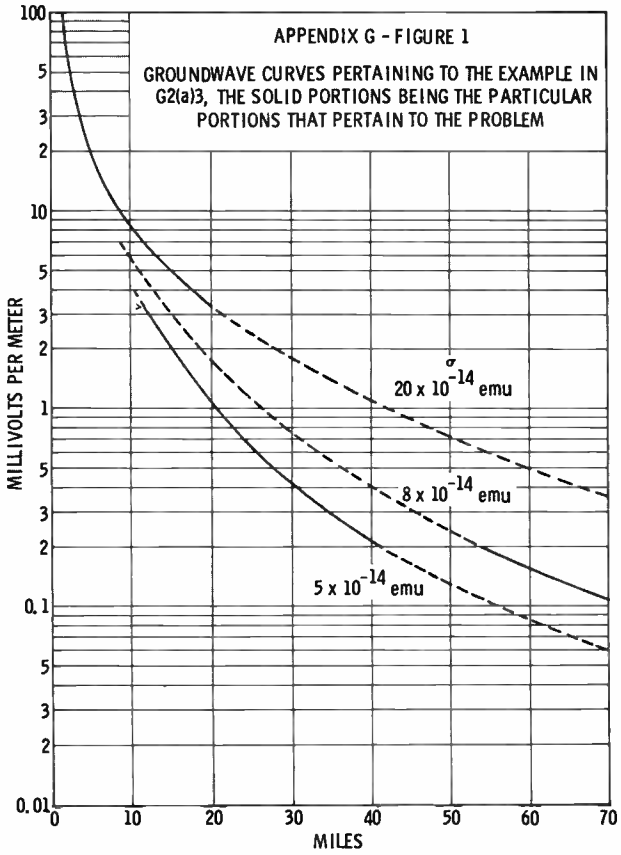
(b) *Sky Wave Interference to Ground Wave Service (RSS Rule)*

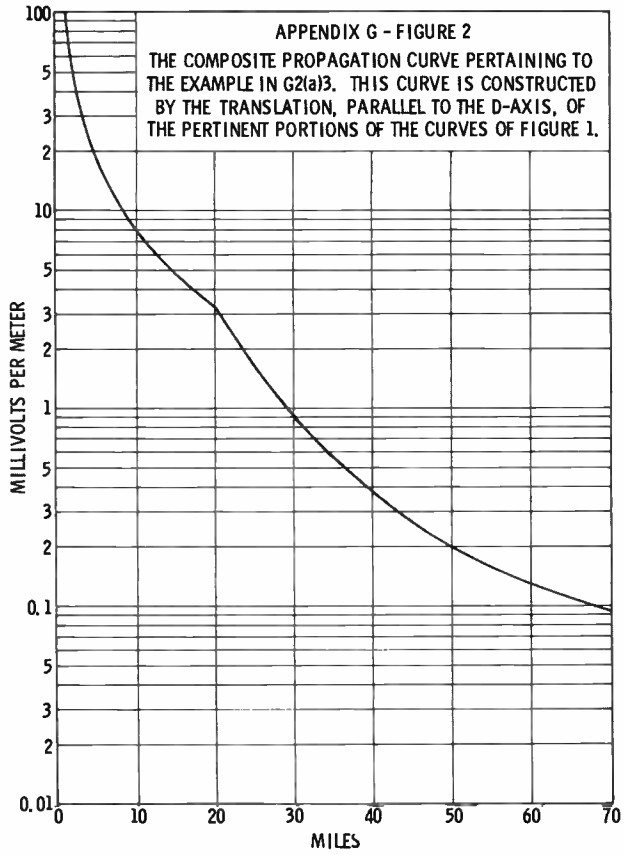
(1) For broadcasting stations on the same channel, sky wave interference to ground wave service is based on a minimum ratio of 20 to 1 desired to undesired field intensity. Thus, the undesired 10% sky wave field multiplied by 20 will give the limitation to the desired signal. To determine the 10% field at any distance requires, therefore, determination of the maximum radiation within the limits of the pertinent angles. The ratio of the value of this maximum radiated field, to 100 mV/m is used as the multiplying factor for the value of the field read from the 10% curve of Appendix E.

(2) The interference from two or more 10% sky wave signals to a desired ground wave signal is taken to be the root sum square (RSS) value of such interfering field intensities. Calculation is accomplished by considering the signals in order of decreasing magnitude, adding the squares of the values and extracting the square root of the sum, excluding those signals which are less than 50% of the RSS value of the higher signals already included. The RSS value will not be considered to be increased when a new interfering signal is added which is less than 50% of the RSS value of interference from existing stations and which is, at the same time, less than the smallest signal included in the RSS value of interference from existing stations.

(c) *Sky Wave Interference to Sky Wave Service (Single Signal Rule)*

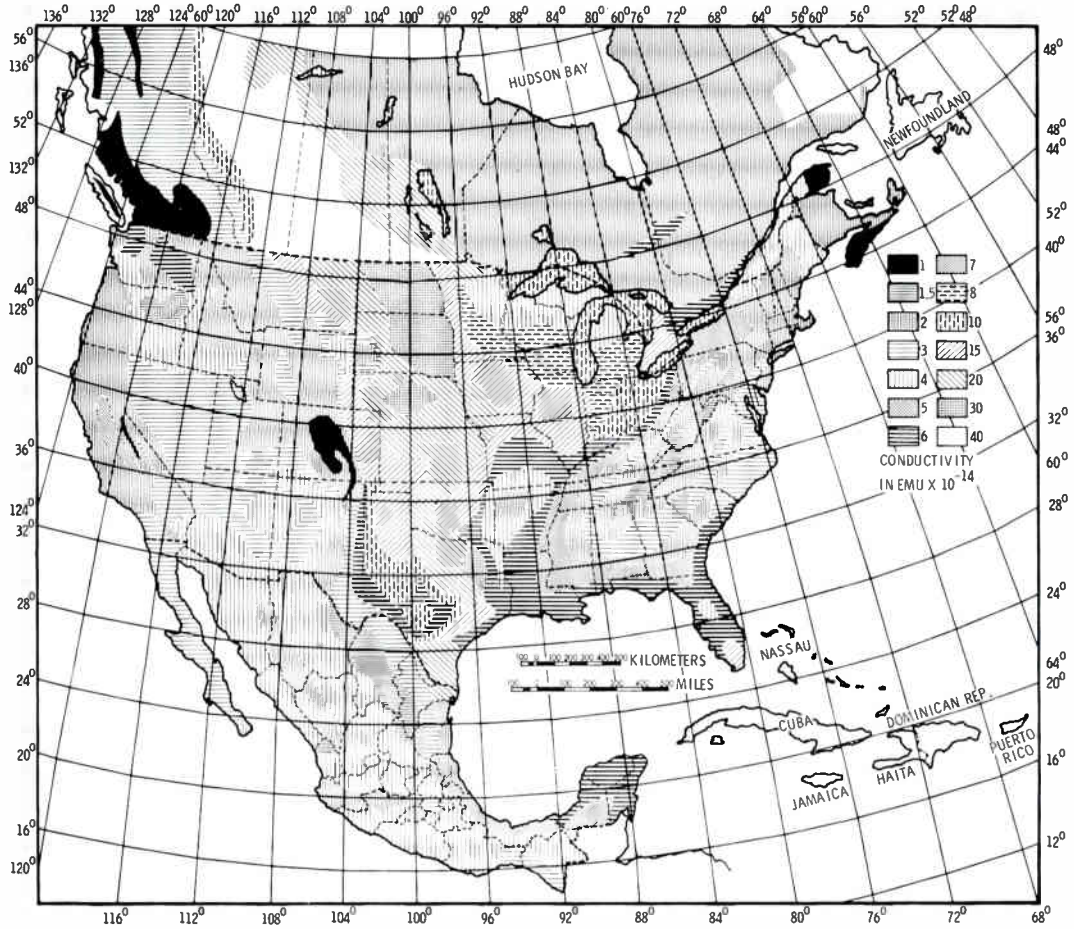
Each interfering sky wave signal is considered without reference to other existing interfering signals. If because of a previous assignment, one interfering signal at a point on the pertinent geographic or 50% sky wave signal intensity contour is in excess of the prescribed value, interfering signals from other countries are nevertheless required to remain below the maximum value prescribed in Appendix B.





Note: These are simplified reproductions of the NARBA curves.

