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Broadcast Engineering

the technical journal of the broadcast-communications industry

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THE "NEWLINE" VIDEO TEST SET

FEATURES

Model # 6601 Video Test Set $1990

MODEL 6620 "NEWLINE" SYNC GENERATOR

FEATURES

DESCRIPTION

SPECIFICATIONS

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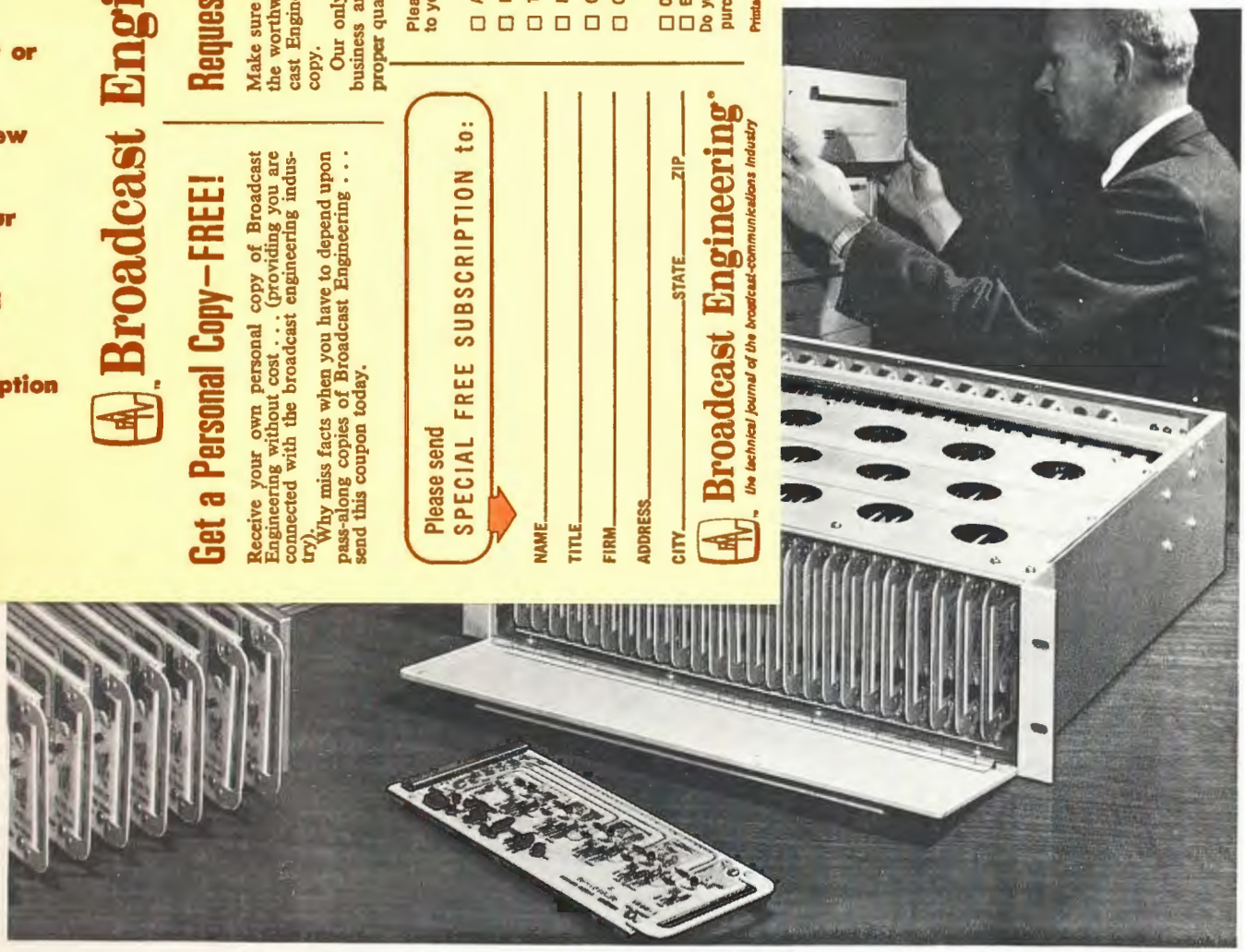

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THE "NEWLINE" VIDEO TEST SET

FEATURES: multiburst • pair window (T and TP) • standing controls, latter as modulated, internally or externally • front panel composition comp switch • internally or externally driven • rack mounting or instantly portable • highest quality silicon transistor circuits.

Model #6601 Video Test Set: **$1990**

MODEL 6620 "NEWLINE" SYNC GENERATOR

FEATURES

All Transistor • Built-In Sync Lock
Compact 1¾" Rack Space • Ultimate Stability
Built-In Power Supply • EIA Sync
Self Contained Power Supply

DESCRIPTION

The 6620 "NEWLINE" Sync Generator is housed in a 1¾" anodized dust proof frame suitable for rack mounting or portable use. All circuitry is mounted on a ¼ glass epoxy printed circuit board. A front panel mode switch offers selection of Crystal Free Running, ATC or Sync Lock. The master oscillator circuitry is designed for ultimate timing accuracy. Sync Lock circuitry will lock the master oscillator in phase to an external composite video signal. Multivibrators generate all required pulses. Each pulse is regenerated for accurate control of rise times.

SPECIFICATIONS

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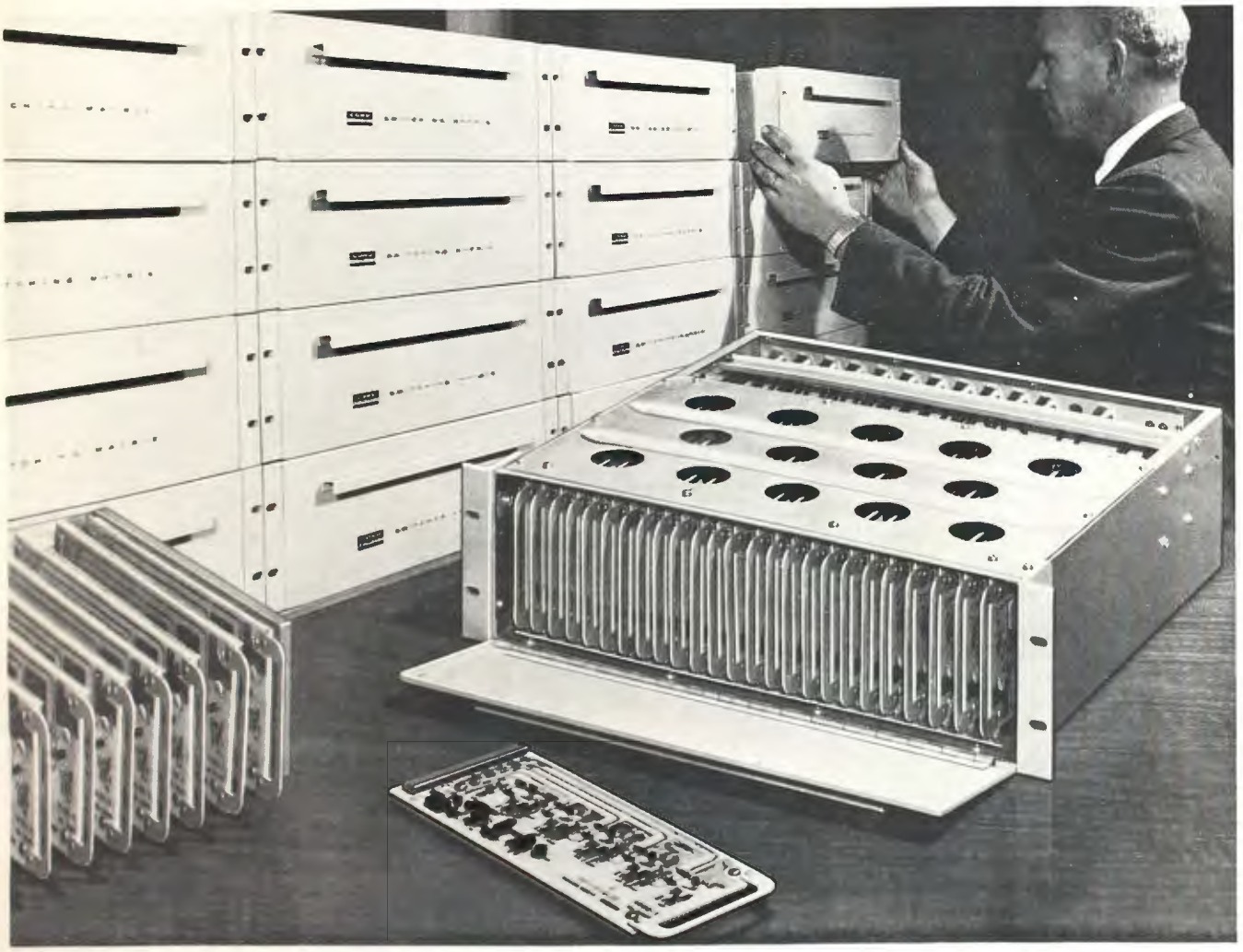

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Volume 8, No. 5 May, 1966

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The facilities of KCSM (FM) and KCSM-TV, on the campus of the College of San Mateo, were required to meet aesthetic as well as technical restrictions. For a detailed description, see page 26.

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It prevents FM overmodulation without distortion.
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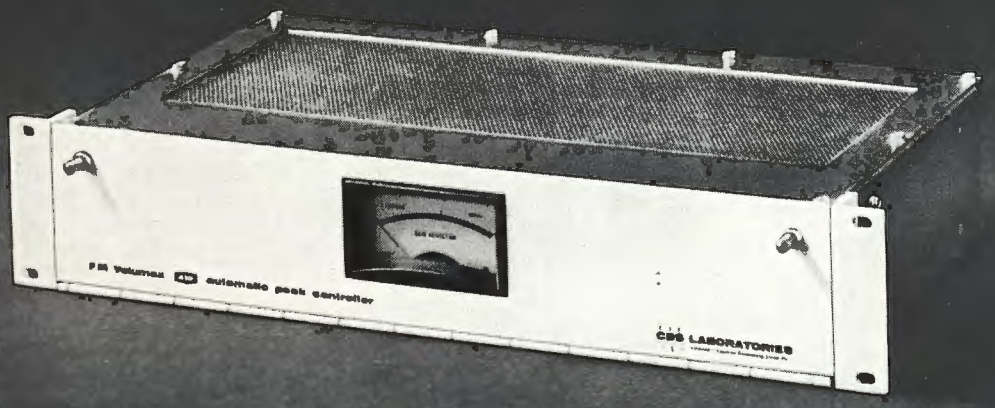

Overmodulation. An FM station engineer's headache. Use a clipper and you get distortion. Use a common limiter and you get pumping. You could reduce modulation levels. But that's not the answer.

So CBS Laboratories developed something new. A solid state FM limiting device that replaces common limiters and clippers. And it is unconditionally guaranteed to prevent FM overmodulation and SCA crosstalk *without distortion.*

Hard to believe it does everything we say? Just send this page and your station letterhead. We'll send you the FM Volumax free. (For MPX stations we'll send the stereo model.)

Use it 30 days. After that, send it back if you can part with it. We'll even pay the freight. Or keep it for only $695. Double that if you want the stereo model.

AM broadcasters were quick to respond to our free 30-day Audimax and Volumax offer. Now with the new FM Volumax we can make you the same offer. Be the first on *your* band.

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Lenkurt's gallery of 12 microwave systems . . . put them all together and you have an exhibit unmatchable *anywhere* in the world.

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Then, there's our time-proved 300 channel 74B that provides high quality, point-to-point communications for common carrier, industrial and government systems.

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Lenkurt Electric Co., Inc., San Carlos, California. Other offices in Atlanta, Chicago, Dallas, and New York City.

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ANOTHER ENGINEERING FIRST FROM WARD!

NEW SOLID STATE VHF UHF TV DEMODULATOR

Six Plug-in modules — Occupies only half of 5¼" rack frame.

Now, for the first time, you have a highly reliable precision instrument for monitoring, measuring and assessing the characteristics of monochrome and color TV visual and aural transmitters. Check these unique features of the Ward TD-880 TV Demodulator:

- Completely solid state; silicon transistors throughout.
- Switchable VSB/DSB transfer characteristic. Regenerated DSB characteristic provides direct evaluation of VSB transmitter transient and quadrature performance.
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- Solid state vertical interval carrier chopper, switchable on/off and variable in position, for checking modulation level.
- Wide bandwidth; sound notch switchable in or out.
- Nyquist slope shaping independent of active components.
- Switchable "flat" or "receiver" (FCC) frequency-amplitude/phase transfer characteristic.
- Includes wideband DSB color test transmitter for checking demodulator performance. Incorporates crystal aural subcarrier generator for sound notch checks.
- Optional Audio Demodulator module; provides for both direct carrier and intercarrier aural signal monitoring.

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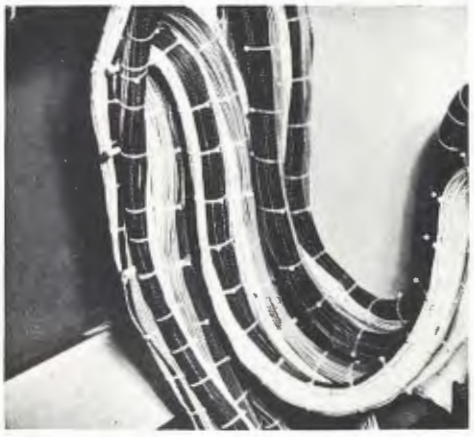
New Techniques for Communication Wiring — the TY-RAP® SYSTEM



POINT-TO-POINT WIRE BUNDLING SIMPLIFIED

New self-locking TY-RAP ties and manual tools are recommended for field tying and wherever you run wires from one point to another. The photo above is a communications installation which utilizes self-locking ties as well as self-locking clamps and identifying straps.

TY-RAP is a registered trademark of The Thomas & Betts Co. assigned to the line of cable ties, clamps, straps and accessories.

PRE-MOUNTABLE MINIATURE CLAMP PRACTICALLY HIDDEN FROM VIEW

High density electronic packaging and appearance problems are solved with the TY-RAP miniature mount. Harnesses and cables can be tied to these pre-mountable bases with standard TY-RAP ties. The mounts are available in various sizes and accommodate different cable bundle diameters, holding strength up to 50 lbs. Available with screw holes, the mount is easily fastened to chassis. Clamping Section of T&B catalog T66 illustrates over 30 catalog numbers with complete details.

NEW STRAPS IDENTIFY AND TIE

Harnesses, breakouts, cabling, tubes and lab set-ups are easily and quickly tied and identified with TY-RAP Identification Straps. The identification surface is easily marked with pencil, ball point pen, marking pens or heat stamped. Identified wire bundles and harnesses aid trouble-shooting and wire reworking. Since the identifying strap is also a tie, it will not loosen under vibration or stress as can conventional identifying plates. Single and continuous length identification plates are also described in the TY-RAP Identification Section of the 40-page brochure.

NEW SNAP-IN RETAINING CLAMP

Ideal for supporting long runs of cable in point-to-point wiring. This clamp, TC70 series is available in 5 sizes to accommodate bundles from ¼" to 1½" in diameter. Wire bundles are quickly snapped into place after the clamps have been mounted in position. These clamps are not only recommended for permanent wiring, but also as a handy device for temporary wiring and bread boarding.

NEW KNOCK-IN MINIATURE MOUNT

Speed and flexibility are the major benefits of these new knock-in mounting bases. Quick installations are completed simply by knocking in the projecting pin which locks the mount in position. Production flexibility can be achieved by pre-mounting these bases while the harnesses or cable bundles are being fabricated. The clamping section of the new catalog illustrates several types of pre-mountable devices.

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New from Wilkinson!

Model 4N-1

4 in 1 Portable Solid-State

FIELD INTENSITY METER + NULL DETECTOR + STANDARD SIGNAL GENERATOR + AM MONITOR RECEIVER!

At last a practical, extremely versatile instrument for broadcast stations and consultants. The new Wilkinson Model 4N-1 all solid state Field Meter combines all the features broadcast engineers have long been awaiting in a completely portable 12-pound unit.

As a Field Intensity meter, the Wilkinson 4N-1 measures field strength with 3% accuracy and reduces measurement time because no nulling is required. Long-term reliability is assured because all critical circuitry is passive.

As a Null Detector for use with a RF bridge to measure impedances, the Wilkinson 4N-1 eliminates the complexity of a multi-instrument AC test set-up. Visual null detection eliminates earphones and broken ear drums.

As a Standard Signal Generator, the Wilkinson 4N-1 is invaluable since its output accuracy of 3% from one microvolt to one volt is essential to many broadcast applications.

As a Monitor Receiver, the Wilkinson 4N-1 has sensitivity of 5 microvolts nominal, permitting excellent off-air monitoring in extreme fringe areas.

The frequency range of the complete Wilkinson 4N-1 is 535-1605 kc.

The Wilkinson 4N-1 is powered by dependable nickel cadmium batteries, rechargeable from AC or an automobile source. Ease of operation is assured by simplicity of procedure, oversized controls and meter, built in speaker and illuminated panel. The Wilkinson 4N-1 is packaged in a sturdy and attractive genuine cowhide case. When the case is closed, the power is interlocked off.

For complete details write on your company letterhead to:

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LETTERS to the editor

DEAR EDITOR:

I am very glad to see "Engineers' Exchange" reappear in BROADCAST ENGINEERING. It is always interesting and very often useful to me. The exchange of ideas and information between engineers cannot but upgrade the broadcasting industry. It's a "natural"; after all, we are in the communications business. I consider the magazine a "must" for every engineer in broadcasting. It is timely, well written, informative, and enjoyable. I have all the issues filed, and refer to them often.

HENLEY MCELVEEN, JR.
Chief Engineer
WJOT Radio
Lake City, South Carolina

We appreciate the kind words, Mr. McElveen; letters such as this go a long way toward smoothing the sometimes rocky road of magazine publishing. Engineers' Exchange will continue as long as our readers support it. We've been pleased with the response to our requests for material for the department, but keep the items coming!—Ed.

DEAR EDITOR:

Regarding "Radio Station Floor Plans" (March 1966 BROADCAST ENGINEERING), I see that the problem of retaining key engineering personnel has finally been solved, and at no cost. I presume that the control room in Floor Plan B (page 22) has been built around the technician, and since there is no doorway to provide an escape route, he is thereby prevented from going to work for the competition. A solution at last!

RALPH T. OLSEN
Engineering Department
WFMF, Chicago

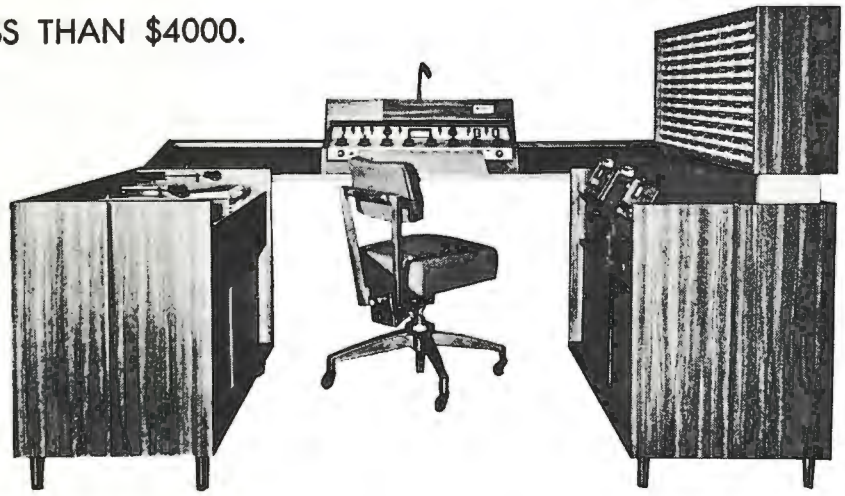
The design should also prove appealing to those disc jockeys who on occasion barricade themselves in the control room and play the same record continuously for 24 hours. For most purposes, however, the original design is more practical. It shows a control-room door just to the left of the door that closes off the hall.—Ed. ▲

NEW

FOR THE BROADCASTER WHO CARES ABOUT LOOKS!

A COMPLETE "SHOWCASE" AUDIO CONTROL CENTER

FOR LESS THAN $4000.



SPARTA now makes it possible to buy top quality studio equipment, as well as high style "Showcase" cabinets — at a price that fits every budget conscious broadcaster.

- A SPARTA transistorized Studio Console with microphone and digital clock.
- SPARTA dual Turntable System.
- Complete SPARTA-MATIC Tape Cartridge System and cartridge library.

This entire audio center, including SPARTA "Showcase" cabinetry comes to you ready to install in your studio — OR the mix and match "Showcase" cabinetry may be purchased separately to meet customized studio requirements.

CABINETRY CONSTRUCTION AND FINISH

SPARTA Showcase Cabinets are constructed with top grade wood veneers laminated under heat and pressure to a beautiful platinum toned walnut wood grain finish. Table and desk tops are finished with an extremely hard Formica laminate, in a soft Dove Grey to blend with the rich wood grain. The design thoughtfully provides easy access to all wiring, yet keeps it out of sight for a truly customized appearance.

STUDIO CONSOLE DESK

Sleek, modern styling accents the spacious console desk that is designed for ideal operator convenience. Stainless steel pedestal legs provide plenty of knee room, and just the right height for the console. Plenty of counter depth, too. Fits most any console arrangement.

SINGLE OR DUAL TURNTABLE CABINET RETURNS

To mix and match with the studio control desk, the turntable top is identical to the console desk level. Available for one or two SPARTA TC-12 turntable installations. Sliding doors concealing the record storage area can be removed for standard rack mount.

UTILITY TABLE RETURN CABINET WITH HUTCH ACCESSORY

Standard 19" wide shelves are located immediately beneath table top area so both rack mounted and table top cartridge equipment can be utilized. There is still plenty of storage area below. The separate CARTRIDGE HUTCH fits neatly over the utility table cabinet to store cartridges at finger-tip convenience. Height is low enough so operator need not move from his chair to reach the top row.

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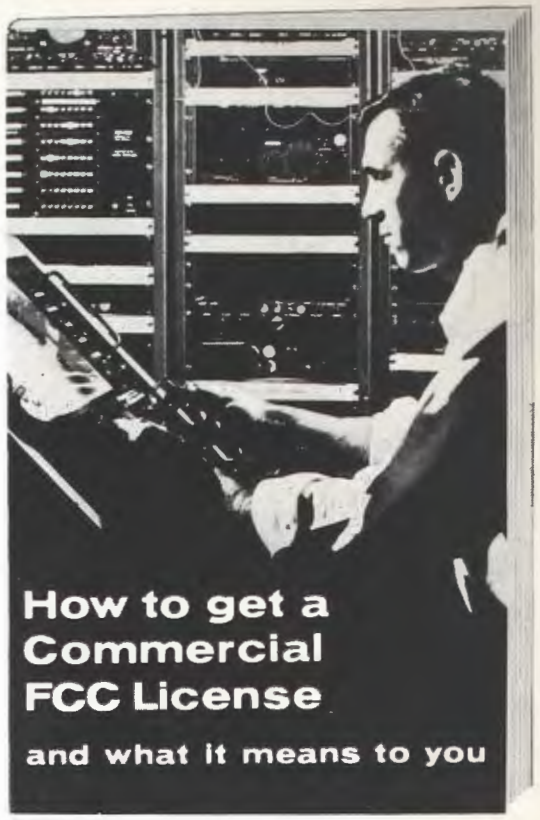
Want a permanent career in broadcasting?

This free book may change your life

It takes the mystery out of getting the FCC License you need for security and success



NO WONDER you're interested in a career in broadcasting. It puts you right "where the action is"—behind the scenes of show business, news reporting, politics. You meet famous people. You're the first to know the big news about fires, riots, plane crashes. You get to hear wonderful music. You feel in contact with an audience of thousands.

And one of the most secure high-pay jobs in the field is that of the licensed Broadcast Engineer. He's the key man required on the job by the United States Government

New job opportunities are opening up constantly for qualified license-holders. Many more will be needed to operate and maintain the countless new UHF-TV stations expected to begin operation, now that all new TV sets can receive UHF.

So if you dream of making broadcasting your life work, you need that Government FCC License.

But how do you go about getting it? Where do you apply, and when? How do you get ready for it?

To help you, we have published a 24-page booklet, "How to Get a Commercial FCC License." It tells you exactly which types of licenses and permits are issued by the Federal Communications Commission, and what kinds of electronic equipment each type allows you to operate and maintain.

You will learn which subjects must be mastered for each kind of license. Thirty typical exam questions will give you an idea of the level of training required. You'll be told where and how often the exams are held, and how to find out about the exams held nearest your home.

Frankly, the FCC exams are rough if you're unprepared. Two out of three applicants fail to pass. Some fail seven or eight times.

But with the right preparation, it's easier than you would imagine. Better than 9 out of 10 CIE-trained men pass the exam with no difficulty. Our record is so good that we are able to promise every student in writing: *after completing your CIE course, you'll be able to pass your FCC exam the very first try, or CIE will refund your tuition in full.*

We'll send you a free copy of our school catalog in addition to your free FCC booklet. Then you can see for yourself how thorough our home study courses and teaching methods are. No obligation, of course.

To receive both books free, just mail coupon below. If coupon is missing, write to Cleveland Institute of Electronics, 1776 East 17th Street, Dept. BE-26, Cleveland, Ohio 44114. Do it right now—if you want a solid career in broadcasting, this could be the turning point in your life.

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says Matt Stuczynski, senior transmitter operator, Station WBOE. "Even though I had only six weeks of high school algebra, CIE's AUTO-PROGRAMMED™ lessons make electronics theory and fundamentals easy. After completing my CIE course, I took and passed the 1st Class FCC Exam. I now have a good job in studio operation, transmitting, proof of performance, equipment servicing. Believe me, CIE lives up to its promises. I really enjoy my work and I'm on my way up."

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A PASSIVE-REPEATER TELEVISION STL

by ***Harold A. Dorschug,*** Director of Engineering, WTIC AM-FM-TV, Hartford, Conn. — Two dishes back-to-back redirect the microwave beam around an obstruction.

When WTIC-TV moved to its new studio building, Broadcast House, it faced a problem not uncommon to those stations operating from downtown locations. It was originally located in one of the home office buildings of its parent company, the Travelers Insurance Company. From a set-back on the 12th floor, clear line-of-sight existed to the transmitter approximately 8 miles west in Avon, Connecticut. The STL transmitting terminal was located at that point.

Broadcast House was the first structure erected in Hartford's Constitution Plaza urban redevelopment area. The building itself is of four-story construction. Because of variations in terrain, only the two top floors are at or above the plaza level. A problem in relocating the microwave transmitting terminal for the STL arose because a 20-story building was under construction directly west of Broadcast House. While it might have been possible to utilize this structure to avoid the obstruction, its completion was not scheduled until sometime after WTIC-TV moved to its new location.

A study of proposed construction in the immediate area revealed that line-of-sight would exist between Broadcast House and the original location of the microwave facility. If the signal could be carried to that point and redirected in a practical manner, WTIC-TV could still operate its STL.

There were several methods to do this, and all had both advantages and disadvantages. They were: 1. A completely separate link resulting in a double-hop system, 2. A coaxial cable between the two points with suitable terminal equipment, 3. A passive repeater.

The first would have been the easiest to accomplish, but it would have been most expensive, both in capital equipment investment and continuing maintenance costs. The second was somewhat more attractive with regard to maintenance, because it was thought that cable equipment would require less attention. However, when the matter of obtaining the proper cable and terminal equipment was sufficiently studied, it was found to be impractical. This was in spite of the fact that municipal approval had been obtained to use a trench being planned through the street for steam and water pipes which would have minimized many of the difficulties offered by the cable. No serious effort was made to utilize a common-carrier facility in view of the reluctance of the telephone company to allow interconnection with private facilities for "piecing out" a circuit.

When the literature regarding passive devices was examined, it became evident that a passive repeater was the answer. Such a device would require no maintenance, other than periodic painting and inspection, would consume no power, and would have no parts to fail. Once installed, it should last indefinitely.

Passive repeaters take two basic forms, a flat reflector or something more sophisticated with a curved shape capable of focusing the signal. A flat reflector can be used to redirect a signal path up to approximately 120°, but above that value the efficiency drops off rapidly because the effective surface in use becomes too small. In practical form the second type of repeater is usually two parabolic antennas aimed in the desired directions, mounted back-to-back. Each is equipped with the usual button-hook, and these are connected with waveguide. Such an arrangement can be used in almost any situation because the individual dishes are separately mounted. In each case, gain varies with size. Reflectors are available in sizes up to 30′ x 40′, but a dish larger than 10′ is rare in broadcasting.

Because the path loss for each part of the circuit facing a passive

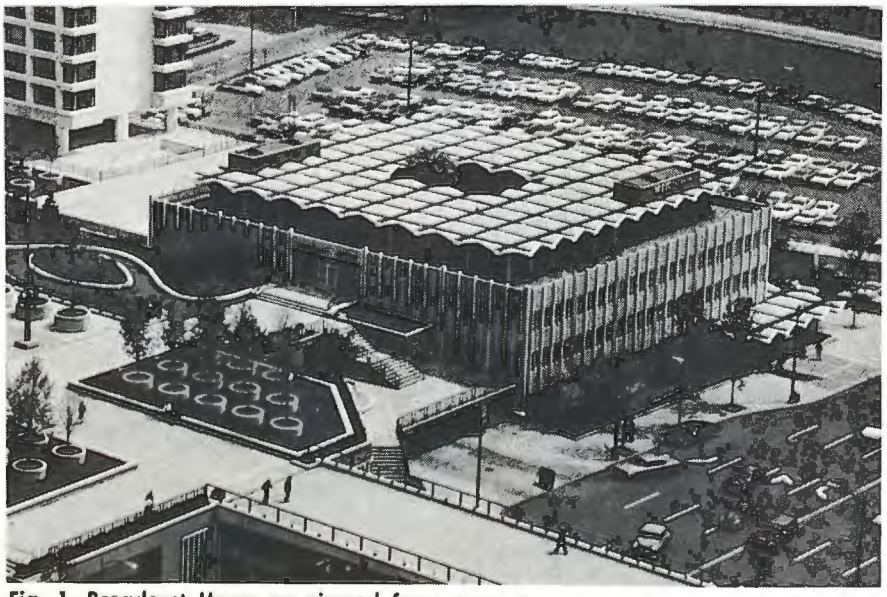


Fig. 1. Broadcast House as viewed from repeater; antennas are above entrance.

repeater must be considered separately, and because of the manner in which these losses add, it is possible to use these devices only when they are close to one end of the over-all circuit. The distance from Broadcast House to the repeater point was 760′, considered to be satisfactory. A view of this path is shown in Fig. 1.

The original circuit utilized a 1-watt, 7-gHz transmitter with 4′ dish, an 8′ x 6′ reflector mounted about 200′ above ground on the Channel 3 tower eight miles away, and a receiver at ground level. The overall system calculations indicated the following performance:

$$\frac{\text{Carrier}}{\text{Noise}} = P_t + G_t + L_p + G_{r1} + G_r - N_r$$

where:

P_t = Transmitter power in dbm
= +30 dbm

G_t, G_r = Gain of transmitting and receiving antennas
= 37 db for 4′ dish

G_{r1} = Reflector gain at receiving terminal (from manufacturer's information)
= −2.8 db

L_p = Path loss
= (37 + 20 log f_{mHz} + 20 log S_{miles})
= (37 + 20 log 7000 +20 log 8) = −132 db

N_r = Receiver noise level
= −87 dbm

Substituting:

C/N = +30 +37 −132 −2.8 + 37 − (−87) = 56.2 db

Since it is the ratio of peak-to-peak signal to rms noise that is desired, the C/N must be corrected by adding 12 db.

Spp/Nrms = 56.2 + 12 = 68.2 db

This is a predicted value subject to refinement by consideration of field losses as discussed later. However, it was typical of a medium-length circuit at this frequency, and the actual performance was very good.

Calculations for the proposed arrangement using the passive relay were performed as follows:

$$C/N = P_t + G_t + L_{p1} + G_{bb1} + G_{bb2} + L_{p2} + G_{r1} + G_r - N_r$$

where:

L_{p1} = Path loss between transmitter and relay input antenna

L_{p2} = Path loss between relay output antenna and receiver (remains the same as previously calculated.)