APPENDIX H—Map of Conductivity of the North American Region



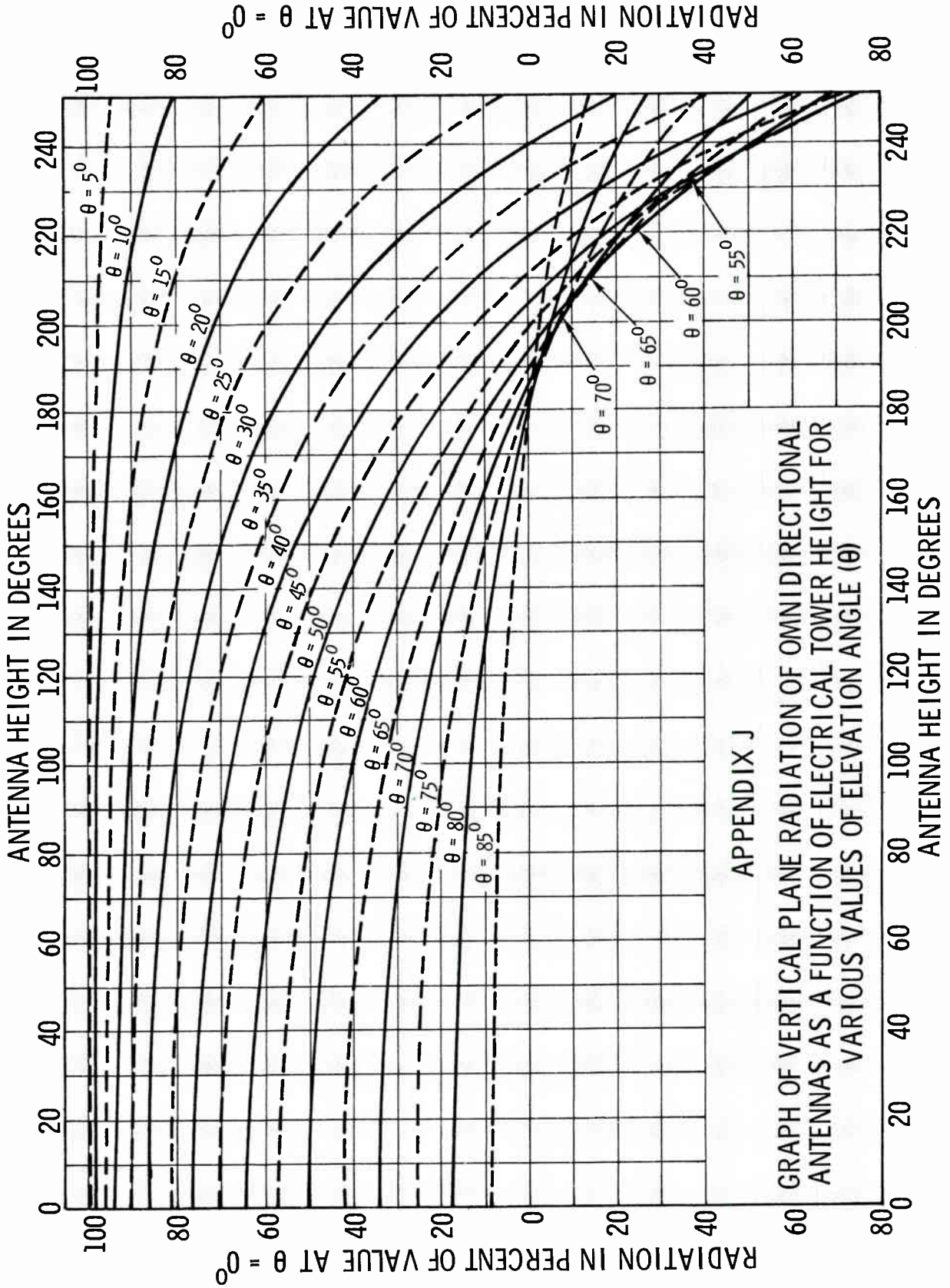
Note: This is a simplified reproduction of the NARBA map.

APPENDIX I
GROUND WAVE FIELD INTENSITY VERSUS DISTANCE CURVES

Editor's Note: This appendix consists of 20 sets of curves which correspond to the graphs contained in Section 73.184 of the FCC Rules and Regulations.

APPENDIX J

Editor's Note: Appendix J consists of a family of curves showing vertical-plane radiation as a function of antenna height for omnidirectional antennas. The graph is reproduced in simplified form below.



• *Please turn to page 46.*

Model 635A Dynamic Microphone $82.00 List. (Normal trade discounts apply.)

How can a microphone as good as the E-V Model 635 be made obsolete? By making it better! It wasn't easy. After all, professional sound engineers have depended on the 635 since 1947.

During this time, the 635 earned a reputation for toughness and dependability that was unrivalled by other omnidirectional dynamics. And internal changes through the years have kept the 635 well in the forefront of microphone design.

But now the time has come for an all new 635: the Electro-Voice Model 635A. It's slimmer, for easier hand-held use. Lighter, too. With a slip-in mount (or accessory snap-on Model 311 mount) for maximum versatility on desk or floor stands. The new, stronger steel case reduces hum pickup, and offers a matte, satin chromium finish perfect for films or TV.

The new 635A is totally new inside, too—and all for the best. A new four-stage filter keeps "pops" and wind noise out of the sound track, while guarding against dirt and moisture in the microphone, completely eliminating any need for external wind protection. Of course you still get high output (—55db) and smooth, crisp response. And you can still depend on the exclusive E-V Acoustalloy® diaphragm that is guaranteed against failure for life* (it's that tough)!

We expect to see plenty of the "old" 635's in daily use for years. But more and more, the new 635A will take over as the new standard. It's easy to find out why: just ask your E-V Professional Microphone distributor for a free demonstration in your studio. Or write us today for complete data. We'll be proud to tell you how much better the new Model 635A really is!

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*The E-V Professional Microphone Guarantee: All E-V professional microphones are guaranteed UNCONDITIONALLY against malfunction for two years from date of purchase. Within this period, Electro-Voice will repair or replace, at no charge, any microphone exhibiting any malfunction, regardless of cause, including accidental abuse. In addition, all E-V microphones are GUARANTEED FOR LIFE against defects in the original workmanship and materials.

ELECTRO-VOICE, INC., Dept. 47IV, 638 Cecil Street, Buchanan, Michigan 49107.

Electro-Voice®
SETTING NEW STANDARDS IN SOUND

April 1967

We interrupt this magazine to bring you...

Late Bulletin from Washington

by Howard T. Head

Cuba No Respecter of NARBA

A number of recent reports make it plain that standard broadcast operations in Cuba are departing more and more from the provisions of NARBA (the North American Regional Broadcasting Agreement), which governs the use of the standard broadcast channels in the North American region. Monitoring reports in the U. S. indicate the Cubans are employing high power on many of the clear and regional channels, in disregard of the treaty provisions which limit power on the regional channels and establish a priority system on the clear channels. Also, jamming signals from Cuba are frequently heard on channels used by the Voice of America and some U. S. commercial stations which carry programs in Spanish beamed toward Cuba.

The Commission has received reports that several transmitters with powers in excess of 50 kw are either in operation or under construction. These problems are known to be under consideration by both the FCC and Department of State, but there appears to be little hope for any definitive action to resolve broadcasting problems between the U. S. and Cuba.

CATV On-Channel Carriage near Technical Solution

New CATV equipment which is expected to be available soon should go far toward solving problems of cochannel interference in strong-signal areas, where cable and radiated signals on the same channel both enter the receiver. Operators of CATV systems have long insisted that on-channel carriage of a television station is not technically feasible in many instances because of this interference. Where this is the case, the channel capacity of the system is reduced, since the channel is likewise not available for the carriage of other program material.

Although the radiated signal may enter the television receiver from a number of sources, the principal problem appears to be the failure of baluns to reject the currents set up by voltages induced on the outer conductors of CATV drop cables. Improved baluns will be available shortly, providing very substantial improvement in the rejection of these unbalanced currents.

Another solution will be provided by special CATV converters, which will accept the unbalanced CATV cable signal directly for conversion to a balanced output on an unused television broadcast channel. Twelve-channel converters built on this principle are already available in limited quantities, and twenty-channel converters are under development.

FCC Softening On FM Separation Requirements

In at least one instance, the Commission has relaxed the mileage-separation requirements of the FM channel-allocation standards so as to permit a different site for an authorized FM transmitter. The original grant authorized operation at a site meeting all mileage-separation requirements. However, the permittee subsequently requested and obtained permission to build instead at his AM transmitter site, pointing out the need for economy in the early stages of FM operation. The short-spacing was less than a mile, and was not opposed by the affected station.

Thus far, waivers of this type have been granted only in cases of existing or authorized stations. There does not yet appear to be any disposition on the part of the Commission to waive the mileage-separation requirements, even by small amounts, to permit the making of new FM channel assignments.

Short Circuits

Prior coordination with the Interior and Agriculture Departments is now required for any proposals involving the construction of radio facilities on land under their control (see June 1966 Bulletin) . . . An AM licensee in Pennsylvania has been fined substantially for technical violations which included unauthorized operation with the nighttime directional antenna during daytime hours. . . A California court has ruled that unauthorized persons may not intercept FM multiplex (SCA) programs without permission. . . A Memphis, Tennessee television station has proposed that the power limit for VHF television translators be increased from 1 watt to 5 watts. . . NAB has opposed an FCC proposal to require all Class-C FM stations to increase ERP to at least 50 kw within five years.

Howard T. Head. . . in Washington

(continued from page 41)

APPENDIX K
ABBREVIATIONS

kc/s	—	kilocycles per second
W	—	watts
kW	—	kilowatts
U	—	unlimited time (day and night)
D	—	day-time only
N	—	night-time only
S	—	shared hours of operation with other co-channel broadcasting stations when used in connection with the operating hours of a broadcasting station
S.H.	—	specified hours of operation
ND	—	omnidirectional or non-directional
PO	—	present operation
mV/m	—	millivolts per meter
μV/m	—	microvolts per meter
f	—	frequency
θ	—	angle above horizon
MEOV	—	maximum expected operating value
RSS	—	root sum square
SYNC	—	synchronous operation
DA-1	—	directional antenna: the digit indicates same pattern but not necessarily the same power day and night.
DA-2	—	directional antenna: the digit indicates different patterns day and night, with either the same or different power day and night.
DA-N	—	directional antenna: the "N" indicates directional antenna used for night-time operation only; omnidirectional day.
DA-D	—	directional antenna: the "D" indicates directional antenna used for day-time operation only.
e.m.u.	—	electro-magnetic unit
σ	—	conductivity
Vide	—	see assignment on

FINAL PROTOCOL
To the
North American Regional Broadcasting Agreement
Washington, D. C., 1950

At the time of signing the North American Regional Broadcasting Agreement, Washington, D.C., (1950), the undersigned Plenipotentiaries take note of the following reservations:

For Cuba:

The Delegation of Cuba, considering that this Agreement provides technical formulae which offer appropriate protection at the boundary of the country for which there is a recognized priority for Class I-A broadcasting stations, declares on signing this Agreement that it makes formal reservation and does not accept any obligation with reference to the provision of Note (3). Appendix B, Annex 2 which contains the so-called "650 mile rule."