G_{bb1}, G_{bb2} = Relay antenna gains
= 37 db for 4′ antennas

Other symbols are the same as used previously.

Substituting:

$$L_{p1} = (37 + 20 \log 7000 + 20 \log \frac{760}{5280}) = -96.7 \text{ db}$$

C/N = +30 +37 −96.7 +37 +37 −132 −2.8 +37 −(−87) = 33.5 db

S/N = 33.5 + 12
= 45.5db pp/rms

The EIA STL S/N objective is 48 db pp/rms. Subjective qualitative tests based on viewing conducted by industry groups and Bell System Committees indicate that a S/N of 43 db pp/rms has a noise level barely perceptible on close examination. This should be the minimum performance objective. Also, the existence of field losses makes a higher value necessary in order to provide a cushion for these unknowns.

Since the predicted performance was marginal, it was necessary to improve it and to provide protection against fading. In this frequency range, higher transmitter powers were not available at the time. Neither were preamplifiers for use with the receiver. The only expedient was to increase the size of the dishes. Because of esthetic considerations, the use of dishes larger than 6′ at Broadcast House was not possible. Eight-foot dishes could be used in the relay without problems. At the receiving terminal at Avon, 6′ dishes would provide questionable improvement because the reflector would not illuminate satisfactorily the dishes of both the regular and standby receivers. It was decided to leave these unchanged pending performance results. Using larger dishes with a gain of 42 db, calculations were reworked as follows:

C/N = +30 +39.5 −96.7 +42 +42 −132 −2.8 + 37 −(−87) = 46 db

S/N = 46 + 12 = 58 db pp/rms

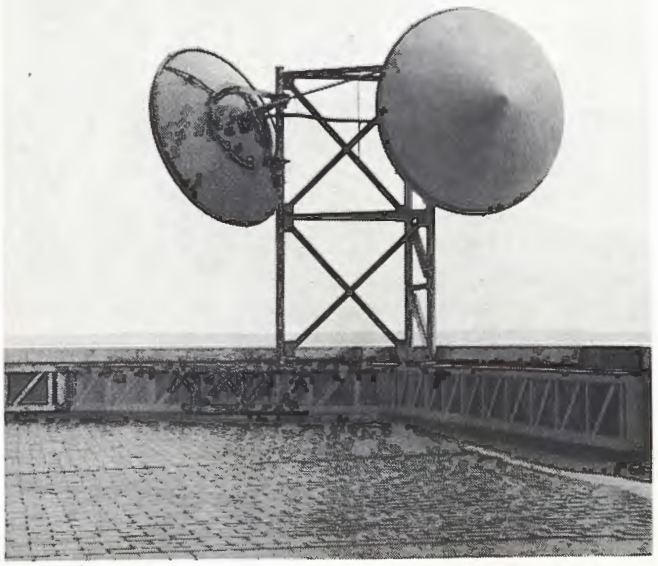


Fig. 2. Passive repeater has heavy steel girder for base.

Fig. 3. Main and alternate transmitters of WTIC-TV STL.

At this point, due consideration was given to the matter of field losses. These consist mainly of factors causing less than theoretical performance such as antenna variations (2 db), reflector alignment (1 db), ferrite isolator if used (1 db), and miscellaneous (2 db). For a system using four antennas such as we were considering, the maximum expected field losses could attain a value of 12 db. However, even if this random situation occurred, performance would be only 2 db under the EIA objective and still 3 db better than tests had shown necessary for a picture with barely perceptible noise. This result appeared satisfactory, and the decision was made to reconstruct the system on this basis.

The design of the supporting structure, given to a local consulting engineering firm, was based on specifications deemed necessary to insure safety during storms and high winds. The result is shown in Fig. 2. The base is welded to the frame of the building, and no shift in alignment has been noticed during the period of operation. The parabolas are mounted by means of adjustable rings and tower-leg supports. The feed points are connected by means of flexible wavegides. Fig. 3 shows the two transmitters at the studio building. The reflector mounted on the WTIC-TV tower is shown in Fig. 4. One of the receiving units is shown in Fig. 5.

It was possible to install the passive relay while the original circuit was still in use inasmuch as it is behind and somewhat higher than the original transmitter. This operation was performed by attaching the standby transmitter to the outgoing antenna on a temporary basis and orienting the dish toward the permanent receiving location. When this had been done, the transmitter was carried to the new location and connected to the new antenna. The standby receiver was then connected to the incoming portion of the relay and this portion of the circuit aligned. No problems were encountered; however, it is very important that the dishes not be oriented erroneously on sidelobes.

When the studio move was definitely scheduled, the FCC was requested to modify the licenses for the two STL transmitters for change of location. At the same time, a description of the passive relay was submitted with the bearings of the basic and redirected signal paths. These are now incorporated in the licenses.

By utilizing the standby transmitter, it was possible to have the new link in the circuit ready for use at the time of the studio move, and the change was made with no loss of air time.

When the standby transmitter was installed at Broadcast House in its intended position as a backup, a puzzling situation developed. With the main transmitter operating, it was not possible to tune the standby even with the nonradiating slug in the waveguide. Investigation showed that the one watt from the main transmitter was being reflected from the 8′ dish in the relay only 700′ away with sufficient strength to affect the klystron. The solution was to install a ferrite isolator in each buttonhook. When this was done, both transmitters became stable. The operation had to be performed on the buttonhooks by a local welding shop since the manufacturers do not supply them factory installed. In doing this it was necessary to maintain the exact position of the mouth of the feed assembly.

It would appear that a passive relay used within its capabilities offers television systems engineers an opportunity to operate microwave circuits around path obstructions that otherwise would make operation impossible. The author acknowledges the assistance of the microwave equipment manufacturers; of the late Herman D. Taylor, former Chief Engineer of WTIC-AM-FM-TV, for his work on mechanical details; and of Stephen J. Myers, Supervisor of Facilities, for his work in alignment and performance tests on the system. ▲

Fig. 4. Passive reflector mounted on transmitting tower.

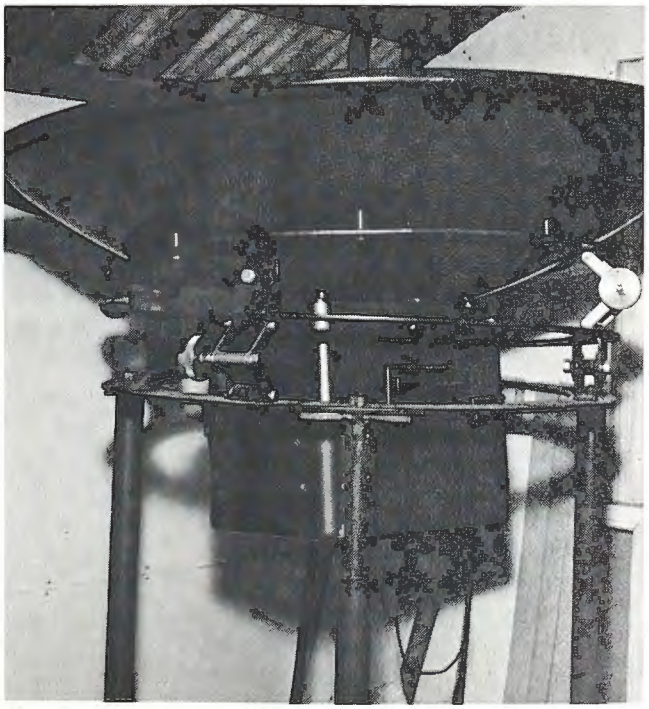


Fig. 5. Microwave receiver aimed at reflector on tower.

INTERPRETING THE PULSE-CROSS DISPLAY

by ***Donald M. Launer,*** TV Master Control Engineer, American Broadcasting Company—
A rapid, practical method of examining synchronizing pulses transmitted with video.

A rapid and simple method of checking the relative phasing and duration of the synchronizing information transmitted with the video signal must be available to the TV broadcaster. The pulse-cross technique[1] provides this information in a display which is operationally simple to manipulate and interpret. The method of measurement is basically oscillographic. Intensity modulation of the scanning beam produces a pattern from which the time relationships of the synchronizing detail can be obtained.

In obtaining a pulse-cross pattern (Fig. 1), it is necessary to phase both the horizontal and vertical sync and blanking near the center of the raster. At the same time, it is desirable to expand the vertical interval so that the individual scanning lines may be observed and measured more easily. Certain commercial pulse-cross monitors do not provide this expansion and consequently are limited in their operational flexibility. Although the vertical interval is both phased and expanded, it is desirable only to phase the horizontal interval while maintaining the same horizontal sweep spread and linearity so that the horizontal scanning time will remain unaffected. By doing this, it becomes possible to measure the pulse widths directly on the face of the monitor and determine what part of the total line period they occupy. It is also advantageous that both fields be displayed in interlace, although some pulse-cross monitors are limited by showing only single fields.

When the pulse-cross was first used by broadcasters, the presentation showed the synchronizing information as black. Currently, however, most pulse-cross monitors employ polarity reversal when switched to pulse-cross, showing sync as white and video as black. Although the advantages of polarity reversal are debatable, it is now the generally accepted presentation. Hence this type of display is used in the accompanying explanatory illustrations. The pulse-cross thus obtained will show rapidly and accurately most of the defects present in the standard sync signal, such as incorrect pulse widths, wrong number or position of pulses, and phase distortion of pulses.

[1] "Special Oscilloscope Test for Television Waveforms," by A. V. Loughren and W. F. Bailey, Rochester Fall Meeting, IRE, Nov. 1940.

"Producing and Interpreting the Pulse-Cross," by D. M. Launer, *TV Engineering*, Sept. & Nov. 1951.

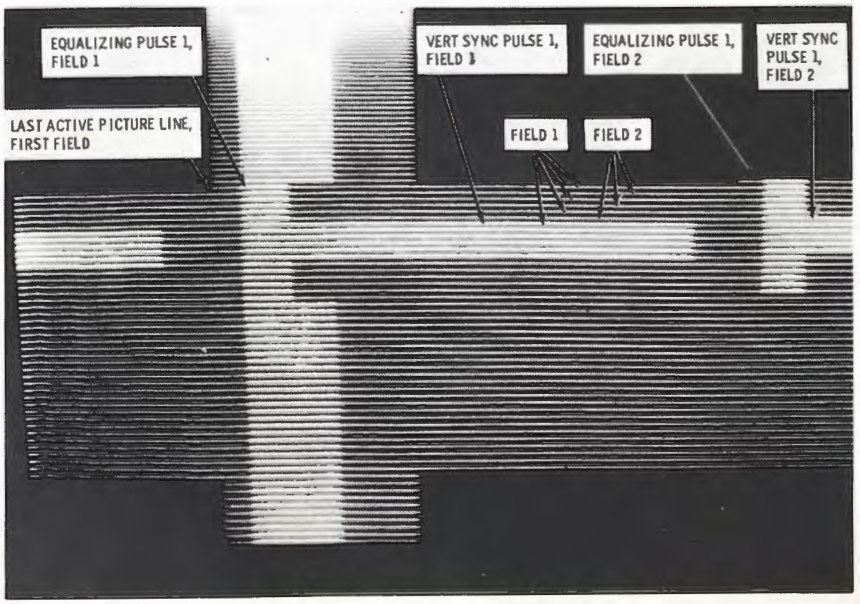


Fig. 1. Synchronizing pulses are easily examined in pulse-cross presentation.

Sequential Examination of a Typical Pulse-Cross Pattern

Although a check of sync-generator operation and transmission variations may be made very easily by counting pulse groups and measuring pulse widths, a more complete understanding of what is being seen and what is happening in the pulse-cross display is necessary to determine the cause of difficulty.

Pulses viewed on the pulse-cross are presented differently from the usual EIA waveform presentation. The pulse-cross pattern illustrated in Fig. 1 will be used as a typical example, with the various pulses being examined in the *sequence* of their occurrence, rather than grouping them for quantitative measurement. Two fields of the synchronizing waveform have been arranged in Fig. 2 with horizontal sync in vertical alignment so that all the horizontal pulses of both fields appear in the same relative position as they do on the pulse-cross pattern.

A sequential analysis of the pattern in Fig. 1 starts with the last active line at the bottom of the picture (the last picture line—in the

black area at the upper left—before horizontal blanking). To the right is horizontal blanking, then the first equalizing pulse of field 1 (defined as that field which has a whole horizontal line between the first equalizing pulse and the preceding horizontal sync pulse). Farther to the right on this line is equalizing pulse 2 of field 1, which is at mid-line position. The next sequential line in field 1 is the second line down from the starting point. On this line there appear equalizing pulses 3 and 4. Progressing through alternate lines in the display leads to equalizing pulses 5 and 6 and the first vertical sync pulse of the first field, which begins in line with horizontal sync. This same process, following alternate lines belonging to the first field, continues through vertical sync, trailing equalizing pulses, blanking, and picture information until the completion of the field 1/60th of a second after its start. At this time, the vertical blanking interval at the start of the second field is entered. (The second field is defined as that one which has a half line between the first equalizing pulse and the preceding horizontal sync pulse.) One line above the starting line of the previous field is the first equalizing pulse of the second field, which occurs at the center of the horizontal line (Fig. 2). Again a line is skipped to reach equalizing pulses 2 and 3. This process repeats as for the first field, until the 525 lines comprising a full frame are completed. By comparing Figs. 1 and 2, it is seen that the vertical sync of alternate fields

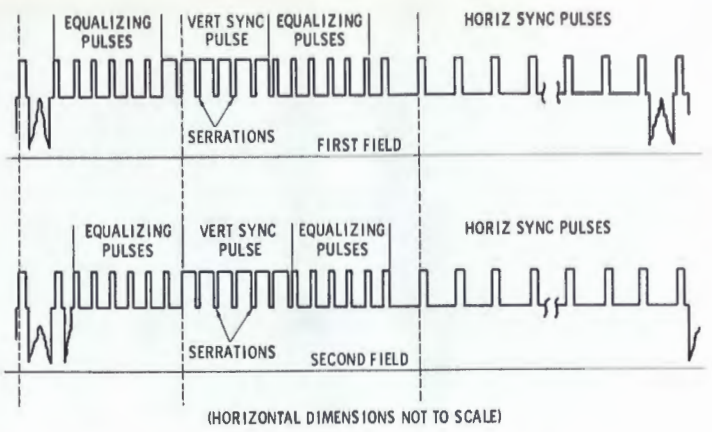


Fig. 2. Waveform of the synchronizing pulses shown in the display of Fig. 1.

is displaced by half a line, providing graphic illustration of how interlace is accomplished in our system of scanning.

By analyzing the pattern with the sequential method, and by understanding the order and sequence of all pulses, many of the confusing aspects of the pulse-cross display will be more readily understood and its usefulness enhanced.

Black-and-White Pulse Widths

All pulse widths shown on the FCC "Standard Synchronizing Waveform" chart are represented by a percentage of the total period "H," where H denotes the interval between successive scanning lines from the leading edge of one horizontal sync pulse to the leading edge of the next pulse.

Fig. 3 shows the location and width of pulses for black-and-white transmissions. They are as follows:

1. Total horizontal blanking width, 0.18H (11.43 μsec) max.
2. Front-porch width, 0.02H (1.27 μsec) min.
3. Horizontal sync width, 0.08H $\pm$ 0.01H (4.445 to 5.715 μsec.)
4. The leading edge of horizontal sync to the end of horizontal blanking, 0.14H (8.89 μsec) min.
5. Back-porch width — no back-porch tolerances are specified, since the exact width of the back porch will be determined by the individual values of the preceding four pulse widths.
6. Vertical blanking front porch (vertical blanking before the first equalizing pulse), 0.02H to 1.02H (1.27 to 64.77 μsec.)
7. Six equalizing pulses before vertical sync in line with horizontal sync, and with a nominal pulse width of 0.45 to 0.50 of horizontal sync width.[2]
8. Six equalizing pulses before

• *Please turn to page 64*

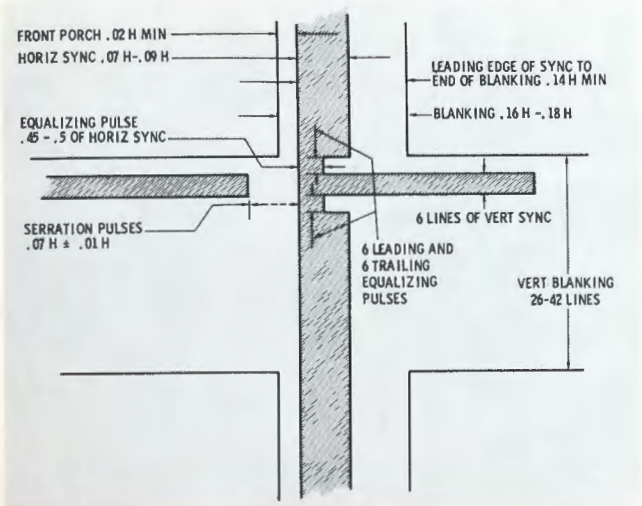


Fig. 3. Durations of the pulses correspond to distances.

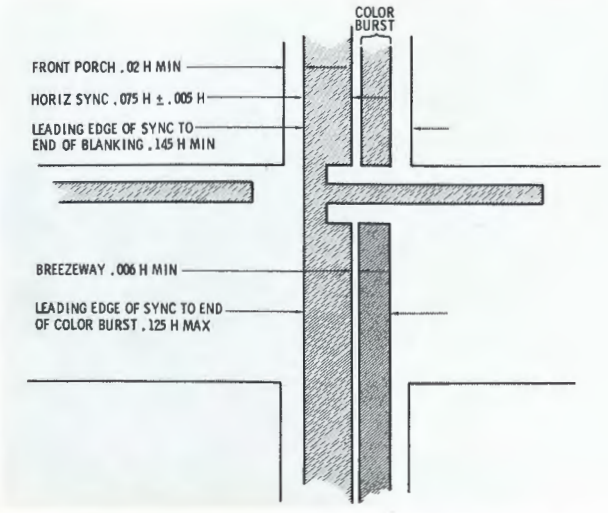


Fig. 4. Diagram shows pulse-cross measurements for color.

DETERMINING DIRECTIONAL ANTENNA FEED PARAMETERS

by George M. Frese, Northwest Regional Editor—Be prepared if trouble should strike; become better acquainted with your directional-antenna system.

There are approximately 1300 broadcast directional-antenna systems in operation in the United States. Many of these stations have changed technical directors several times. Quite often the new man finds in the station files technical manuals on all the commercial equipment, but only a schematic diagram in the FCC 302 application to describe the directional-antenna feed system. The new director wants to know how his newly acquired antenna system works so that he can retain it in or, if necessary, restore it to its intended licensed condition.

This article is written to explain the operation of an antenna system already designed and operating. The original designer may have used detailed mathematical procedures, or he may have found the solution by field trial-and-error methods, but regardless of how the system was originally designed, the station engineer can determine how it works. No two directional-antenna systems are alike. To demonstrate a procedure to arrive at a system analysis, a simple system involving only two towers will be used.

First draw a functional block diagram of the system as shown in Fig. 1. Second draw a simplified schematic diagram, and label the parts in some simple manner as shown in Fig. 2. Third, make a table of the system characteristics such as Table 1. If you can fill in all the data asked for in the table, you have a surprisingly complete knowledge of your DA system; thus completing the table is really the object of this project. Some of the items can be determined with relative ease. Methods for finding some of the others, marked with asterisks, will be described in the remainder of this article.

The table shown serves as a typical example. Your specific table will have some additional items and some omitted. There may appear to be many items, some seemingly needless information. But when trouble strikes, it is most helpful to have this information, plus additional tuning graphs and charts.

Antenna Characteristics

The analysis of the feed system begins with an evaluation of the an-

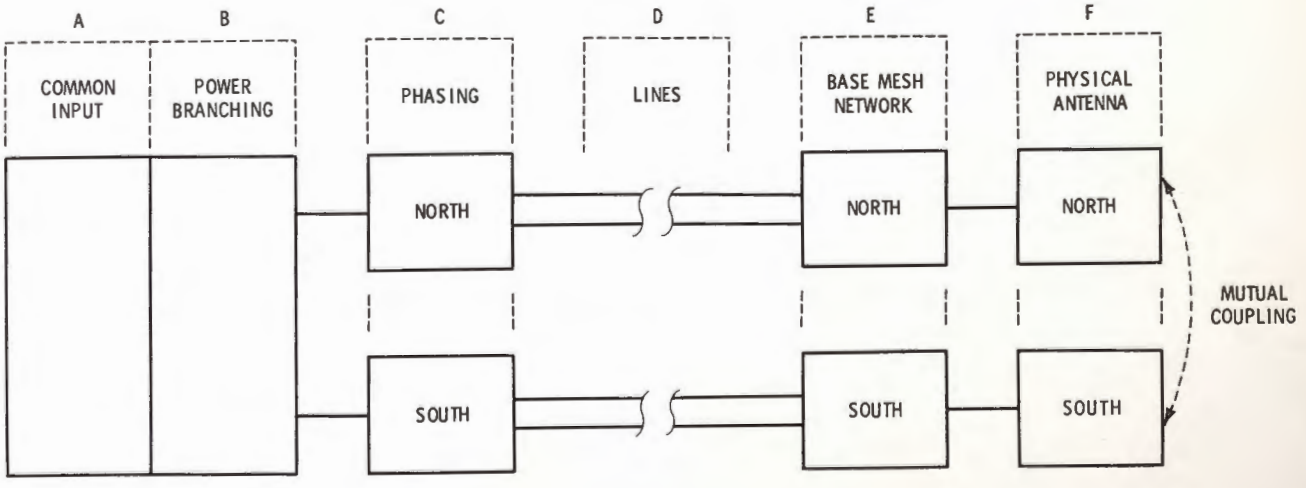


Fig. 1. The first step in analyzing the directional antenna feed system is to draw a complete functional block diagram.

tenna characteristics. These are tabulated in Section F of Table 1.

Antenna Base Self-Impedance

This quantity is determined best by an RF-bridge measurement of each tower with the other tower(s) made inactive. Otherwise, you may have to use tower graph data to arrive at an approximate value. For most systems, the self-impedance will have been measured and recorded as a part of the antenna proof of performance.

Antenna Base Directional-Operation Impedance

It is important to determine the antenna base directional-operation impedance for each tower as a starting point for your design. The best way to obtain this information would be to break the antenna base lead, insert an in-line operating bridge, and measure the impedance. You could then record the values in your table and proceed with the design (assuming the antenna is tuned correctly). However, many stations do not have an RF in-line bridge available. The computation of the base operation impedance is more involved than can be treated here; some stations, however, may have this information available as part of the original consultant's design. For stations not so fortunate, the following simplified, approximate method can be used.

To use this method, you must know the antenna-base self-impedance ($42+j35$ in our example), tower spacing (90°), and field parameters ($N,1.0\angle -90°$; $S,1.0\angle 0°$). The diagrams in Fig. 3 should help to clarify this abbreviated approach. Vector A[1] represents the relative base current needed to produce the desired field. Vector B represents the current induced into the tower by the other tower. Its magnitude and phase are dependent on mutual coupling between the towers. For this simple case, the amplitude is assumed to be 0.25 times vector A. The phase shown for B is determined by the parameters and tower spacing.

[1] For a review of vector notation and computation, see the February, 1965 issue of BROADCAST ENGINEERING, p 22.

The impedance calculation is shown in Fig. 3. The vector diagram shows that a current C must enter point x due to a voltage, vector D, applied at point x. This voltage is found by multiplying current C by the base self-impedance of the tower. The directional-operation impedance is then found by dividing voltage D by the base current, vector A.

Current into Base

Once the individual base driving impedances are known, simple algebra can be used to arrive at the currents into the bases. First write the knowns as follows:

$$(I^2R)_N + (I^2R)_S = 1000 \text{ watts}$$

$$I_N = I_S$$

therefore,

$$I^2(R_N + R_S) = 1000$$

$$I^2 = \frac{1000}{R_N + R_S}$$

$$= \frac{1000}{52.6 + 31.5}$$

$$= \frac{1000}{84.1} = 11.9$$

$$I = 3.45 \text{ amps}$$

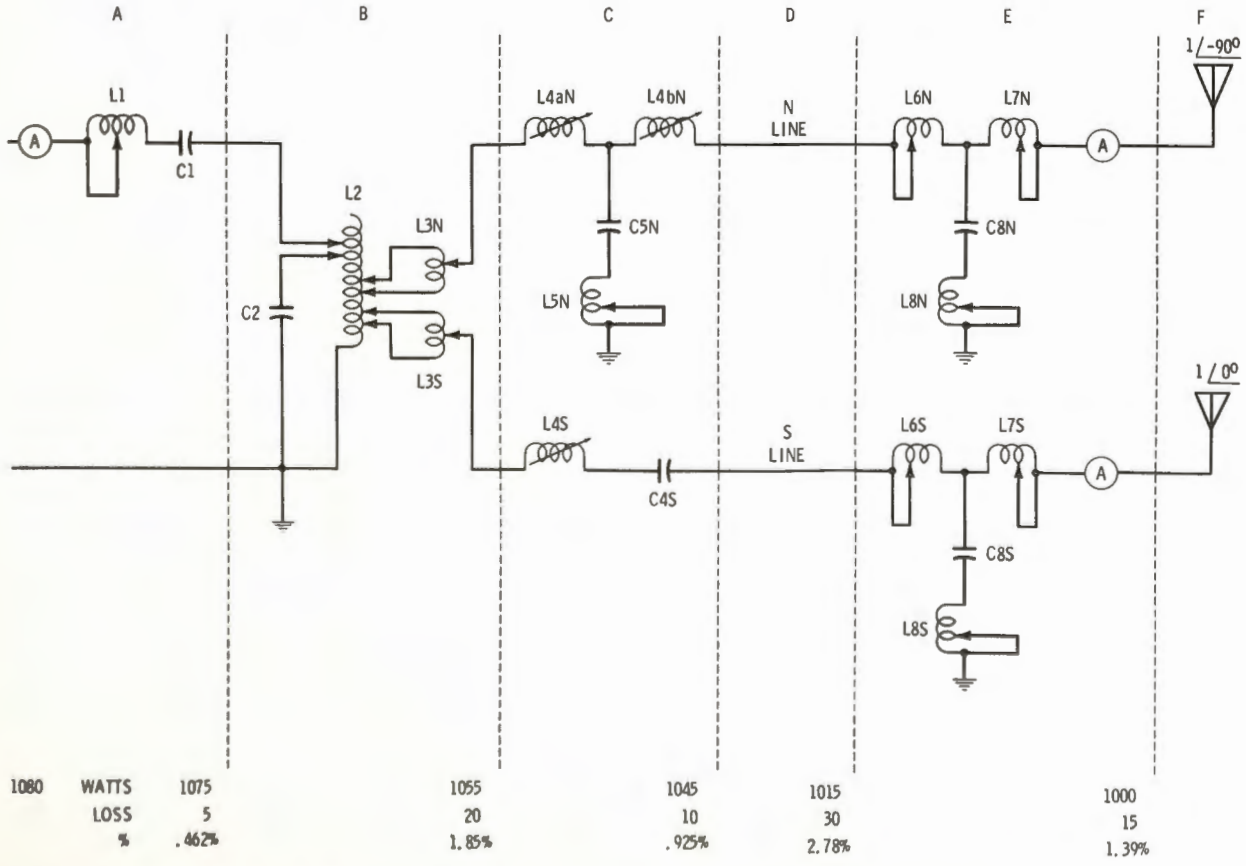


Fig. 2. With the aid of the block diagram, next draw a simplified schematic and label all the parts in the diagram

Table 1. Feed System Design Table

	Item Number	Description of Data	Towers North	Towers South
Antenna Characteristics (Section F)	1	Tower Height in Feet	250′	250′
	2	Tower Height in Electrical Degrees	91.5°	91.5°
	*3	Antenna Base Self-Impedance	42 + j35	42 + j35
	4	Tower Line	0°	180°
	5	Tower Spacing in Feet	246′	246′
	6	Tower Spacing in Electrical Degrees	90°	90°
	7	Theoretical Field Parameters	1.0 $\angle -90°$	1.0 $\angle 0°$
	8	Licensed Bose Currents and Phase	1.0 $\angle -90°$	1.0 $\angle 0°$
	*9	Antenna Base D. A. Operating Impedance	52.6 + j43.8	31.5 + j26.2
	*10	Current into Base	3.45A	3.45A
	*11	Power into each Tower	626W	374W
	*12	Voltoge across Tower Base	236 $\angle -50.2°$	108.7 $\angle +39.8$
Base Mesh Network (Section E)	1	Clip Settings Coil L7	✓	✓
	*2	Inductance L7	0	3.18 μh
	*3	Reactance L7	0	+j20
	4	Clip Setting L8	✓	✓
	5	Inductance L8	1.6 μh	.748 μh
	6	Reactance L8	+j10.1	+j4.7
	7	Clip Setting L6	✓	✓
	*8	Inductance L6	7.17 μh	8.04 μh
	*9	Reactance L6	+j45.0	+j50.5
	10	Capacitance C8	.0025 mfd	.0035 mfd
	11	Capacitive Reactonce C8	−j63.1	−j45.5
	*12	Shunt Reactance $X_{L8} + X_{C8}$	−j53.2	−j40.8
	*13	Current Through Shunt Reactance	4.44A	4.65A
	*14	Phase Lead or Lag Through Mesh	−80.1°	−99.9°
	*15	Power into network	635w	379w
	*16	Current into Network	3.49A	2.72A
Transmission Lines (Section D)	1	Type of Line	⅞ Styro	⅞ Styro
	2	Characteristic Impedance of Line	52 Ω	52 Ω
	3	Propagation Constant	.92	.92
	4	Line Length in Feet	300′	250′
	*5	Line Length in Electrical Degrees	119.3°	99.5°
	6	Current into Line	3.55 a	2.73a
	*7	Line Efficiency	97.0%	97.5%
	*8	Power into Line	655w	389w
	*9	Power Ratio into Line	1.0	.594
	*10	Voltoge across Line input	185	142
	*11	Voltage or Current rotio into Lines	1.0	.768
Phasing Mesh Network (Section C)	*1	Phase Lead or Lag of Mesh	−90°	0°
	2	Jeep Reading L4		
	*3	Reactance L4	+j52	+j52
	*4	Capacitance C4	None	.003
	*5	Reactance C4	"	−j52
	*6	Capacitance C5	.0025	None
	*7	Reactance C5	−j63	"
	*8	Reactance L5	+j10	None
	9	Clip Setting L5	✓	"
	*10	Total Shunt Reactance	−j53	"
	*11	Power into Phasor	662w	392w
	*12	Power Ratio	1.0	.599
	*13	Voltage into Phasor	185	142
	*14	Current into Phasor	3.56 a	2.74 a
	*15	Voltage or Current into Phasor	1.0	.769
Branching Network (Section B)	1	L3 Jeep Reading (Current)	✓	✓
	2	L2 Low Clip Setting to L3	✓	✓
	3	L2 Upper Clip Setting to L3	✓	✓
	4	L2 Clip Setting to C2	✓	✓
	5	L2 Clip Setting to C1	✓	✓
	6	C2 Capacitance	.001 mfd	—
	7	C2 Capacitive reactance	−j158	—
	8	C2 Current	8.3a	—
	9	Power into Branching Tank	1075w	—
Input Matching (Section A)	1	C1 Capacitance	.005	—
	2	C2 Reactance	−j31.6	—
	3	L1 Inductance	5 μh	—
	4	L1 Reactance	−j31.6	—
	5	L1 Clip Setting		
	6	Impedance into Common Input	52−j0	—
	7	Power into Common Input	1080w	—
	8	Current into Common Input	4.56a	—
External Monitoring	1	Remote Base Current Reading	✓	✓
	2	5% Current ratio tolerance	✓	✓
	3	Phase Monitor Readings	✓	✓
	4	Monitor Point Desired Reading	✓	—
	5	Manitor Point Maximum Allowable	✓	—

Power into Each Tower

$$P = I^2R$$

$$P = 3.45^2 \times 52.6$$

$$P = 626 \text{ watts north}$$

$$P = 3.45^2 \times 31.5$$

$$= 374 \text{ watts south}$$

$$626 + 374 = 1000 \text{ watts total}$$

Voltage Across Base

$$E = IZ$$

$$E_N = 3.45 \angle -90^\circ \times 68.4 \angle 39.8^\circ$$

$$= 236.0 \angle -50.2^\circ$$

$$E_S = 3.45 \angle 0^\circ \times 31.5 \angle 39.8^\circ$$

$$= 108.7 \angle 39.8^\circ$$

Base Mesh Network Characteristics

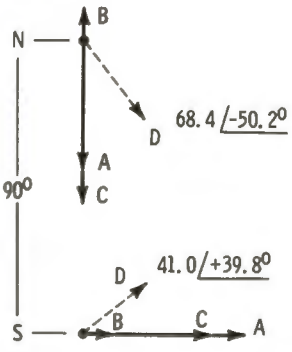
There are two functions of the base mesh network: to match the impedance of the antenna base to the characteristic impedance of the transmission line, and to produce a specified amount of lag or lead as a part of the overall phasing. Sometimes neither object is achieved completely in this network, requiring compensation in other parts of the system. Usually such compensation can be accomplished, but the solution is less desirable than with the mesh correctly tuned. There will be a needless standing wave on the feed lines, increased system power loss, less safety regarding voltage breakdown; and the phase and current jeep controls may not function as expected.