For Dominican Republic:

The Delegation of the Dominican Republic, in accepting the "650 mile rule" established in Note (3), Appendix B, Annex 2, declares that it undertakes no obligation in regard to the application of said rule in respect to Class I-A stations which, in accordance with the provisions set forth in the Note of Appendix A, of said Annex 2, may be situated in Puerto Rico or the Virgin Islands.

In WITNESS WHEREOF, the respective Plenipotentiaries have signed this Final Protocol of Signature in the English, Spanish and French languages, in a single copy which shall be deposited in the archives of the Government of Canada. The texts in each language shall be equally valid. An authentic copy thereof shall be forwarded by the Government of Canada to the Government of each country in the North American Region, to the Secretary General of the International Telecommunication Union and to the Agency performing the notification exchange function.

DONE at Washington, D.C., this fifteenth day of November, 1950.

Miratel

MC19 COLOR series

FEATURES:

The MC19 Series is a professional 19" color monitor available in either cabinet or rack mounting. The monitor was designed for broadcast studio requirements and includes many features recommended by broadcast users.

There are two basic chassis configurations, one offering fully regulated power supplies, the other offering unregulated low voltage supply. The deluxe model includes three looping video inputs with a front panel selector switch, also underscan with front panel size and convergence controls.

Both models include an aperture corrector to provide high frequency boost when desired.

Independent control of each gun permits setup in any desired sequence, setup select switch is provided. A high stability sync tip clamp provides accurate dc tracking, plus a proven decoder with calibrated chroma insuring optimum chroma fidelity.

The standard unit weighs 85 pounds. Power consumption 275 watts nominal.

SPECIFICATIONS

TECHNICAL DATA:

Input Power:
275 watts, 120 volts, 60 Hz (525/60 cycle N.T.S.C.). 3-wire line cord, 8′ long.

Video Input Signal:
0.5V peak to peak, minimum. Sync negative.

Video Input:
Three, high impedance bridging inputs.

External Sync:
High impedance, 1-8 volts.

Video Response:
Adjustable beyond 3.58 M Hz by internal aperture corrector.

Linearity:
Better than 2%.

TUBES:

RCA19EYP22 Kinescope

Tube and Transistor

Deflection and Sync Circuits

MECHANICAL:

Height	21⅝″
Width	23¼″
Depth	16½″

MODEL NO.	NET PRICE
MCR19MD — Deluxe-regulated	$975.00 ea.
MCR19RD — Deluxe-regulated	965.00 ea.
MCU19MD — Deluxe-unregulated	695.00 ea.
MCU19RD — Deluxe-unregulated	685.00 ea.
MCR19M — Standard-regulated	895.00 ea.
MCR19R — Standard-regulated	885.00 ea.
MCU19M — Standard-unregulated	595.00 ea.
MCU19R — Standard-unregulated	585.00 ea.

All prices FOB, St. Paul, Minnesota. Prices subject to change without notice.

CONTROLS:

Front panel controls, primary

*1. Underscan
2. Brightness
3. Contrast
4. Aperture
5. Saturation — chroma
6. Hue
7. Internal/external sync
*8. Channel selector 1-2-3
9. Power Switch — On/Off

Secondary Group — Behind Panel

1. Vertical and Horizontal Hold
2. Vertical Size and Vertical Linearity
3. Focus
*4. Underscan
5. Vertical hold
6. Width
*7. Convergence 1-2-3
8. Convergence Controls — 16 — Three on Underscan
9. Vertical Center
10. Blue cathode drive
11. Green cathode drive
12. Red, Blue and Green Screen controls
13. Kine bias
14. Service Normal switch (setup)
15. Color killer control
16. Manual degaussing switch

REAR APRON CONTROLS, INPUTS:

1. Horizontal Centering
2. Voltage Regulator Adjustment
3. Course Horizontal Hold
4. SO239 Looping External Sync Input
*5. 3-SO239 Looping Video Signal Inputs
6. Main Power Circuit Breaker
7. High Voltage Fuse
8. AC Power Cord

*Deluxe models only

Miratel

3600 RICHARDSON STREET, NEW BRIGHTON
ST. PAUL, MINNESOTA 55112 633-1742

BOOK REVIEW

Television Film Engineering: Rodger J. Ross; John Wiley & Sons, Inc., New York, 1966; 507 pages, 6″ x 9″, hard cover, $15.00.

This volume has been designed to serve as a complete reference work for those whose television or motion-picture work involves a relationship between television and film.

Part One is comprised of three chapters which deal with the film process, the television system, and films for television use. Each is a relatively complete technical description of its subject, with particular emphasis on industry standards, recommended practices, and practical applications.

Part Two is devoted to the "Measurement and Control of the Image-Forming Process," and covers the subjects of sensitometry (including density, gray-scale, etc.), film speed and exposure control, and the control of film processing.

Part Three serves to link the motion-picture process with a television system by showing how film can be evaluated for television use, and how exposure standards can be established and maintained throughout both systems. This part also explains in detail the film sound in both the cine and magnetic process, and how film can be used for television recording. The last chapter deals with color film and color television.

This work is thorough, covering quite technical material, but it does so in a way that permits a technician or engineer with little or no cinematographic experience to become familiar with the technical requirements and interrelationships of motion-picture film and television. Special emphasis is placed on 16-mm film, with particular reference to commercially available film and equipment and its practical application in professional television film production and projection.

The book is almost completely devoid of mathematics and can serve as both a text and standard reference on its subject. ▲

NEWS of the Industry

NATIONAL

To Discontinue Models

Vitro Electronics, producer of Nems-Clarke equipment, is discontinuing the Model 120E Field Intensity Meter and the Model 108E Phase Meter from its standard line of proprietary equipment. The Model 120E has been replaced by the solid-state FIM-135 Field Intensity Meter. The Model 108E has been replaced by the solid-state Model 112 Phase Monitor, which provides direct readout of phase angle and loop current and is adaptable to remote operation.

Southwest Representative Appointed

Broadcast Supply Inc. has been appointed sales representative in the Southern California, Arizona, and Southwestern Nevada territory for **Teletronix,** division of **Babcock Electronics Corp.** The company, headquartered at Fountain Valley, Calif., will represent the complete Teletronix line of broadcast transmitting and audio equipment.

Tubeless Television Camera

A tubeless television camera smaller than a man's hand has been built by the **Radio Corporation of America.** The experimental camera was developed at RCA Laboratories in a research program sponsored by the U. S. Air Force Avionics Laboratory, RTD, Wright-Patterson Air Force Base.

The camera, which can be operated on battery power, takes pictures by means of networks of 132,000 thin-film devices deposited on four glass slides one-inch square. Among the thin-film elements are some that respond to the presence of light and others that perform various circuit functions; thus the networks take the place of the conventional pickup tube and other picture-processing elements

EIMAC 15 kW tetrode offers high power gain for advanced transmitters

Most new high-power 20 kW FM transmitters use the EIMAC 4CX15,000A tetrode for service as a Class-C amplifier. The tube features a new internal mechanical structure which minimizes rf losses, and is capable of operation at full power ratings to 110 MHz. EIMAC also recommends the 4CX15,000A for 220 MHz operation at lower power levels for VHF-TV transmitters. ■ EIMAC's long experience in tube technology and ceramic-to-metal sealing leadership have combined to produce a tetrode of optimum design and structural integrity. That's why the 4CX15,000A is used in more new transmitters than any other ceramic tetrode with similar characteristics. For more information write Product Manager, Power Grid Tubes, or contact your nearest EIMAC distributor.