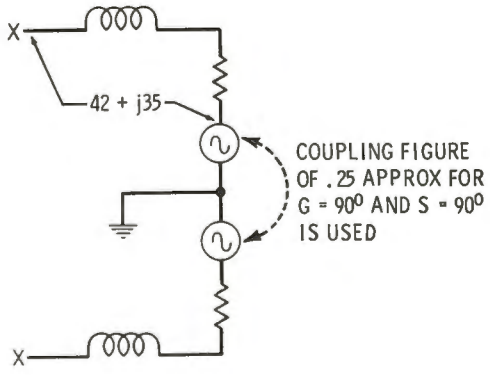
Matching

In our sample case we wish to match the 52-ohm lines to the antenna base operating impedance. For the north tower, matching is $52 + j0$ to $52.6 + j43.8$. For the south tower, maching is $52 + j0$ to $31.5 + j26.2$.

Phase Characteristics

To determine the phase characteristic needed, it is necessary to consider phase characteristics of the entire system. In the example, a $-90^\circ \pm$ phasor is used in the north line, and a $0^\circ \pm$ phasor is used in the south line. The 0° phasor actually is not needed in this case, but is included for further academic study. A variable phasor network should be operated close to its nominal delay; otherwise a rapid impedance change is experienced with the phase change. The transmission lines produce a fixed delay depending on their length. In the example, operation is assumed to be on 1000 kHz; the north transmission line measures 300′ and the south line





A. Total tower base current (in this case one unit amp each tower)

B. Current induced by opposite tower (Vector is delayed 90° plus 180° displacement).

C. Vector *A* − *B* gives remaining current needed to be supplied by a mesh driving voltage at point x.

D. Mesh driving voltage at point x:

$$E = IZ$$

$$E_N = 1.25 \angle -90^\circ \times 54.7 \angle +39.8^\circ = 64.8 \angle -50.2^\circ \text{ unit volts}$$

$$E_S = .75 \angle 0^\circ \times 54.7 \angle +39.8^\circ = 41.0 \angle +39.8^\circ \text{ unit volts}$$

Directional-operation impedance is:

$$Z = E/I$$

$$Z_N = 68.4 \angle -50.2^\circ / 1.0 \angle -90^\circ = 68.4 \angle +39.8^\circ = 52.6 + j43.8$$

$$Z_S = 41.0 \angle +39.8^\circ / 1.0 \angle 0^\circ = 41.0 \angle +39.8^\circ = 31.5 + j26.2$$

Fig. 3. Directional-operation impedances are determined using a vector diagram of the tower base currents and voltages.

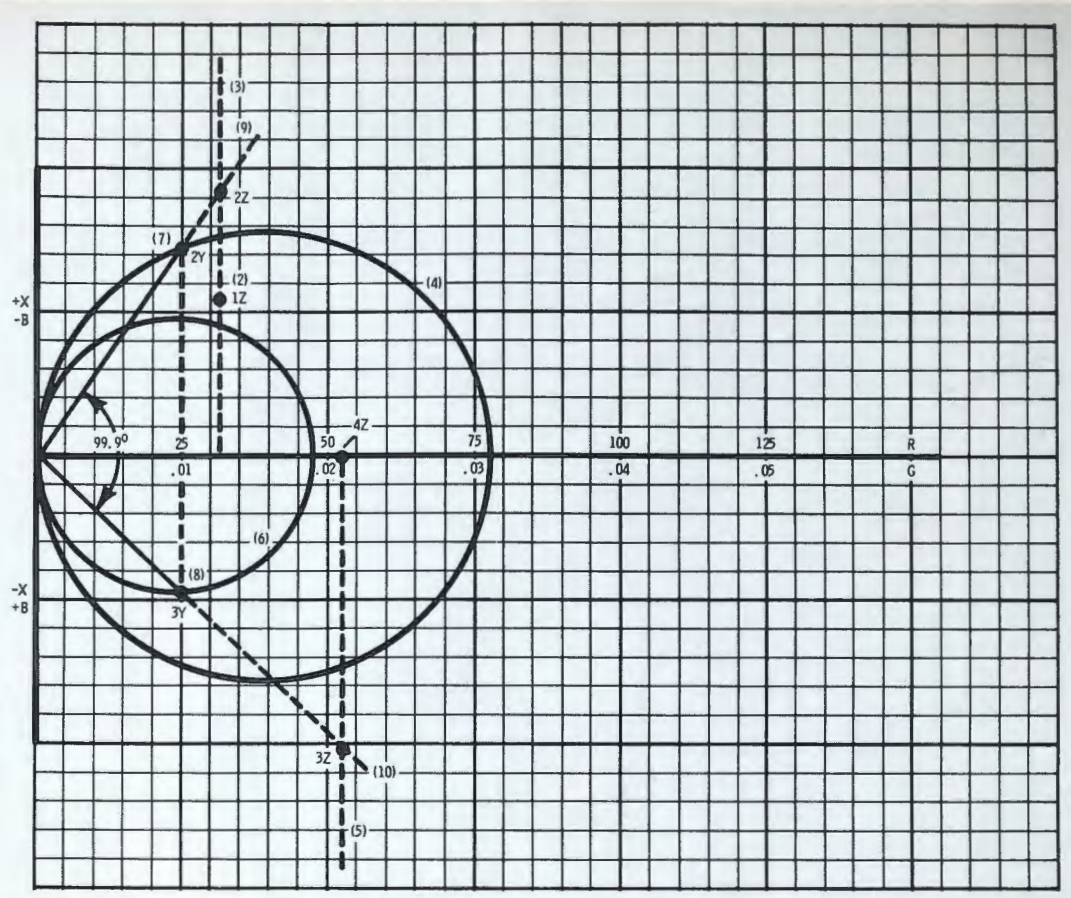


Fig. 4. Component values for the south-tower base mesh are determined by the graphical solution outlined in the text.

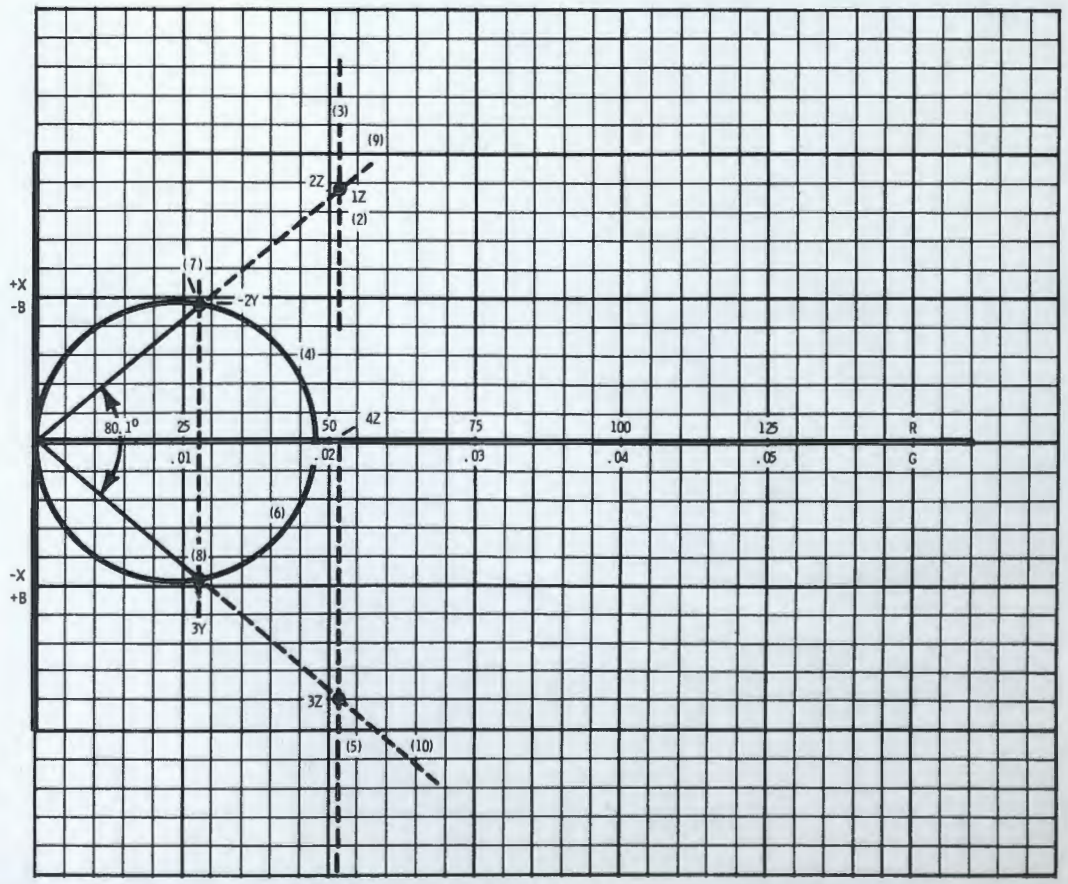


Fig. 5. The solution of the north base mesh network is found by the same graphical procedure used for the south tower.

250′. The electrical length is found by the equation:

$$L = \frac{.366 \times \text{line length in feet}}{\text{propagation K of line}}$$

$$L_N = \frac{.366 \times 300}{.92} = 119.3°$$

$$L_S = \frac{.366 \times 250}{.92} = 99.5°$$

The system delays through the phasor and lines are as follows: north $-90° - 119.3° = -209.3°$; south $0° - 99.5° = -99.5°$. The difference is $-209.3° + 99.5° = -109.8°$. The north tower lags the south. Only a $-90°$ lag is desired; therefore, the south base mesh network must lag the north base mesh network by 19.8°. This is best done by tuning the south mesh for $-90° - 19.8/2 = -99.9°$ and the north mesh for $-90° + 19.8/2 = -80.1°$.

Solving the Base Mesh Networks

There are various approaches to a network solution, but a simple graphic approach will be shown here. The details of this method appear in the January 1964 issue of BROADCAST ENGINEERING (page 12). Fig. 4 shows the graph for the south base mesh, and Fig. 5 for the north base mesh. Here are the steps for drawing the graph shown in Fig. 4:

1. Draw the graph ordinates and abscissas as shown.
2. Locate the tower-impedance point $(31.5 + j26.2)$ on the graph and mark this 1Z.
3. Draw dotted impedance line from $31.5 + j0$ vertically up through point 1Z and extending on.
4. Draw admittance circle of this line. $1/31.5 = .0317$. Radius is $.0317/2 = .0158$ on the admittance scale.
5. Draw dotted impedance line from $52 + j0$ vertically down.
6. Draw admittance circle of this line. $1/52 = .0192$. Radius is $.0192/2 = .0096$.
7. & 8. Locate a point (7) on the upper half of circle 4, and a point (8) on the lower half of circle 6 which are on the same vertical line and produce an angle of 99.9° at the origin.
9. Extend a line from the origin through point 7 until it crosses line 3.
10. Extend a line from the origin through point 8 until it crosses line 5.
11. Label the point of intersection of lines 3 and 9 as 2Z.
12. Label point 7 as 2Y.
13. Label point 8 as 3Y.
14. Label the point of intersection of lines 5 and 10 as 3Z.
15. Label the $52 + j0$ impedance point as 4Z.

The network is solved; the reactance or susceptance values may be read from the graph as follows (refer to Fig. 2 for component identification):

$$X_{L7S} = 1Z \text{ to } 2Z = j20$$

$$Y_{C8S+L8S} = 2Y \text{ to } 3Y = j.0245$$

$$X = \frac{1}{Y} = \frac{1}{j.0245} = -j40.8$$

$$X_{L8S} = 3Z \text{ to } 4Z = j50.5$$

Solve for the values of inductance and capacitance as follows:

$$L = \frac{X_L}{2\pi f} \text{ and } C = \frac{Y_C}{2\pi f}$$

$$L7S = \frac{20}{2 \times 3.14 \times 10^6} = 3.18\ \mu h$$

$$C8S + L8S = \frac{.0245}{6.28 \times 10^6} = .0039 \text{ mf}$$

(Therefore C8S can be no larger than .0039 mf or L8S will not be able to tune it.)

$$L6S = \frac{50.5}{6.28 \times 10^6} = 8.04\ \mu h$$

Table 2 is useful for approximating the value of capacitance or inductance for a given value of impedance or admittance. It can also be used to locate decimal points when using standard equations for exact answers.

The graphic solution of the north tower base mesh is shown in Fig. 5.

Current Through Mesh Shunt Reactance

1. Solve for voltage at mesh center as follows. The impedance is the sum of the directional-operation impedance and the reactance of the output arm of the mesh.

$$E_N = IZ = 3.45\ [52.6 + j\,(43.8 + 0)]$$
$$= 3.45 \times 68.5\ \underline{/39.6°} = 236 \text{ v}$$

$$E_S = IZ = 3.45\ [31.5 + j\,(26.2 + 20)]$$
$$= 3.45 \times 55.0\ \underline{/55.7°} = 190 \text{ v}$$

Table 2. Values of X and B vs. mfd and uh at 1mHz

X	B	mfd	uh	X	B	mfd	uh
10.0	.100	.0159	1.59	63.1	.01585	.00252	10.0
11.2	.0891	.0142	1.78	70.7	.0141	.00224	11.3
12.6	.0891	.0126	2.01	79.4	.0126	.00201	12.6
14.1	.0707	.0113	2.24	89.1	.0112	.00178	14.2
15.85	.0631	.0100	2.52	100.0	.0100	.00159	15.9
17.8	.0562	.00895	2.83	126	.00794	.00126	20.1
20.0	.0500	.00796	3.18	158.5	.00631	.00100	25.2
22.4	.0446	.00710	3.57	200	.00500	.000796	31.8
25.1	.0398	.00634	4.00	251	.00398	.000634	40.0
28.2	.0355	.00565	4.49	316	.00316	.000500	50.0
31.6	.0316	.00500	5.00	398	.00251	.000400	63.4
35.5	.0282	.00449	5.65	500	.00200	.000318	79.6
39.8	.0251	.00400	6.34	631	.001585	.000252	100.0
44.6	.0224	.00357	7.10	794	.00126	.000201	126
50.0	.0200	.00318	7.96	1000	.00100	.000159	159
56.2	.0178	.00283	8.95				

1. Solve for I in shunt:

$$I_N = \frac{E}{X} = \frac{236}{53.2}$$

$$= 4.44 \text{ amps (carrier)}$$

$$I_S = \frac{E}{X} = \frac{190}{40.8}$$

$$= 4.65 \text{ amps}$$

Current into Networks

The network power-loss figure given by the FCC is 92.5%. Thus the power into the common point is 1000/ .925 = 1080 watts; therefore, 80 watts is assumed to be the total loss in the feed system. Estimated losses in each section of the feed system are shown in Fig. 2.

Power into north network:

626 w + 1.39% of 626 = 635 watts

Power into south network:

374 w + 1.39% of 374 = 379 watts

$$I_N = \sqrt{\frac{P}{R}} = \sqrt{\frac{635}{52}} = 3.49 \text{ amps}$$

$$I_S = \sqrt{\frac{P}{R}} = \sqrt{\frac{379}{52}} = 2.72 \text{ amps}$$

Transmission Lines

Line characteristics such as impedance, propagation, efficiency, and power rating can best be obtained from the manufacturer's data sheet. These characteristics can also be measured; but unless trouble is suspected, there is very little need to do so. There aren't any adjustments to be made on the lines proper, yet it is necessary to know some electrical quantities concerning the manner in which they are being operated. Below are some example calculations for the table.