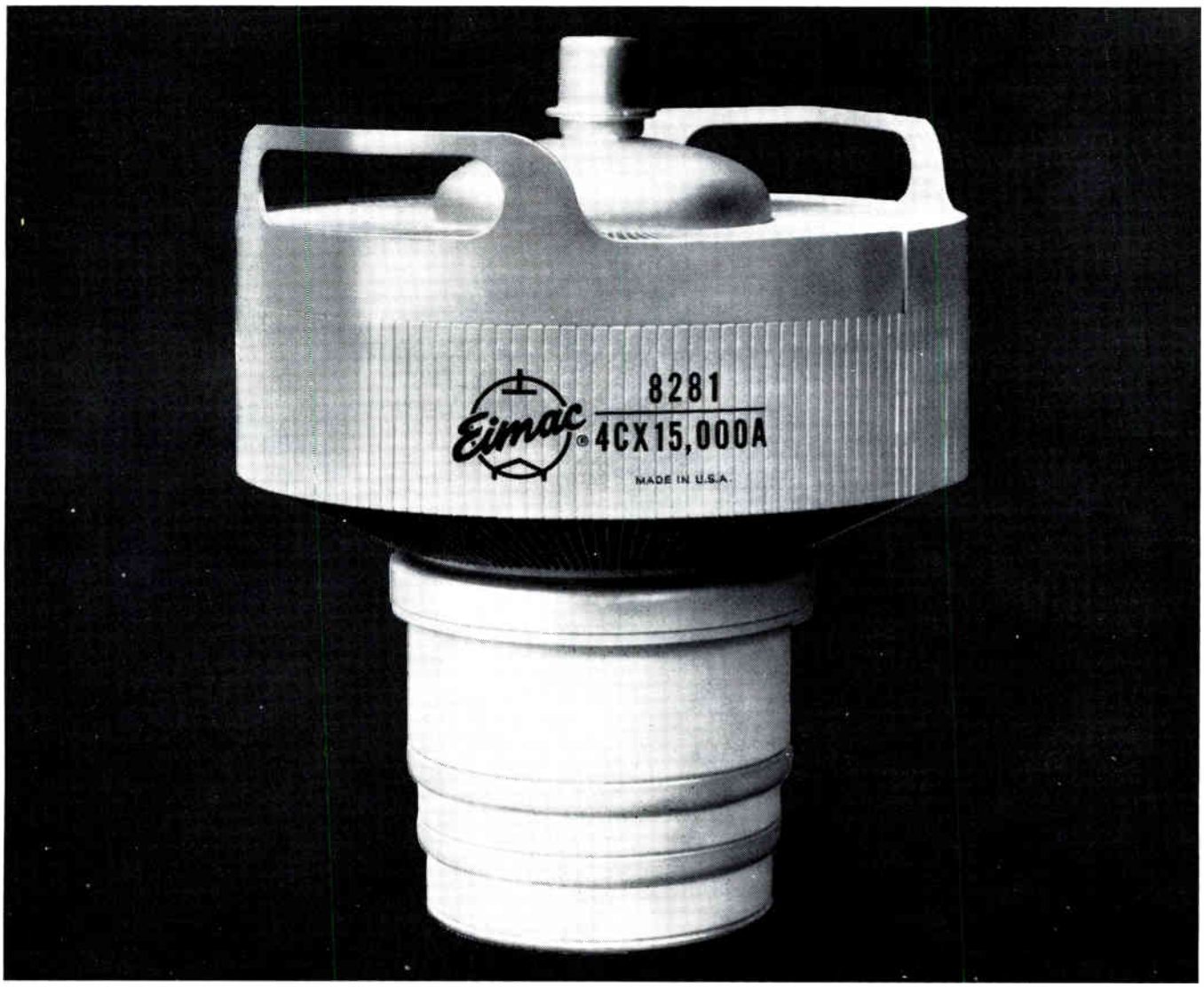
RADIO-FREQUENCY POWER AMPLIFIER OR OSCILLATOR

Class-C Telegraphy or FM Telephony (Key-down conditions)

MAXIMUM RATINGS

DC PLATE VOLTAGE	10,000 MAX. VOLTS
DC SCREEN VOLTAGE	2,000 MAX. VOLTS
DC PLATE CURRENT	5.0 MAX. AMPS
PLATE DISSIPATION	15,000 MAX. WATTS
SCREEN DISSIPATION	450 MAX. WATTS
GRID DISSIPATION	200 MAX. WATTS

EIMAC
Division of Varian
San Carlos, California 94070



Circle Item 16 on Tech Data Card

of a standard television camera. A miniature transmitter, separate from the camera and employing conventional transistors, makes it possible to send the pictures directly from the camera to a television receiver.

The image-sensing area of the experimental camera consists primarily of 32,400 microscopic dots of photoconductive material deposited at the intersections of thin metal conductors that have been evaporated onto a glass slide in a grid pattern. Along two of the four edges of the image-sensing slide are attached two other slides, on each of which have been deposited circuits containing 540 thin-film transistors. These are arranged in such a way that the output transistors of one slide connect with all of the horizontal lines in the image-sensing grid, and the output transistors of the other slide connect with the vertical lines of the grid. A fourth slide carries arrangements of thin-film elements that perform a variety of control functions.

The camera is operated by focusing the televised scene onto the image-sensing array and employing the transistor circuits to scan the array to produce a television signal. As the scene is focused on the sensing array, the various photoconductive dots reduce their electrical resistance in proportion to the amount of light falling on them. An electric pulse is generated in one of the transistor arrays and sent along the vertical lines of the sensing grid, one after another, from left to right, until all have been scanned. As this pulse passes through the photo-conductive dots on each line, each dot that is exposed to light conducts in proportion to the strength of the light. At the same time, the transistors in the second array are used to sample each of the horizontal lines in succession from top to bottom of the sensing grid. This discloses the pattern of conductivity in the photoconductive dots to create an electrical counterpart of the light pattern in the original scene. The entire image-sensing array is scanned 60 times per second, a rate consistent with the scanning rate of a conventional television camera.

The organization and read-out of the photoconductive dots in the sensing array are closely similar to the organization and read-out of data in a standard computer memory. For this reason, it is possible to send pictures from the camera directly to a computer for processing or storage.

At present, the developers report the experimental camera is inferior in resolution, sensitivity, and speed to a conventional television camera. However, they expect to overcome many of these limitations in the future by adopting new circuit ideas and by developing photoconductive arrays with as many as ten times more light-sensing elements than are used in the experimental model.

CATV Outlook Predicted

The CATV industry emerged from the problems and controversies of the past year stronger, more mature, and better able to deal with the challenges of the future, according to Robert H. Beisswenger, president and chief executive officer of the **Jerrold Corp.** Mr. Beisswenger stated that, despite new legislation and governing actions, the strong public needs for better television reception and wider programming choice have resulted in continued steady forward motion of CATV.

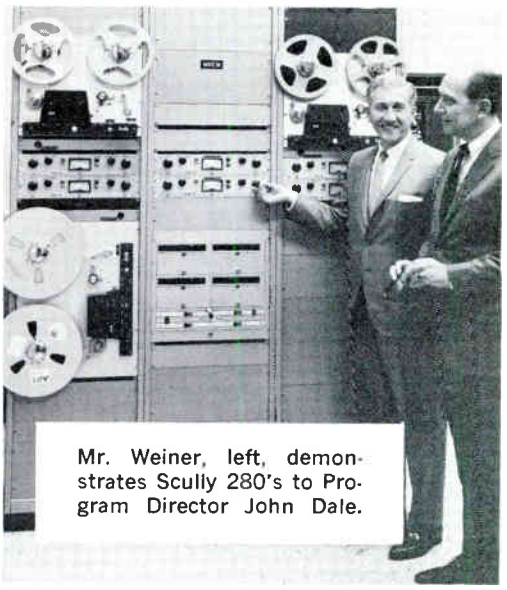
"New York's Great New Sound is WNEW-FM- 'Where The Girls Are'— backed up by our Scully 280's."

MAX WEINER
Chief Engineer
WNEW, New York

WNEW-FM is only one of a growing parade of broadcasters who specify SCULLY recording equipment because its superior performance is proven by the toughest test of all; the daily grind of schedules that must be met without a hitch. SCULLY offers the finest solid-state instrumentation available plus **exclusive plug-in construction** . . . for minimum down-time, fast, easy repair when necessary, no complicated wiring disconnects or desoldering. Relays, modular sub-assemblies, electronic chassis solid-state amplifiers are **all plug in.** WNEW has 4 more coming.

"Seven Scully units in our FM control rooms give our recording crew the precision, flexibility and operational ease they demand."

Alison Steele, one of the three glamour gals who make the new sound on WNEW-FM 14 hours daily.



Mr. Weiner, left, demonstrates Scully 280's to Program Director John Dale.

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

Scully

Circle Item 19 on Tech Data Card

He sees "several significant trends, which have developed during the past year, and which will continue," and makes these seven predictions:

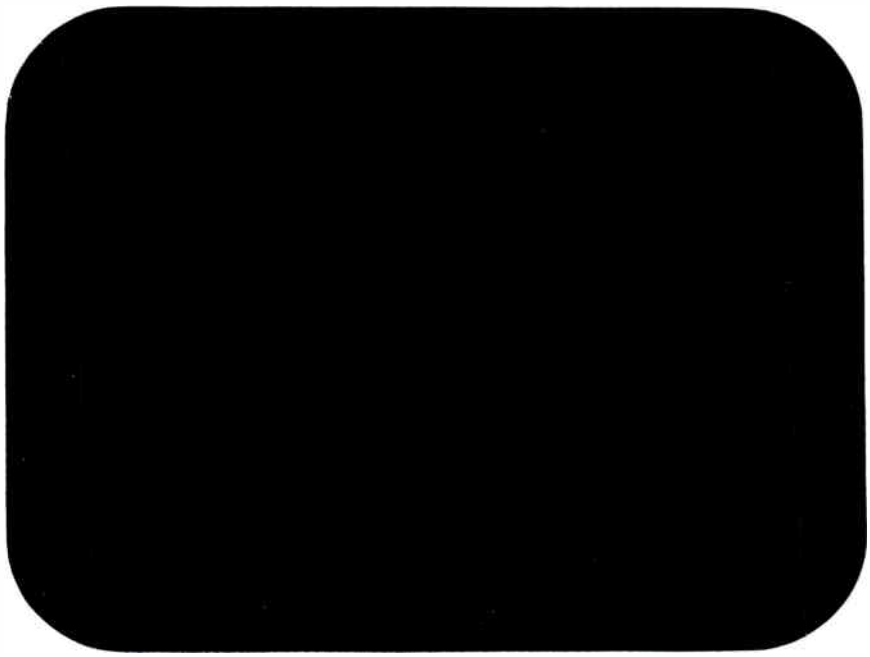
1. "Modernization of existing CATV systems should accelerate, generating increased demand for CATV hardware and system construction."
2. "More leading American companies will diversify into operation of CATV systems."
3. "The great surge of color television sales will continue to generate increasing consumer interest in CATV."
4. "The pace of new system 'starts' will quicken."
5. "During this period of rising prices, monthly charges for CATV service will remain stable."
6. "The CATV and broadcasting industries will learn better to live together and to derive benefits from each other."
7. "Speculation about direct satellite-to-home broadcasting systems will continue, but these systems will not pose any threat to CATV in the foreseeable future."

OBITUARY

Lester H. Carr

Lester H. Carr, 56, electronics engineer and consultant in the com-

mercial and international broadcast fields, died January 2 in Washington after suffering a heart attack Christmas Eve. Mr. Carr was the founder and former president of DECO Electronics, Inc., and of Developmental



Cold camera

on the air in 30 seconds at WBAL-TV.

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

Camera is aligned and locked in fixed position in a small announce booth studio. Few lights are used due to the excellent low-light capabilities of the camera. And as a result, no additional air conditioning facilities are required. While desk and chair are fixed furnishings, backdrop can be quickly changed to fit any presentation situation.

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

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

mti MARYLAND TELECOMMUNICATIONS, INC.

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

Circle Item 22 on Tech Data Card

Engineering Corp. He sold the DECO firm in July 1966 to Westinghouse Electric Corp. and became manager of the newly created DECO Communications Department.

Born in Elk River, Minn., he received his B.E.E. degree from the University of Minnesota in 1934. He was employed with Radio Station KSTP of Minneapolis-St. Paul from 1933 to 1940, rising to the position of chief engineer. He then became transmitter engineer in charge of the Columbia Broadcasting System's Central Division covering radio stations WBBM, Chicago, and KMOX, St. Louis. From 1942 to the end of World War II, he served as a consulting engineer with the U. S. Navy Bureau of Ships, working principally in the fields of navigation and antenna systems.

In 1945, Mr. Carr and another Government engineer, James Weldon, formed Weldon & Carr, consulting radio and television engineers. In 1947, the two partners formed Continental Electronics Manufacturing Co., with Mr. Carr serving as vice-president until its sale to Ling-Temco-Vought in 1959.

In 1952, he formed Developmental Engineering Corp. to specialize in research and development in the fields of antenna and electronics systems engineering. In 1957, he acquired Scatter Communications, Inc., and also formed his own broadcast consulting firm, L. H. Carr and Associates. Developmental Engineering Corp. and Scatter Communications were merged in 1961 to form DECO Electronics, Inc.

PERSONALITIES

James E. Landy has become sales manager for broadcast equipment of **Central Dynamics Corp.** Mr. Landy was formerly with the U.S. Information Agency as chief of studio and remote operations for the Motion Picture and Television Service, and prior to that with RCA as broadcast engineering salesman.

Marcus L. Winchester has been appointed CCTV sales engineer for **Blonder-Tongue Laboratories, Inc.** He will be responsible for establishing and servicing closed-circuit television accounts in the southeast and southwest. Prior to joining Blonder-Tongue, Mr. Winchester had been associated with Specialty Distributing Co. for over eleven years as sales engineer handling closed-circuit television, master antenna television, sound, and special systems accounts. ▲

FULL COLOR SLIDE REPRODUCTION

...at a fraction of the cost

COLOR FLYING SPOT SCANNER,
MODEL 3420-A1
Monochrome Model 3401-A1 also available

This new Telemet Color Flying Spot Scanner is an ideal color slide source. Compact in a 19″ slide frame, 2″ x 2″ slide callups can be reproduced with or without remote. This exceptional unit also features a built-in power supply, built-in gamma amplifier, 600 line resolution, and AGC with optional threshold control. Use with Telemet's new Solid State Color Encoder, Model 3251-A1, for the ultimate in compact color systems.

TELEMET COMPANY
185 DIXON AVE., AMITYVILLE, NEW YORK 11701 • PHONE (516) 541-3600

Circle Item 26 on Tech Data Card

NEW PRODUCTS

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

Solid-State Test Oscillator

(47)

The solid-state **Hewlett-Packard** Model 651B test oscillator covers the spectrum from 10 Hz to 10 MHz in six continuously variable ranges. A dual amplitude control (coarse and fine) facilitates amplitude adjustments. Model 651B was designed for fast, accurate measurements of television amplifiers, filter networks, tuned circuits, and telephone and telegraphic carrier equipment.

Specifications include: frequency response flat within ±2% from 100 Hz to 1 MHz; dial accurate within ±2%, from 100 Hz to 1 MHz; short-term frequency stability, in normal laboratory environments, typically ±0.02%/22 hours; typical amplitude stability ±0.1%/17 hours; output 200mw into 50Ω, 16 mw into 600Ω, or 6.32 V open circuit. Either output is controlled by a 90-dB attenuator in 10-dB steps (±1%).

Two options are available. With Option 01, the 651B output monitor top scale is calibrated in dBm 600Ω, bottom scale calibrated in volts. With Option 02, the 651B output is available in 75Ω and 600Ω.

Model 651B is housed in a Hewlett-Packard 5¼" x 16¾" x 13¼" rack-convertible module. Prices are $590 for Model 651B, $615 for 651B option 01 or option 02.

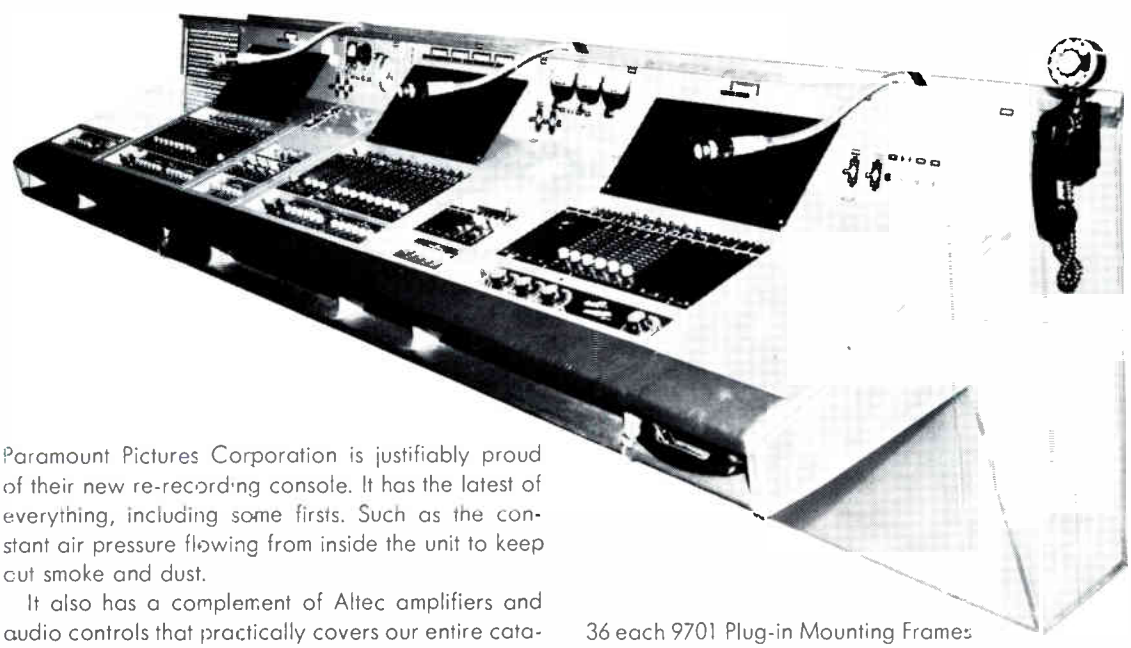
Remote-Controlled Zoom Lens

(48)

Zoomar, Inc. has redesigned its Mark IV remote-controlled industrial-

Three months of competitive 'in use' tests is the reason Paramount chose Altec Audio Controls for their new solid-state console.

Good Reason.



Paramount Pictures Corporation is justifiably proud of their new re-recording console. It has the latest of everything, including some firsts. Such as the constant air pressure flowing from inside the unit to keep out smoke and dust.

It also has a complement of Altec amplifiers and audio controls that practically covers our entire catalog. With good reason. Bruce Denney, Paramount's Assistant Sound Department Head, took three months to test competitive products under actual use. The end result is rewarding.

Here's the list of Altec products used:

36 each SM8272-01-GG Straight Line Mixers
36 each 9611 Escutcheon Plates
4 each RA8400-01 Unbalanced Calibrated Attenuators
30 each 9470A Preamplifiers
5 each 9550A Power Supplies
30 each 9850A Trays
5 each 9852A Trays
6 each 9800A Rack Mounting Frames
36 each 9701 Plug-in Mounting Frames
4 each 7160 VU Meters
1 each 9060A Microphone Equalizer
5 each 9061A Program Equalizers
7 each 9073A Graphic Equalizers
6 each 9069A Variable High Pass Filters
2 each 9068B Variable Low Pass Filters
4 each 9066 Fixed Filters
60 each LP8004-00 Fixed Loss Pads
Monitoring and playback speakers:
3 each A4X "Voice of the Theatre"® Systems
1 each custom monitor with A7-500 system components

Our components were supplied by California Sound Products, Inc., an Authorized Altec Distributor. There's an Altec Distributor in your area who would be happy to discuss your custom-console needs with you. Give him a call, or write Dept. BE 4 for our complete Audio Controls catalog. There are lots of good reasons to do it now.