Power Information for the Transmission Lines

1. Read from a line loss table:
   .043 db/100' at 1.0 mHz
   Efficiency north line:
   .043 × 3 = .129 db = 97%
   Efficiency south line:
   .043 × 2.5 = .108 = 97.5%
2. P line out/eff$_N$ = 635/.97
   = 655 watts into line
   P line out/eff$_S$ = 379/.975
   = 389 watts into line
3. Power loss north line = 655-635
   = 20 watts
   Power loss south line = 389-379
   = 10 watts
4. Power ratio in = 389/655 = .594

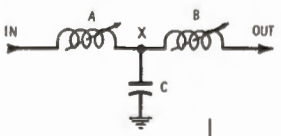
Voltage Across Line Input

1. $E_N = \sqrt{PR} = \sqrt{655 \times 52}$
   $= \sqrt{34060} = 185$ volts rms carrier
   $E_S = \sqrt{PR} = \sqrt{389X52}$
   $= \sqrt{20228} = 142$ volts
2. Voltage ratio = 142/185 = .768

The voltage or current ratio figure has several uses in testing the

Table 3. Phase-Shift Network Information

Phase Shift	Xa & Xb / Zo	Xc / Zo	for Zo = 52 Ohms Xa & Xb	Xc	@ 1.0mHz La & Lb uh	@ 1.0mHz Cc mfd	Per Amp Ex	Input Ic	Phase Meter
0°	0	∞	0	∞	0	0	52.0	0	2.00
10°	.0875	5.767	4.6	299.9	.73	.0053	52.1	.18	1.99
20°	.1763	2.924	9.2	152.0	1.46	.00105	52.8	.34	1.97
30°	.2680	2.000	13.9	104.0	2.21	.00153	53.8	.51	1.93
40°	.3640	1.556	18.9	80.9	3.01	.00197	55.2	.68	1.88
50°	.4663	1.305	24.2	67.9	3.85	.00234	57.2	.84	1.89
60°	.5774	1.155	30.0	60.1	4.78	.00265	59.9	.99	1.73
70°	.7002	1.064	36.4	55.3	5.79	.00288	63.4	1.14	1.64
80°	.8391	1.015	43.6	52.8	6.94	.00302	67.9	1.28	1.56
90°	1.000	1.000	52.0	52.0	8.28	.00306	73.5	1.414	1.414
100°	1.192	1.015	62.0	52.8	9.87	.00302	80.9	1.56	1.28
110°	1.428	1.064	74.3	55.3	11.83	.00288	90.0	1.64	1.14
120°	1.732	1.155	89.6	60.1	14.26	.00265	104	1.73	.99
130°	2.145	1.305	111.5	67.9	17.75	.00234	123	1.81	.84
140°	2.748	1.556	142.5	80.9	22.75	.00197	152	1.88	.68
150°	3.732	2.000	194.1	104.0	30.90	.00153	201	1.93	.51
160°	5.671	2.924	294.9	152.0	46.95	.00105	300	1.97	.34
170°	11.43	2.924	594.4	299.9	94.63	.0053	595	1.99	.17
180°	∞	∞	∞	∞	∞	0		2.00	0
	Tan Phase Shift / 2	1 / sin PS	52Xa	52Xc	$L_a = \frac{X_a}{6.28}$	.1592 / Xc	$\sqrt{1 + X_a^2} \times 52$		



system. For example, 52-ohm carbon resistors could be substituted in place of the lines. A unit test oscillator could be connected to the common input, and with the use of an RF VTVM probe the branching and phasing circuits could be checked for tuning. Then replace the lines and read again. This is a good test for line mismatch as well as branching tuning.

Phasing Mesh Networks

The purpose of the phase network is to provide a variable change in phase without introducing a change of impedance into the circuit. This is not accomplished perfectly, nor does it have to be; but to ignore the problem may produce some poor solutions. A simple way to explain what is wanted in the phasing network is given in Table 3. From this the reactive and parts values can be found easily to fill in Table 2.

For the south-line phasor, a simple series-resonant circuit is used. A good design uses $X_C = -j52$ ohms and $X_L = +j104$ ohms to cover approximately $\pm 45°$ from one end of L4S to the other.

In this example, the north phasor works best at $-90° \pm 15°$, and the south phasor at $0° \pm 15°$. If the phasor parts can be determined or measured, phase delay could be determined from Table 3. It is not difficult to measure the phase delay of the phasor or of the base mesh network. One suggested method is to use the phase-measuring RF voltage mixer (Fig. 6). If you can assume a reasonable line matching, one voltage probe can be connected to the phasor input and the other to the output. If current phase rather than voltage phase is desired, such as at the tower base, a current probe should be used. The output of the mixer box is connected to an RF or receiver-type voltmeter. S1 is switched on and R1 adusted for one volt; S1 is then switched off, S2 switched on, and R2 adjusted for one volt. Then S1 is switched back on, and the resultant voltage observed. The phase-delay characteristic can be read from the "Phase Meter" column of Table 3.

Branching Section

There are several types of branching circuits. One of the common circuits used has been shown. The solutions of the branching circuit are determined by the setting of the six L2 clips and the value of C2. Improper clip settings could increase power losses, produce excessive voltages, cause improper jeep control, and/or cause poor bandpass. It is beyond the scope of this article to explain all these conditions, but here are a few simple checks that can be made to determine whether this particular branching circuit is tuned within reason: All clips for L3N and L3S should be below C1 and C2; inductive reactance from L3N armature to ground should be approximately $+j50$ ohms; the C1 and C2 clips should be quite close together (could be one clip); C2 should be of such a value that only a few turns are needed from the high side of L3N to C2 clip. (The smaller the capacitance is, the more turns will be needed on L2 and the farther down the coil the clip for C1 will appear.) The lower clip of L3S should be about one turn below the low clip of L3N, and the high clip of L3S should be about one turn below the high clip of L3N; the separation of the L3S clips on L2 should be approximately equal to the inductance of jeep coil L3.

Common Input Section

It is possible that L1 and C1 could be eliminated and the correct common impedance obtained by juggling the C1 and C2 clips; or the input circuit could be a complete impedance-matching circuit. A good solution is to add the series circuit as shown here. The C1 clip on L2 is used for the final resistance setting, and L1 is set for the final reactance setting.

Conclusion

The first step is to make up a table similar to Table 1. The table should be complete with all of the needed items and characteristics. When you have filled in all the items, you should be more effective in the operation of your directional antenna system. ▲

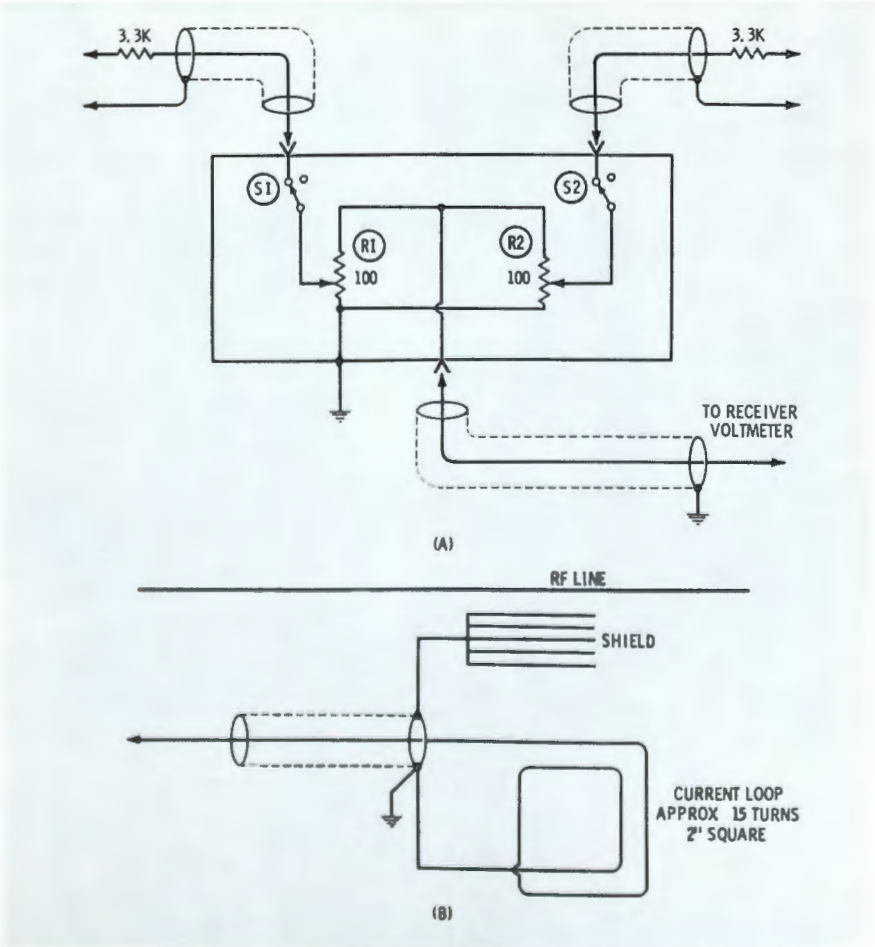


Fig. 6. Phase shift can be measured by using this mixer with an RF voltmeter

AN EDUCATIONAL BROADCAST CENTER

by Charles L. Smith, Redwood City, California—A modern junior-college radio and television facility.

From a meager entry into broadcasting more than ten years ago at a temporary campus, California's College of San Mateo has expanded its former 10-watt FM station into a complete radio-television broadcast center. Channel 14 operations began during the Fall 1964 semester from the new College Heights campus of CSM.

The campus is located on a 153-acre site on the crest of the hills west of San Mateo overlooking San Francisco Bay. Motorists approaching College Heights on the new 19th Avenue Freeway see the most unique part of KCSM's plant—its antenna system (Fig 1).

Antenna System

The Board of Trustees, the College administration, and the faculty insisted upon an aesthetic design that would blend with the modern architecture of the new campus. Dr. Jacob H. Wiens, Director, College of the Air, designed a free-standing, tapered antenna tower that conformed to both aesthetic and technical requirements. The tower diameter is 36″ at the base, tapering to 18″ at the top.

The tower was fabricated by a local firm from ⅜″, type-A7 steel in three 30′ sections; each section was rolled, tapered, and welded along its seam; then the three sections were joined end-to-end and welded together. The 90′ tower was trucked to the site, set into position by a crane, leveled, and bolted onto a 76-cubic-yard concrete base. Four 2⅝″ bolts hold the tower in position. A second, larger crane lifted the 48′ UHF pylon antenna into place atop the tower. A 5-bay FM antenna was installed on the tower between the 40′ and 89′ levels.

The antenna system is designed to withstand 130-mph winds — and vandals. Aesthetic requirements precluded an unsightly fence around the tower; therefore, vandal-proofing had to be an integral part of the design. Climbing hooks, from the ground up to the 20′ level, are removable. A 4″ conduit, carrying both the FM and TV transmission lines from the transmitter room, runs underground to the interior of the tower.

The UHF pylon antenna with its power gain of 23 provides a visual ERP of 16 kw; the FM antenna with its gain of 5 radiates 350 watts. With the exception of a few

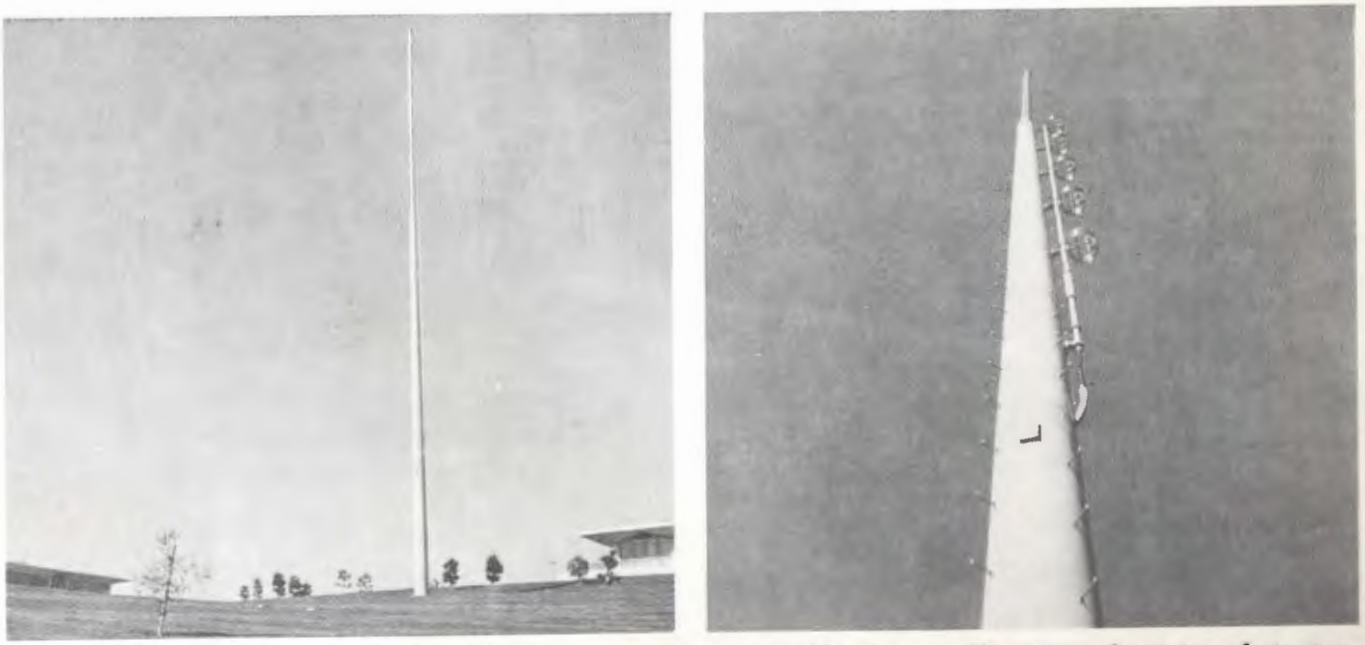


Fig. 1. Views of KCSM tower, antennas. FM antenna is five rings on side of tower; TV antenna forms top of structure.

shadow areas, both the FM and TV signals cover most of the San Francisco Bay Area quite well. A few isolated reports of reception have been received from listeners as far away as Sacramento — 80 miles northeast of San Mateo, thus indicating that the relatively low-power signals are being radiated very effectively by the antennas.

Cost of the special tower was approximately $10,000. The FM and TV antennas plus installation brought the total antenna-system costs to about $27,000.

Television Facilities

Live video programs originate in the 1740-sq. ft. television studio before image-orthicon cameras and under an array of assorted incandescent lighting. Here, production students learn artistic lighting techniques necessary to create the desired mood of the shows. The intensity of the lighting is controlled by 36 variable autotransformers at a light-control panel. A vidicon camera, modified for EIA house sync, is available for through-the-micropscope shots. On shows that require a large number of "spaghetti-board" supers and easel-card shots, studio vidicon cameras are borrowed from the auxiliary studio.

The 820-sq ft auxiliary studio, though originally designed as a radio studio, has been equipped with a pair of studio vidicon cameras, and now doubles as both an FM and a TV studio. First-semester students learn basic TV production techniques with vidicon cameras and "flat" fluorescent lighting before integrating with upper classmen in the main studio on IO cameras with adjustable lighting.

All live air shows are directed and controlled from the master TV and audio control room (Fig. 2) located adjacent to the main studio. Camera-control units, the video switcher, 16-mm film projectors, slide carousels, audio tape decks, a turntable, and a dual-channel audio board are situated in master control.

Control room 2 (for the auxiliary studio) was originally designed for audio use as an announcing booth and was equipped with a small monaural audio board, two turntables, and three audio tape decks.