A Division of LTV Ling Altec, Inc.
Anaheim, California 92803

ALTEC LANSING

Circle Item 29 on Tech Data Card

TV zoom lens. The new model, designated the Mark IV-B, is shorter and cylindrical in shape. Weight has been reduced from 4 to 3 pounds. This has been achieved by redesigning the drive motors and gear system to permit more dense packaging.

The Mark IV-B lens offers speed and focal length ranges as follows: F/2, 17 mm to 70 mm; F/2.8, 30 mm to 125 mm; F/4, 35 mm to 140 mm.

Three accessory close-up lenses which do not require a retainer ring are available. The same control box used with the Mark IV lens will also serve the Mark IV-B.

Video/Audio Control Unit

(49)

This new control unit is designed

by **Dynair Electronics, Inc.** to facilitate the manual or automatic programming of television in instructional television systems, CATV systems, or in any application requiring simultaneous switching of many program sources to multiple output channels.

The basic Salvo Control Unit allows the operator to preselect five inputs on each of four 15-input, 5-output program boards. The selected five inputs of a given board may then be switched to the five program output lines by depressing a related push button.

The actual switching is accomplished through a solid-state switching frame controlled by DC voltages directed through the four computer-type patch boards of the control unit. The same voltages control audio relay racks when audio video switching is specified. Custom units are available for various numbers of inputs, outputs, or program changes.

The unit may be controlled locally by the use of four interlocked push buttons on the front panel. A fifth push button provides facilities for remote program actuation, which may be accomplished by an identical set of four push buttons. If desired, the unit may be controlled by a time clock, providing completely automated programming.

Quartz Lighting Kits

(50)

Three new lightweight and compact "quartz" lighting kits have been introduced by **ColorTran Industries, Inc.** The kits are intended to provide flexible and efficient lighting arrangements for motion picture, TV, and still photography, both for location use and in studio applications.

Each kit contains tungsten-halogen "quartz" light fixtures with related ac-

cessories such as barndoors, scrims, gaffer grips, and aluminum stands in a self-contained, single fitted carrying case. The foam-lined carrying cases, with adjustable foam-lined partitions, are designed to give the lighting equipment maximum protection against shock.

The fixtures selected for each kit provide controlled lighting, permitting a focusing range from spot to flood, plus "fill" lights where broad, even coverage is desired.

The 19-piece Flight Kit weighs 36 pounds and is priced at $480.30. The 25-piece Location Lighting Kit (shown) weighs 54 pounds and is priced at $646.95. The 26-piece Cameraman's Lighting Kit weighs 32 pounds and is priced at $527.55.

Television Camera

(51)

A new photoconductive black-and-white television camera, the Mark VI, has been developed by the **Marconi Co.** The camera, in its basic form, is designed for telecine operation using a vidicon tube. This basic unit can be built up into a studio or outside broadcast camera, using a number of additional units. In these applications, a Plumbicon® camera tube is used.

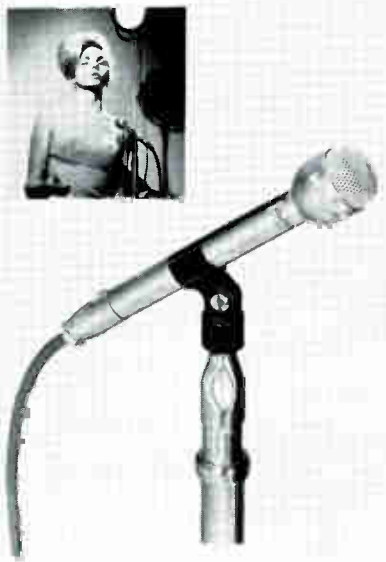
Many standard features from other Marconi cameras have been included in the Mark VI, to provide maximum compatibility. The camera uses similar types of zoom lenses to the Mark V image-orthicon camera and the Mark VII color camera. The tilting viewfinder used on these cameras has also been used on the new unit. The camera cable is common to the Mark V and its predecessor, the Mark IV.

The Mark VI is built to be usable with illumination levels down to 50 foot-candles or less. The camera is fully transistorized and designed to provide sufficient stability for "hands-off" operation.

Cardioid Microphone

(52)

A dynamic "super-cardioid" microphone, the RE15, has been created by **Electro-Voice, Inc.** for professional applications. Frequency response of the microphone is nearly independent of angular location of sound source to minimize off-axis coloration and pickup of unwanted sounds. The "super-cardioid" directional pattern



of the RE15 has greatest sound rejection, up to 26 dB, at 150° off-axis, where it is needed most for stand or boom use. At other points, its pattern is a closely controlled classic cardioid.

The slender steel case, internal mechanical nesting method of construction, and nonmetallic Acoustalloy® diaphragm are intended to add ruggedness and reduce noise generated by AC lines, cable friction, or mechanical shock. The light weight of the microphone makes it useful for pass-around situations and interviews, and the satin nickel finish minimizes reflections for on-camera use under bright lights. Frequency response of the microphone is listed at 60 to 15,000 Hz, and output level is −55 dB. The RE15 incorporates a "bass tilt" switch to aid in overcoming boomy acoustical conditions.

A broadcast-type cable and a Model 310 stand clamp are provided. Professional user's net price is $153.

Tower System
(53)

A free-standing tower system eliminating piece markings and allowing

many combinations of height and loading is a product of **Andrews Towers, Inc.** The free-standing tower of certain heights can be erected in as little as ten hours without benefit of plans or drawings. The system is fabricated on a series of jigs built into the plant as a component part of the manufacturing facilities.

The entire tower system is based upon a 1000-foot tower divided into sections. Each section has a series of struts, rods, and welding plates that are of the same length and are interchangeable within that particular section. From the base upward, component parts of higher sections are some six inches shorter than the components of the section beneath; thus none of the components need be marked. Erection crews simply select the longer components first and then erect them.

From the various sections of the 1000-foot basic structure, towers can be assembled to meet a variety of conditions of wind load, antenna load, antenna reflectors, and height for VHF, microwave, and television applications.

Direct Vidicon Replacements

(54)

Two direct-replacement vidicons built to meet the specification/performance requirements of several popular types are offered on a 90-day free-trial basis through **Amperex Electronic Corp.** franchised broadcast tube distributors.

The Amperex type 8483, designed for telecasting applications, serves as a direct plug-in replacement for types 7038, 7291, 7325, 7336, 7697, 7735A, and 7735B. The suggested resale price of the 8483 is $185. The Amperex 55852N, intended for highly critical pick-up requirements, is a direct plug-in replacement for types 8507, 8541, and 8572. Its suggested resale price is $250.

Unit Adds Color to B-W Facilities

(55)

The "Colorizer" allows a TV station not otherwise equipped for color to begin transmitting many color effects. These include spot color advertisements and the ability to fade to any color, to insert colors in black-and-white broadcasts, and to trans-

mit monochrome slides and station-identification letters and titles to home color receivers. The unit does not replace color cameras for live programs or color motion pictures.

The unit, which is about the size of a carton of cigarettes, will be sold for approximately $1500 by **Riker Video Industries.** Many stations already have the peripheral equipment necessary to utilize the Colorizer. It is estimated that those not having the necessary equipment will be able to acquire a complete package for making use of the Colorizer for about $4500.

Microphone System

(56)

A solid-state condenser microphone system, operable on either AC or DC, with optional cardioid or omnidirectional characteristics, has been added to the **Altec Lansing** line of microphones for the broadcast and recording industries. The system is available in Models M49 (AC/cardioid), M50 (DC/cardioid), M51 (AC/omnidirectional), and M52 (DC/omnidirectional). This system is intended to provide a flat frequency response from 20 to 20,000 Hz. The specified output level is 53 dBm re 10 dynes/cm^2.

Utilizing a microphone diaphragm under 0.5 inch in diameter, the system also features the 195A base employing an FET as an emitter follower. The separate power supply provides balanced outputs for standard 150/250-ohm microphone preamp inputs. The power supply is about the size of two back-to-back packs of cigarets and is finished in hard chrome. Two mercury batteries are intended to provide 2500 operational hours (up to a year in normal use).

Each system is provided with a wind/pop screen, microphone holder, and a 25-foot 2-wire shielded cable. Connectors and mounting hardware are attached.

The systems are designed to operate in a high-temperature ambient up to 55°C maximum (131°F). ▲

Engineers' TECH DATA

ANTENNAS & TRANSMISSION LINES

70. ANDREW—Technical Bulletin 251 describes line of phase-stabilized and phase-compensated coaxial cables for broadcast and other applications. Catalog 25 contains information on antennas, transmission lines, and related equipment.
71. ANDREWS TOWERS—Literature concerns passive reflector with interchangeable parts and provisions for adjustment from the tower.
72. CCA—Offered is catalog sheet on dual-polarized FM antenna.

AUDIO EQUIPMENT

73. CROWN INT'L—Subject of descriptive material is Model SA30-30, 60-watt solid-state stereo power amplifier.
74. DOBBS/STANFORD—Information on Butoba MT225 tape recorders and Stanford MB headphones and microphones includes price lists.
75. UNITED RADIO SUPPLY—Sheet gives specifications of Kustom Electronics broadcast console.

CATV EQUIPMENT

76. AEL—Individual sheets describe four new amplifiers in the Colorvue line of CATV equipment, Models CVT-1, CVT-1A, CVT-1B, and CVT-1AB.

COMPONENTS & MATERIALS

77. BARRY CONTROLS—Four-page Bulletin 10 provides information about **Noise-Damp** panels, housings, mufflers, and enclosures for noise isolation.
78. CAMBRIDGE THERMIONIC—**Product News** contains information on Cambion hardware; quick-selection chart is included.
79. CLAROSTAT—Thirty-two-page full-line catalog features potentiometers, field-assembled controls, power rheostats, resistors, sound-system attenuators, theater speaker controls, "Claro-Dec" precision decade boxes, shafts, bushings, rotary selector switches, and high-voltage couplers.
80. HOLLAND—Information sheet illustrates 75-ohm BNC video test termination.
81. FRAZAR & HANSEN—Short-form catalog covers Lemo line of Swiss-made, precision-machined connectors.
82. INT'L ELECTRONIC RESEARCH—Eight-page short-form catalog describes firm's line of semiconductor heat dissipators and heat-dissipating electron-tube shields; photos, tables, graphs, and prices are included.
83. MAGNECRAFT—Catalog sheet and brochure tell about telephone-type and coaxial relays for video and RF switching.
84. SHALLCROSS—Three catalogs list precision power and wirewound resistors, precision resistance decades, and precision instruments.
85. WESTINGHOUSE—Eight-page brochure has as its subject **Hipernom** alloy for magnetic shielding and laminations; also available is 36-page design handbook, "The When Why and How of Magnetic Shielding."

MICROWAVE & STL EQUIPMENT

86. MOSELEY ASSOCIATES—Bulletin 219 describes Model PCL-303 solid-state aural STL; Bulletin 221 describes Model ADP-101 automatic data printer for printing transmitter logs.

MISCELLANEOUS

87. MAGNE-TRONICS—Literature about motivational background music service for FM SCA operations is offered.

MOBILE RADIO & COMMUNICATIONS

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

RECORDING & PLAYBACK EQUIPMENT

89. AMPEX—Tips on extending the life of video tape through proper handling and storage are contained in Bulletin No. T059.
90. BROADCAST ELECTRONICS—Literature on Spotmaster tape-cartridge equipment gives specifications and price information on recorder/reproducer units, reproducer only, Ten Spot multiple units, audio distribution amplifier, remote amplifiers, equalized turntable preamplifier, tape-cartridge winder, and cartridge racks.
91. SPARTA—Descriptive material concerns Sparta-Matic CE-2 tape eraser for reels and cartridges.
92. STANCIL-HOFFMAN—Leaflets and data sheets describe Model S-7 Series magnetic film recorder-reproducers and Model R-70 Series magnetic tape recorders. Pamphlet explains basic theory and application of interlock motors for motion-picture synchronization.
93. VIKING OF MINNEAPOLIS—Subject of brochure is Studio 96 professional tape transport and associated electronics.

REFERENCE MATERIAL & SCHOOLS

94. BIRD ELECTRONIC—"Peaks Are-a-Mess" is title of application note PRMS-67, an essay on peak, rms, and average RF power.
95. CLEVELAND INSTITUTE OF ELECTRONICS—Pocket-size plastic "Electronics Data Guide" includes formulas and tables for: frequency vs wavelength, dB, length of antennas, and color code.
96. COLORTRAN—Issue No. 2 of **ColorTran News** features application stories of interest to the motion picture and TV industries.
97. DYNAIR—Four-page paper is titled "Hum Reduction in Video Systems."
98. HAYDEN—Catalog lists texts, professional books, and references for the scientist, engineer, and student.
99. INFO INC.—Catalog shows selection of special-purpose slide rules, calculators, slide charts, drawing aids, and kits.

TELEVISION EQUIPMENT

100. BLONDER-TONGUE—Four-page brochure on TC-Series transistor vidicon cameras includes features and technical data on general-purpose closed-circuit camera, camera with rack vidicon mount, camera with protection from effects of weather, and flush-mounted surveillance camera.
101. CLEVELAND ELECTRONICS — A 52-page quick-reference step-down die-cut catalog covers complete information on vidicon, **Plumbicon,** and image-orthicon deflection components.
102. COHU—3200 Series vidicon cameras, 1000 Series color television system, and 9830 Series color encoder are subjects of brochures.
103. COLORADO VIDEO—Data sheet describes Model 201 video converter for reducing normal TV signals to audio bandwidths.
104. INT'L NUCLEAR—Literature is about Model TDA7 transistorized plug-in video/pulse distribution amplifier.

• *Please turn to page 68*

Advertisers' Index

Professional Services

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CONSULTING RADIO ENGINEERS
Applications and Field Engineering
345 Colorado Blvd.
Phone: (Area Code 303) 333-5562
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Member AFCCE

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

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

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

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

Kits serviced, shipped. Professional, reasonable. Also small broadcast rack and table units, carts, tuners limiters. Write: 109 Pinetree, Woodbridge, Va. 4-67-tf

Classified

Advertising rates in the Classified Section are fifteen cents per word. Minimum charge is $2.00. Blind box number is 50 cents extra.

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

EQUIPMENT FOR SALE

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

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

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

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

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

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

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

New Sportsmaster cartridge equipment, QRK turntables, all models available, will take in any trade regardless age or condition. Audiovox. 4310 S.W. 75 Ave., Miami, Florida. 3-67-tf

CARTRIDGE TAPE EQUIPMENT

Completely reconditioned and guaranteed. Spotmaster Model 500 Record/Playbacks, $350.00. Model 505 Playbacks $250.00. 30-day money-back guarantee on all equipment.

BROADCAST PRODUCTS COMPANY

18804 Woodway Drive, Derwood, Maryland. 20855

(301)942-1224 3-67-12t

U-shaped Broadcast Console, Collins 808-A Remote Console, 2 A.T.C. Playbacks, 1 Recording Amplifier. Meades, 10800 Dale St., Space 715, Stanton, Calif. 3-67-5t

FOR SALE: Large assortment tube type television equipment, cameras, switchers, sync generators, stab amplifiers, power supplies, monitors, etc. Cox Broadcasting Corporation, 1601 West Peachtree Street, N. E., Atlanta, Georgia. 4-67-4t

VIDEO TAPE RECORDER — AMPEX VR1000C. Late model. One owner. Complete with Amtec and Intersync, two spare heads, fully optimized. Guaranteed better than new machine. Original investment over $70,000. Specially priced at $27,500, FOB Hollywood, Calif. Phone Gordon Enterprises, (213) 766-3725 or 877-2135. 4-67-1t

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

EQUIPMENT WANTED

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

"Arcturus" Catalog
A Trusted Name in Electronics Since 1925
FREE Catalog. Electronic parts, tubes. Wholesale. Thousands of items. Unbeatable prices.
ARCTURUS ELECTRONICS BE
502-22 street, Union City, N. J. 07087

EMPLOYMENT

Need general maintenance technician with first phone and some experience in broadcasting. Salary commensurate with radio and television maintenance experience. Send resume and phone number to George Wussow, KHSL-TV, P.O. Box 489, Chico, California 95926. 4-67-3t

Top quality TV broadcast engineer. Prefer tech school grad or extensive military electronics. Opportunity to develop full potential with five-station AM and TV network. Contact Mike Rastovich, Chief Engineer, KEPR-TV, Box 2648, Pasco, Washington. 509-547-0547. 4-67-1t

Opening for studio engineer with 1st class license in large, mid-Michigan market, VHF color operaton, at top wage. Call Chief Engineer collect 313-239.6611. 4-67-tf

MICROWAVE RELAY TECHNICIANS: Immediate and future openings at all experience levels with fastest growing Microwave Common Carrier in U.S. First or second class FCC radiotelephone license required. Prefer men with microwave and video experience but will consider other related background. Work in New York and Pennsylvania. Good pay, terrific growth opportunities. Reply to: John Murray or Alan Burgess, Eastern Microwave, Inc., WSYR-TV, 1030 James St., Syracuse, N.Y. 13203. 4-67-2t

(Help Wanted—Television—Technical) Established group-owned TV station in the Southeast has opening for video operator with first class license and potential for growing into administrative duties assisting the Chief Engineer. This is a position with an aggressive fast-growing company and has excellent possibilities. Send resume to Dept 174, Broadcast Engineering. 4-67-2t

Job Headquarters for all Radio and Television Engineers. Immediate openings exist in 9 western states and elsewhere for qualified engineer and technical personnel. All categories from trainees to experienced transmitter maintenance, chief, assistant chief, live color video maintenance and technical operations. Send us your complete resume now. The AMPS Agency, 3974 Wilshire Blvd., Los Angeles, California 90005. Telephone DU 8-3116.
By Broadcasters—For Broadcasters 11-66-tf

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

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

TELEVISION ENGINEERS

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

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

Symbol of Excellence in Electronics

EMPLOYMENT

IMMEDIATE EMPLOYMENT — ENGINEER, background in video equipment maintenance. Good salary and fringe benefits. Contact Robert Schlorff, Mass Communciations, Wayne State University, Detroit, Michigan. 3-67-2t

WANTED: Technicians for closed circuit television-video tape-TV cameras—maintenance. Allstate Communications, 1200 West Chestnut Street, Union, New Jersey, 201-687-8810. 3-67-1t

SALES ENGINEER

A Canadian manufacturer of competitive, high quality, high performance Video Studio equipment has established a U.S. Subsidiary.