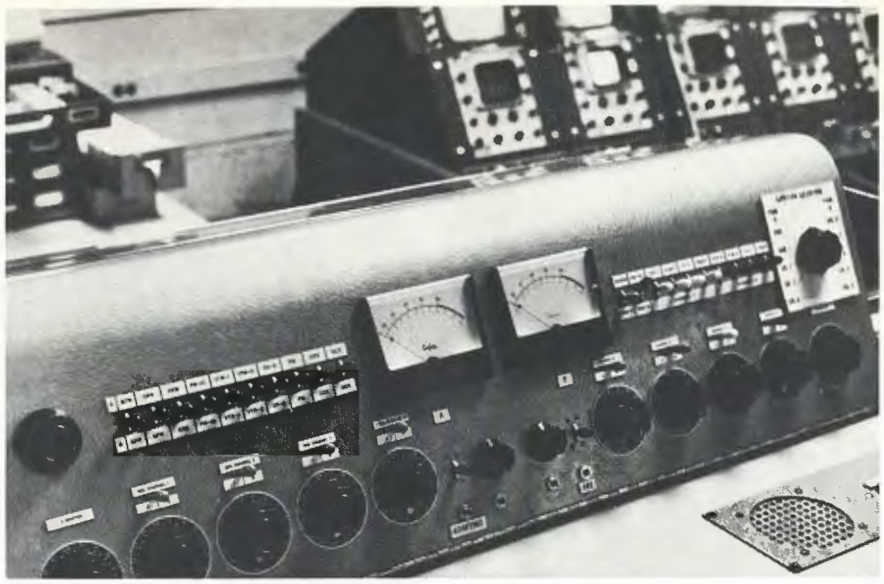


Fig. 2. Dual-channel audio board in TV master control room is student-built.

Two camera-control units were added for controlling the vidicon cameras used in the auxiliary studio. Thus, the control room can now serve as an announcing booth, an audio recording center, a radio control room, or as a TV control room, thereby increasing its usefulness to the station.

Two solid-state video tape recorders are in almost constant use either recording or playing back locally produced shows, playing back tapes from other educational institutions, or recording student laboratory projects for subsequent playback and critique purposes. Electronic-editing facilities are also available.

A separate push-button switcher (Fig. 3), located between the two VTR's, is available for selecting incoming video and audio to each recorder. The operator can select signals from the test generator, from control room 1, from control room 2, from the other VTR (for dubbing purposes), and from the transmitter patch bay (for off-the-air pickups, remotes, etc.).

The transmitter room, located in the basement, contains the one-kilowatt transmitter, delegate switcher, and shop area. Input signals to the transmitter can be selected directly from their sources without a feed from master control, thus relieving the master control room of routine control functions. Such flexibility releases master control and the main studio for other purposes (such as taping new shows) while the station is broadcasting programs that originate from non-studio

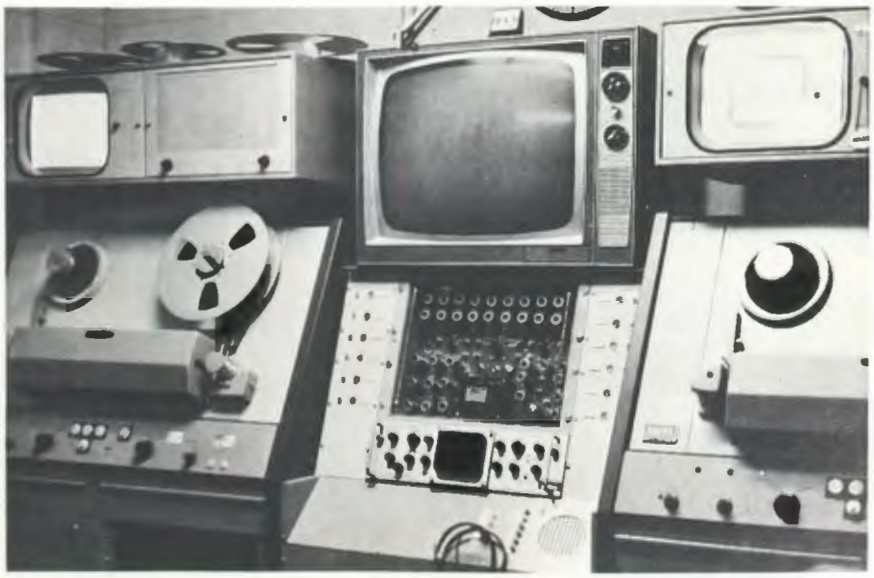


Fig. 3. Push-button switcher selects video, audio inputs to video recorders.

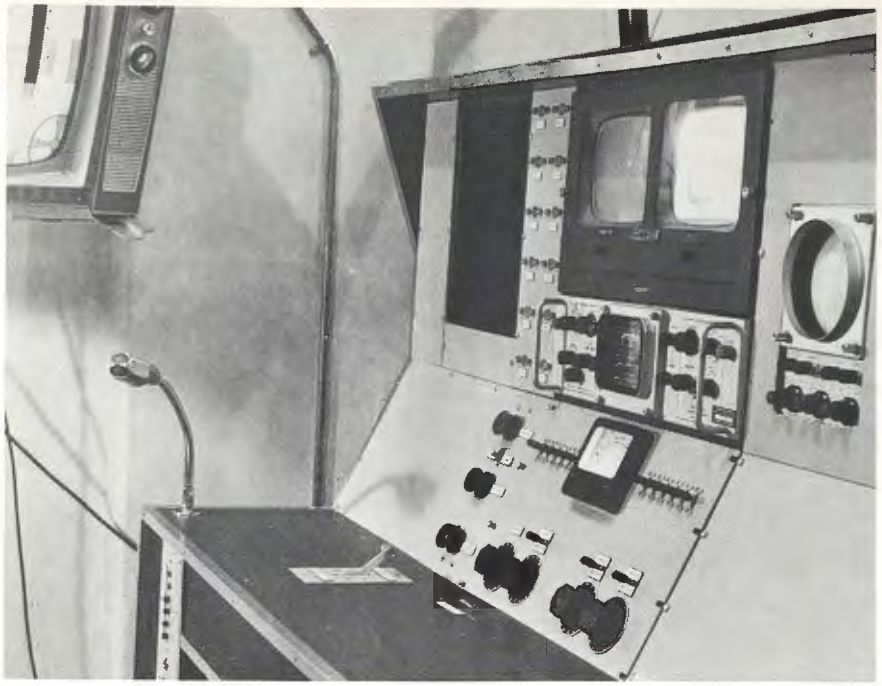


Fig. 4. Delegate switcher controls inputs to KCSM-TV channel-14 transmitter.

sources. As an example, the delegate switcher (Fig. 4) can take video and audio from VTR 1 for broadcasting while VTR 2 records a new program from the main studio through master control.

In addition to its open-circuit television facilities for UHF broadcasting, CSM's Telecommunications Department serves campus classrooms with audio-visual material over a closed circuit network that has 180 potential outlets. Programs are presently sent down the cables on channels 3, 6, and 8; channels 10 and 13 will be added later. Program sources include any of the station's composite video sources, off-the-air pickups, and separate CCTV film chains located in the transmitter room.

Each CCTV film chain consists of a vidicon camera mounted on the base of a 16-mm film projector and coupled to it by an optical multiplexer mounted longitudinally on the front of the projector. Advantages of this system include floor-space conservation and much lower costs than conventional multiplexer-camera arrangements.

Radio Facilities

The present FM radio facilities of KCSM contrast vividly with the original installation of the early 1950's. The entire FM facility, from turntables and tape decks to the transmitter, is housed in the FM control room. After completing courses in microphone techniques and announcing, radio students work on-the-air shifts announcing live shows; engineering students operate the board and recording equipment, and monitor the transmitter.

Fig. 5. Another student-built dual-channel audio board is in use at KCSM-FM.

At present, all radio shows are broadcast monophonically. However, a dual-channel audio board (Fig. 5), designed for stereo broadcasting, and stereo tape decks are available for future conversion to stereo. This conversion will not be undertaken until the 75-watt composite transmitter is replaced by a 2- to 5-kw unit sometime in the future. Despite the existing transmitter's relatively low power, it provides excellent monaural signals; worst-case distortion occurs at 50 Hz, and that never exceeds 0.3%.

Staff-Built Equipment

Much of the broadcast equipment used at KCSM is staff-built; knowledgeable technical visitors to the station are often impressed by both the quality and the quantity of the equipment. Engineering students, under the direction of a staff engineer, do much of the actual fabrication work, thereby acquiring valuable practical experience.

Staff-built equipment includes the lighting control board, TV and FM dual-channel audio boards, FM transmitter, delegate switcher, VTR switcher, and the CCTV optical multiplexers.

Conclusion

The modern broadcast facilities at the College of San Mateo help telecommunications students learn actual station-operation techniques. Graduates of CSM's telecom program will provide the broadcast industry with experienced production and technical personnel. KCSM-TV is offering the general public college-level telecourses over channel 14. Both the FM and the TV outlets provide a forum for discussing important local public affairs. These facilities of the San Mateo Junior College graphically illustrate the tremendous progress in American education afforded by radio and television. ▲

INSPECTION AND MAINTENANCE OF AM GROUND SYSTEMS

by ***Frank B. Ridgeway,*** BE Consulting Author—If the ground system deteriorates, so does the station's coverage.

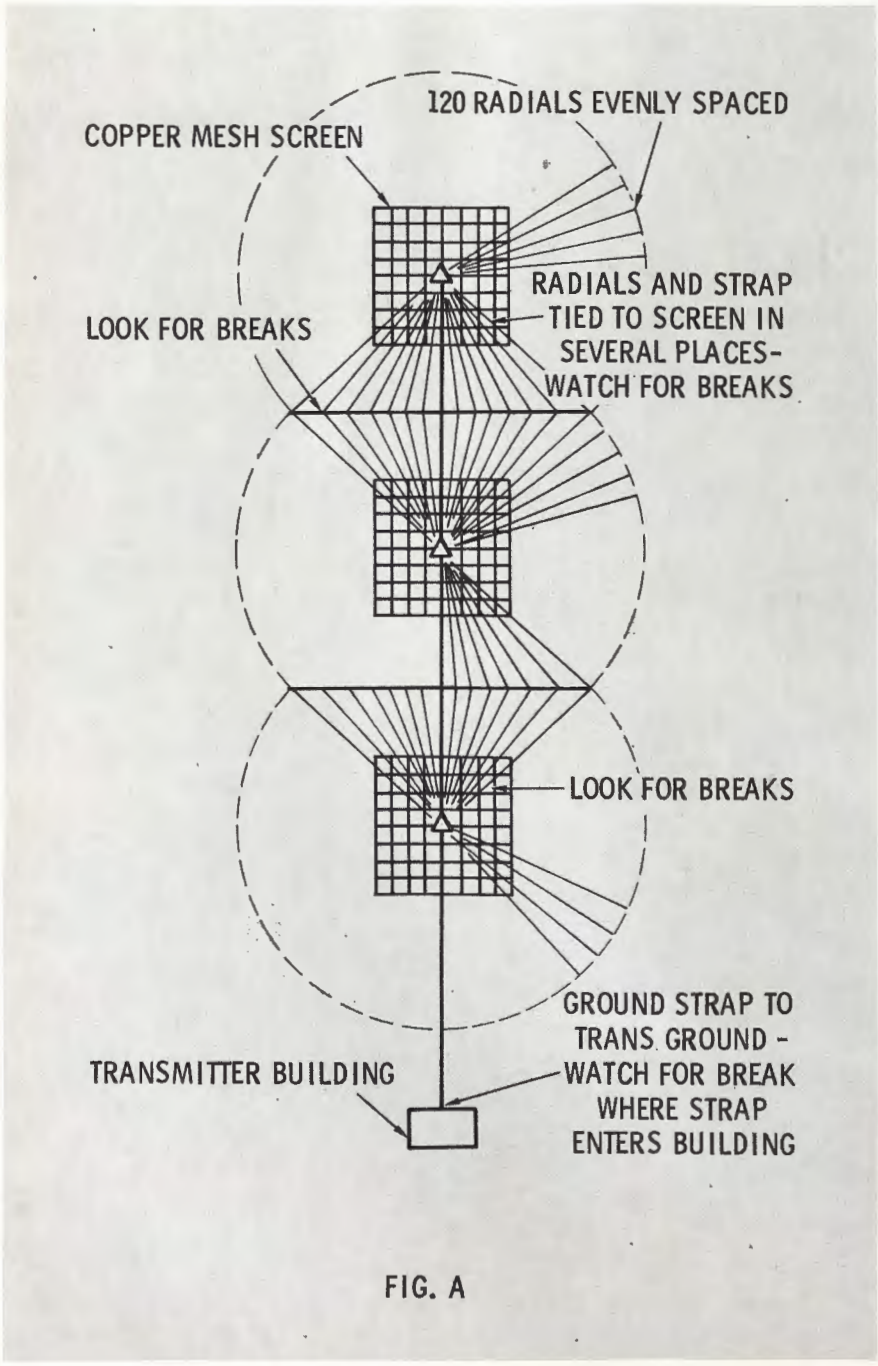


FIG. A

Points to check regularly to be sure the ground system operates efficiently.

The importance of a good ground system in an AM station cannot be overlooked.[1] Yet the mere installation of a ground system can be a waste of time unless it is properly maintained. A well maintained ground system will contribute much to the efficiency and stability of a radiation pattern. This is especially true in "end-fire" arrays where the base impedances of the towers tend to become low because of the mutual impedances between the radiators.

Currents flow through the radiator-ground capacitance and then must be conducted back to the base of the radiator through the surrounding earth. The chief source of energy loss in an AM broadcast antenna system is the earth surrounding the antenna, because earth is a poor conductor. Furthermore, skin effect confines the returning currents to the area near the earth's surface where the moisture content is lowest.

In any radiating system, there are three main types of resistance: radiation resistance (not a loss) which causes power to be radiated; ohmic resistance, or loss, which consumes power in the system; and dielectric losses caused by imperfect dielectrics, such as trees near the antenna system. Naturally, the higher the ratio of radiation resistance to ohmic resistance the more efficient the system will be. Any poor connection in the ground system will increase the ohmic resistance, thus consuming power and reducing the radiated power. Dielec-

[1]See also "Removing the Mystery From Grounding," by Thomas R. Haskett, February, 1966 BROADCAST ENGINEERING, page 17.

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!

*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. 561V
638 Cecil Street, Buchanan, Michigan 49107

Electro-Voice®
SETTING NEW STANDARDS IN SOUND

Well-kept transmitter area helps to minimize system-efficiency changes.

tric losses can be controlled by clearing trees and other objects from the antenna site. These factors enter into the effective maintenance of a ground system.

A good ground system for an AM station consists of the following: a ground screen of 23-gauge expanded copper mesh 48′ square placed under each tower, with 120 radials of No. 10 bare copper wire, evenly spaced, extending at least a quarter wavelength from the tower. An additional 120 radials of wire, 50′ in length, evenly spaced between the longer radials could be substituted for the ground screen. However, copper screen is more efficient, especially where the towers approach one-half wavelength in height, and will reduce the "E" losses around the tower base.

If guyed towers are installed, the 120 radials should be interwoven in the copper mesh and brought up to a band of copper strap at least 3″ wide around the concrete base of the tower; each radial should be bonded to the copper mesh in several places with silver solder. Ordinary solder may eventually corrode, causing high-resistance joints. The insulator base, lightning gap, and tuning box should be bonded to the copper strap. If coaxial cable is used, the outer conductor should be bonded to the strap.

Because of line expansion and contraction, strap had to be replaced.

Where possible, the antenna ground system should be connected to the copper ground strap in the transmitter building. In one five-tower array in which the outer conductors of the coax lines were tied to the transmitter ground, it was found the efficiency of the array increased when all metal beams in the transmitter building were bonded together and tied to the transmitter ground, which in turn was connected directly to the antenna ground system. If self-supporting towers are used, the ground mesh should be laid out under the entire tower with the radials interwoven into the copper mesh to the center of the mesh. The insulator bases and lightning gap should be bonded to the mesh.

The tuning boxes and coax outer conductors should be bonded to the mesh by means of a 4″ copper strap brought down to and extended beneath the mesh for 3 or 4′ and bonded in as many places as practical.

In directional arrays where the towers are spaced less than a half wavelength apart, for maximum efficiency the ground radials running between the towers must be bonded to a heavy copper bus or strap running perpendicular to the line of towers and midway between them.