We seek experienced, capable and enterprising Sales Engineers for the United States Market.

Top financial rewards for the right men.

Please direct resumes and enquiries to: Mr. Paul Gyrsting, 403 Main St., Cambridge, Mass., U.S.A. or Telephone Collect: (617)—547-8826 (Cambridge), (514)—697-0810, (Montreal).

CD ltd **CENTRAL DYNAMICS CORPORATION**

RCA

BURBANK, CALIF.

has an exceptional challenge for a

PROJECT LEADER

Color TV Camera

This is a ground floor opportunity to enhance your career by joining our select team of engineers in the development of TV systems for the Instructional Electronics field. If you have experience as a Project Leader in the development of color TV cameras and associated equipment and a MSEE or equivalent, this position offers unusual professional growth potential.

RCA in Burbank is an engineering oriented organization. Big enough so you'll get lost in the shuffle. Yet of the nation's largest electronics there's room to grow. Not so big that backed by all the resources of one company. We offer liberal fringe benefits including relocation allowances. To inquire, send your resume to: Mr. Glen Seltzer, RCA Broadcast & Communications Products Division, 2700 W. Olive Ave., Burbank, Calif.

An Equal Opportunity Employer

RCA The Most Trusted Name in Electronics

TECHNICAL PLACEMENT

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CHECK AREA OF INTEREST

TV ☐ **RADIO** ☐ **MFG.** ☐

- Director of Eng. ☐
- Xmtr Supervisor ☐
- Studio Supervisor ☐
- Xmtr Technician ☐
- Studio Technician ☐
- Video Tape Technician ☐
- Electronic Engineers ☐

Manufacturing:

- Studio Design ☐
- Xmtr Design ☐
- Allied Fields ☐

Name .....

Address .....

Salary Desired .....

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Nationwide **Broadcast Personnel Consultants**

645 N. Michigan Ave., Chicago, Ill. 60611

POSITIONS IN COLOR TV ENGINEERING

The sudden industry wide acceptance of PLUMBICON Color Cameras has created many entirely new engineering positions in the areas of systems planning, field engineering, equipment packaging, circuit design. Engineers with live camera TV station experience and who are looking for personal advancement will receive training in this new equipment which is already playing a major role in the present shift to color.

Engineering positions in high band quadruplex video tape equipment development are also available.

Salary is commensurate with experience and ability. Locale: New York and California. Relocation assistance provided. Interviews possible in major cities or interview travel expenses paid. 736-5840.

Send complete resume or call Mr. C. E. Spicer or Mr. G. H. Wagner, Visual Electronics Corporation, 356 West 40th Street, New York, N.Y. 10018, telephone (212)

VISUAL ELECTRONICS CORPORATION

JOIN THE "BLUE RIBBON" TEAM IN BROADCAST EQUIPMENT

TECH DATA

(continued from page 65)

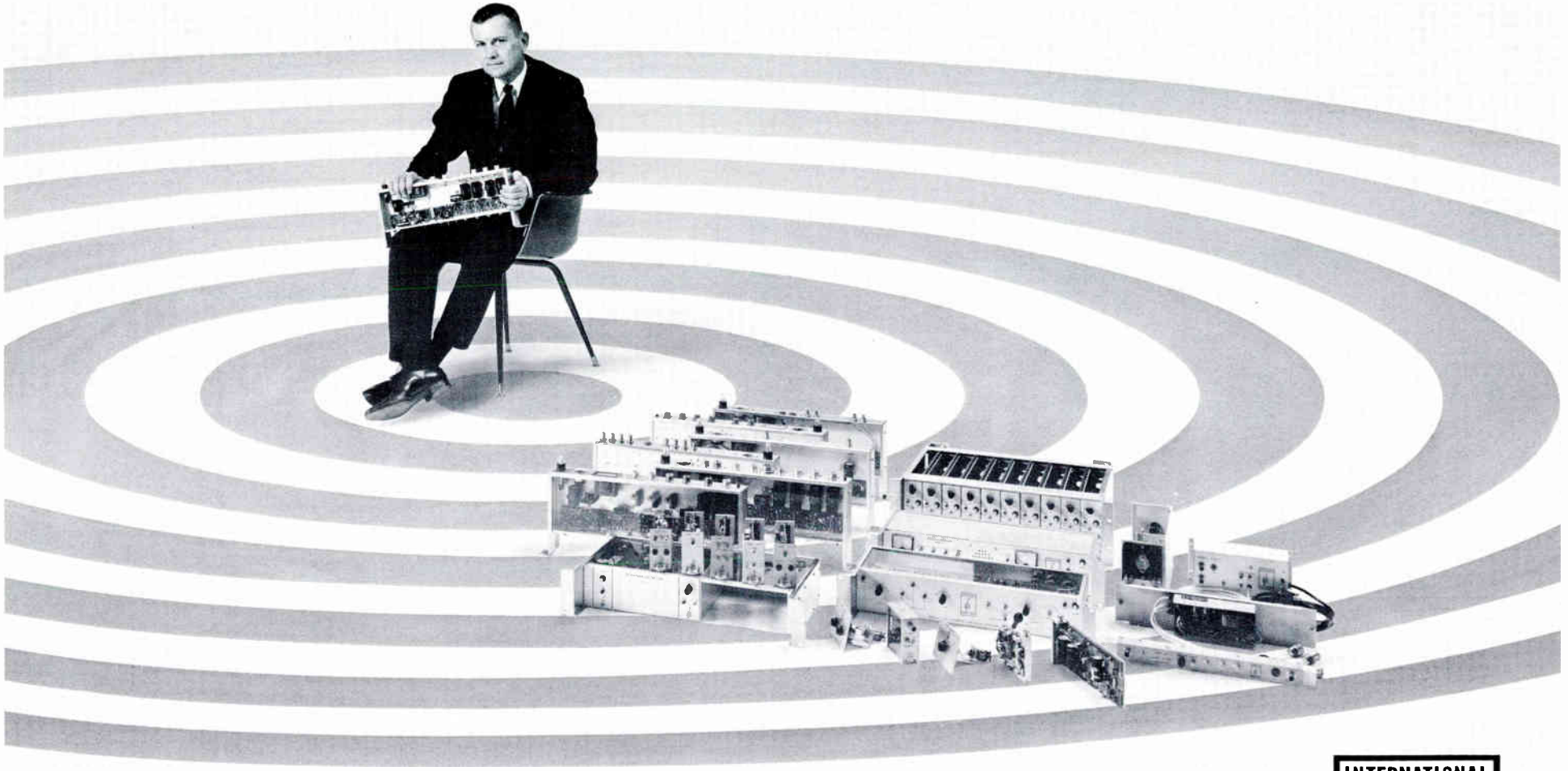
105. LEOPOLD—Descriptive sheets concern Leo-Pod shoulder brace for vidicon and motion-picture cameras, and "Volta-pack" power pack for operation of the Eclair NPR motion-picture camera.
106. TELEMATION—**Telectern** systems providing TV production capabilities for educational, industrial, broadcast, or military applications are described in four-page brochure.
107. TRAID—Brochure on Vue-Tronics Model RK-120 video film recorder and data sheet on Model 16N 16-mm stop-motion sound projector are offered.
108. VITAL INDUSTRIES—Information is on Model VI-10A video distribution amplifier and Model VI-20 pulse distribution amplifier.

TEST AND MEASURING EQUIPMENT

109. BAUER—Data sheet describes Model 380 phase sampler.
110. PRECISE ELECTRONICS—Catalog provides information on line of test instruments.
111. RUSTRAK—Sixteen-page product catalog shows line of miniature chart recorders and accessories for recording current, voltage, power, events, temperature, and pressure.
112. SECO—Model 107C tube tester is subject of four-page, two-color pamphlet.
113. VITRO—Literature is available on Nems-Clarke HFM-140 AM harmonic field-intensity meter and on line of stainless-steel jacks, plugs, and jack panels.

TRANSMITTER & ASSOCIATED EQUIPMENT

114. GATES—Model BC-5H 5-kw AM transmitter and Model BC-10H 10-kw AM transmitter are described in separate two-color brochures.



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Write or wire or phone collect: Ray Weiland, President **INTERNATIONAL NUCLEAR CORPORATION** 608 Norris Avenue, Nashville, Tennessee 37204 • 615 — 254-3365 "Transistorizing the Television Industry"

Circle Item 45 on Tech Data Card

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RCA solid-state rectifiers are made to last! Plug in one RCA rectifier unit as a direct replacement for one of your mercury vapor or gas rectifiers and it could very well last the lifetime of your equipment. RCA plug-in rectifier units CR273/8008, CR274/872A, and CR275/866A/3B28 are available only through your RCA Industrial Distributor. The three types he stocks, and can deliver off-the-shelf to you, are of the same high quality as those which have racked up 13,338 trouble-free hours in the visual driver of the transmitter at WBRE-TV Wilkes Barre, Pennsylvania. In fact, the high efficiency and performance of the units at WBRE-TV have remained the same as they were on the first day of installation. Realistically, you have everything to gain when you replace with RCA plug-in rectifiers. You get all of the advantages of RCA solid-state: ruggedness, high-reliability, plus economy. Maintenance and replacement costs are practically non-existent. And costly loss of revenue in off-the-air time, because of rectifier failure, becomes a thing of the past. The time to go to RCA solid-state rectifiers is now—and the price is right! Ask your RCA Industrial Distributor for his latest price and off-the-shelf delivery of these units. Call him.

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