The entire ground system should be located in a field or grassland which has been cleared of all trees, shrubs, etc. Grass should be encouraged to help prevent erosion. If tall weeds grow on the ground area, it should be mowed often to control them. Such growth can cause heavy "E" losses under some conditions, especially at the base of the tower.

Shrubs should never be allowed to grow on the antenna site. Although bulldozers or other machines may be used to clear trees and shrubs, if roots remain in the ground the shrubs and small trees continue to grow. After three or four years they will affect the array to such an extent that between dry weather and wet weather the radiation pattern of the array will change

Summer growth of leaves on underbrush can affect a critical array.

in the nulls. Shrub growth is controlled by spraying it with a solution. The county agricultural agent or farm feed store can be helpful in recommending effective sprays.

Each day when the base currents are read, the ground screen should get a casual inspection for signs of mechanical damage. Bonds to the copper strap around the tower base should be checked for visible breaks.

If erosion causes the dirt to wash away under any part of the ground screen or radials, it should be stopped. Dirt should be replaced to prevent breaks in the screen or radials.

If signs show that a farm wagon or other vehicle has been driven across any part of the system, spot checks should be made to see if any radials have been cut.

At least once a year, preferably in the spring, the radial bonds to the copper bus between towers should be spot checked to make sure that the freezing ground did not pull the bonds apart. At the same time, the bonds between the

• *Please turn to page 68*

Watch for breaks in the ground strap where it enters transmitter building.

DESIGNED FOR THE STATION OPERATOR: This new series of Mark IX Video and Pulse Distribution Amplifiers was designed by Ball Brothers Research Corporation especially for color studio operation. Constructed with the station operator's needs in mind, each unit provides the high performance and reliable operating standards required of broadcast studio equipment.

BUILT FOR SERVICE AND CONVENIENCE: The Mark IX modular units incorporate solid state circuitry, de-rated components, and self-contained, regulated power supplies. Up to 10 video or pulse amplifiers, or any combination of the two, can be plugged into the Mark IX chassis to provide as many as 40 isolated signal outputs at one central distribution point.

MARK IX VIDEO DISTRIBUTION: No high frequency adjustment is required on the Mark IX Video Amplifier because of its built-in wideband frequency response characteristics. Differential gain and phase measurements are shown for all input signal conditions at 0.25 percent and 0.25 degrees, respectively. Convenient test points are provided for signal monitoring and servicing.

MARK IX PULSE DISTRIBUTION: The Mark IX Pulse Amplifier has highly isolated signal outputs with an impedance of 75 ohms terminated at the sending end. Each amplifier has bridging or looping input drive signal provisions. The active circuitry maintains constant pulse rise times of less than 50 nanoseconds and is compensated for possible component replacement. Pulse delay of less than 50 nanoseconds is measured at the output.

Prices: Video-Pulse Amplifier, $255 ea.; Electronic Housing, $275. For full specifications and equipment details contact BBRC, Video Marketing, Boulder, Colorado 80302.

BBRC MARK IX VIDEO-PULSE DISTRIBUTION AMPLIFIER

DA IX

BBRC

BALL BROTHERS RESEARCH CORPORATION • P. O. BOX 1062 • BOULDER, COLORADO 80302 • TEL. 303/444-5300 • TWX 910-928-0141

Circle Item 14 on Tech Data Card

FREQUENCY-MEASURING SERVICES

by Thomas R. Haskett, Central Regional Editor—Here is how these services measure your carrier frequency accurately.

What Is a Hertz?

In this issue of BROADCAST ENGINEERING, the term "hertz" appears for the first time, Used for some time in other countries, and recently adopted by the U.S. National Bureau of Standards, IEEE, and other American organizations, the hertz is the unit of measurement of frequency. One hertz is the equivalent of one cycle per second. Hertz is abbreviated Hz (no period). In accordance with standard procedure, the first letter of the unit abbreviation is capitalized. The usual prefixes can be added to the abbreviation; thus, kHz means the same as kilocycles per second, and mHz means the same as megacycles per second.

The prime reason for adopting the hertz as the unit of frequency measurement is that it is a more precisely defined unit less subject to misuse than its predecessor. Many people speak of tuning a receiver to "1230 kilocycles." Such a statement has no meaning, strictly speaking, for while we have been told that the station frequency is such that twelve hundred and thirty thousand cycles occur, we have not been told during what period of time these cycles occur. The precise statement would be "1230 kilocycles per second." The abbreviation kc likewise has no meaning, and neither does kcs, for it is usually interpreted as meaning kilocycles. Only the abbreviation kc/s denotes the number of cycles occuring within a given period of time. The hertz, however, is defined as one cycle per second, and therefore includes the period of time — it is not necessary to add it. If someone tunes his receiver to "1230 kilohertz," we know precisely what he means.

Incidentally, the name hertz commemorates Heinrich Rudolf Hertz, a German physicist (1857-1894). He discovered radio waves, later called Hertzian waves, and devised the Hertz antenna. We know it today as the simple dipole, an antenna not depending on the presence of ground for operation, fed at the center, where current is maximum.

A frequency-measuring service is an organization that provides broadcasters with accurate measurements of transmitter operating frequency.* Under normal operation, the FCC rules do not require that a station have its transmitter frequency checked by a frequency-measuring service, only that frequency deviation be observed and logged by means of a frequency monitor. However, since the average operating monitor is not particularly accurate, it is wise to have periodic checks of the transmitter and compare these with the monitor readings, as a check on both. If the monitor should become defective, FCC rules require that some external means be employed to check the frequency of the transmitter once every seven days. The "external means" is the frequency-measuring service.

Services Performed

Services provided include checking transmitter frequencies according to the following FCC limits: (AM) the transmitter deviation must not exceed ±20 Hz**, and the associated frequency monitor must have an accuracy of 5 parts in 10^6. (FM) The transmitter deviation must not exceed ±2000 Hz, and the associated frequency monitor must have an accuracy of ±1000 Hz. The FM stereo pilot must be maintained within ±2 Hz of 19 kHz. Although the Commission has no rules regarding the frequency of SCA subcarriers, the usual practice is to maintain them within ±750 Hz of 42 or 67 kHz. (TV) The visual transmitter must be within ±1000 Hz of the assigned frequency, and the aural transmitter must be 4.5 mHz above the visual, ±1000 Hz. The color-television subcarrier must be maintained at a frequency of 3.579545 mHz, ±10 Hz, with maximum rate of change not to exceed 0.1 Hz per second. The accuracy of the TV frequency monitor must be ±500 Hz for 30 days at VHF, or for 10 days at UHF.

FM and TV-aural transmitters employ modulation monitors to measure frequency deviation. These monitors are often calibrated by frequency-measuring services. The FCC-required accuracy of such modulation monitors is 5% modulation at all levels up to and including 100% modulation. The measurement organization assures the broadcaster that the monitors are within these limits. In addition, they may also measure percent modulation by stereo and SCA signals, which do not register on some modulation monitors.

Measuring Equipment Used

A typical measuring service employs a directional antenna and a communications receiver to pick up signal from the station to be measured. In most cases the receiver has variable bandwidth, double conversion with a second IF of 50 kHz, and a sensitivity of one microvolt on the AM broadcast band. It will be similarly sensitive on the FM and TV bands. Also used are

Standard-frequency receiver, counter at a frequency-measuring service.

*See also: C. A. Cady and W. P. Buuk, "Frequency Measurements in the Broadcast Field," BROADCAST ENGINEERING, June 1960, p. 14.

**cps — See box at left.

The case of the unalike look-alikes

(Or why there are no twins in station automation)

Out of the 5,000-plus radio stations in the country, are there any exactly like yours?

Our experience tells us no. We find that regardless of similarity in location, power, personnel, and sound, each station has its own distinctive personality.

At least as far as automation is concerned. And that's why we custom-design ATC automation systems.

We have to consider such things as budget. A good round figure for full automation is $65.00 per week. It could be less. It could be more.

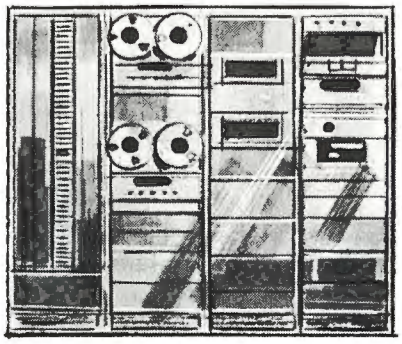
You can buy outright, finance, or lease the equipment.

We have to know what you want to accomplish with automation. Free announcers from control room mechanics for more productive assignments? Make your weekend broadcasts sound as sharp as weekdays without hiring more men? Automate FM around the clock, and AM a few hours a day?

ATC can answer any of these problems, plus many even more complicated.

We can provide three different control methods for automation: (1) punch card, (2) magnetic tape, (3) time/sequence.

We can provide equipment that prints your official log *automatically* as the material is being broadcast. We can provide the original and finest



tape cartridge units. Plus a multiple cartridge handler that plays 55 commercials or program segments in sequence.

The only way you can know for certain what your automation needs are right now is to talk to one of our people. They're all experienced broadcasters. They know your problems. They speak your language.

To hear them speak it, call 309-829-7006. Or write for detailed information on the flexible features of ATC automation.

AUTOMATIC TAPE CONTROL INC.

1107 E. Croxton Avenue
Bloomington, Illinois

Circle Item 15 on Tech Data Card

three instruments of medium quality: an oscilloscope, an audio generator, and an RF generator.

The important items for a frequency-measuring service usually cost several thousand dollars each —events per unit time (EPUT) meter, or frequency counter; a local or secondary frequency standard; and a receiver capable of picking up standard-frequency broadcasts from the National Bureau of Standards and making comparison between the local standard and the NBS standard.

Frequency Standards

The reference frequency for this country is the United States Frequency Standard, maintained at Boulder, Colorado, by the National Bureau of Standards. It consists of a long cesium-beam tube (or resonator) in which exists the transition from the stable to the unstable state of the cesium atom. This transition occurs at a stable rate, and absorbs energy at about 9.2 mHz. A crystal oscillator is calibrated against this resonator and the output frequency amplified and fed to several transmitters. At Ft. Collins, Colorado, NBS operates transmitters WWVL (20 kHz) and WWVB (60 kHz); at Beltsville, Maryland, WWV (2.5, 5, 10, 15, 20, and 25 mHz); and at Maui, Hawaii, WWVH (5, 10, and 15 mHz).

It is interesting to note that primary standards of length, weight, etc., are kept in sealed chambers with temperature and humidity control, and are used only to calibrate secondary standards. Secondaries are then used to calibrate tertiaries (such as station operating monitors), which are then available to everyday users of field-grade instruments. The primary frequency standard is unique in that it is the only standard available directly to the user by means of radio. This means that a much higher order of calibration accuracy for frequency is available without going through so many steps.

With short-term observation (about thirty minutes), it is possible to obtain accuracy to the order of 1 part in 10^7 by the received signals from the 2.5-to-25 mHz transmittres. It is possible to obtain greater accuracy with long observation, but these high-frequency signals suffer from the degrading effects of propagation which destroy their inherent accuracy. The cesium-beam standard itself has an accuracy of one part in 10^{13}. As transmitted, the accuracy is one part in 10^{12}. By utilizing the low-frequency signals at 20 or 60 kHz, at any receiving point in the USA it should be possible to obtain accuracy of one part in 10^{11}. Periodically, lists are published showing corrections, with reference to the primary standard, to the frequencies transmitted; this makes it possible to obtain the accuracy mentioned above.

VLF transmissions are more accurate because they are more reliable. Reception at VLF, although by ground wave, is by means of wave propagation through a sort of duct, in one or two hops. This propagation is very stable, and it is possible to compute the exact elapsed time between the transmission of a signal in Colorado and its reception at the measuring service. The HF signals, on the other hand, travel by means of sky wave (except for those few individuals located near Beltsville, Maryland or Maui, Hawaii) and are subject to fading and phase cancellation, degrading their accuracy.

Most frequency-measuring services maintain a secondary frequency standard, which is a very stable crystal oscillator with an accuracy of one part in 10^9. Usually a special receiver is employed, tuned either to the 20 kHz or the 60 kHz transmissions from Colorado. A phase-comparator circuit then produces an error signal proportional to the variation of the secondary from the primary standard. Often a continuous strip-chart recorder monitors this variation so that the frequency-measuring service can assure its clients that measurements are directly traceable to the primary standard. After a half hour of recording, the secondary standard allows an accuracy of about one part in 10^{10}.

Tertiary standards have less accuracy than secondaries, and are compared with secondaries. Most frequency-measuring services, however, employ what is known as an EPUT meter, or frequency counter. Such a meter can have an accuracy of one part in 10^6 when calibrated against a secondary standard. If an EPUT meter is set to measure the number of events in one second, the reading is the frequency of those events in hertz. However, EPUT meters can measure parameters other than frequency.

It is important to remember that time is not the reciprocal of frequency. To illustrate, consider the exact instant referred to as 3:21:30 p.m., April 15, 1961. This point in time is known as a *time-reference point*. It has no relation to frequency. But should we now refer to the point 3:21:31 p.m., April 15, 1961, and compare it with the previous reference point, we see that the time difference, or *epoch*, is one second. If one thousand cycles have been completed during that time difference, the frequency is 1000 Hz. *Period* is the time required to complete one cycle — 1/1000 of a second in the previous case — and is the reciprocal of frequency.

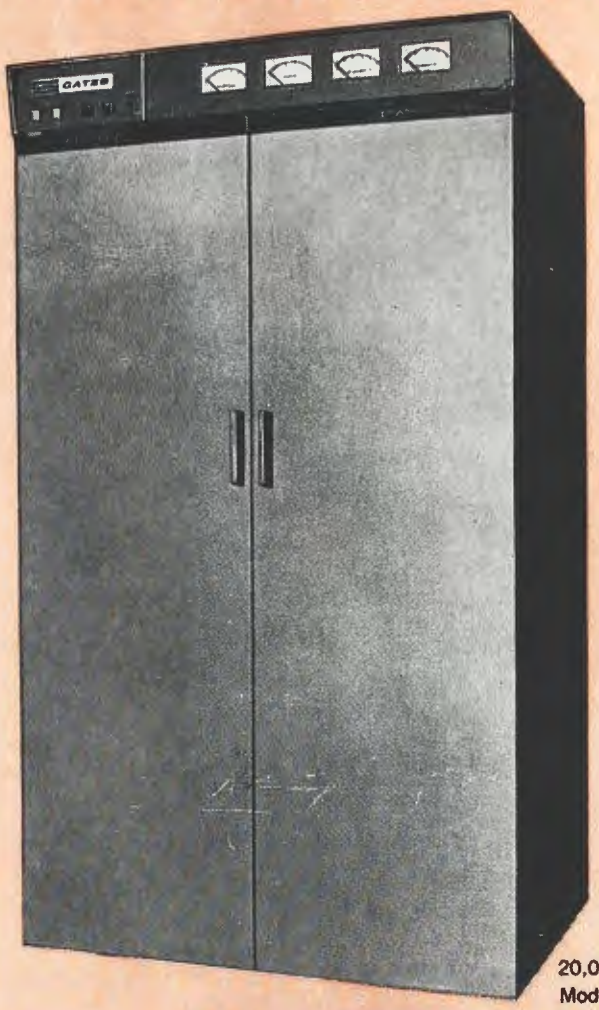
Industry Practice

Broadcast stations comprise the majority of the clients of frequency-measuring services. Some work is done for two-way radio services, but much of this frequency measuring is done by two-way service shops, many of which have frequency meters or counters. Most broadcast stations have their transmitter frequencies measured at monthly intervals, although some have it done weekly. Incidentally, FCC monitoring stations are equipped with secondary frequency standards and can easily determine whether a transmitter is off frequency beyond limits.

There are three considerations necessary to perform good measurements, including measurement of frequency: (1) Reasonable control of environment — no dust, wind, excessive humidity, temperature, vibration, etc. (2) Sufficient equipment of appropriate accuracy. (3) A knowledgeable operator. The third requirement is the most important, for an instrument with six-digit resolution is useless when manipulated by a two-digit operator.

• *Please turn to page 58*

The soundest sound in FM is the new sound of GATES



20,000-watt
Model FM-20G

POWER UP
SPACE DOWN

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Here's top power at lowest per hour operating cost in a compact space-saving cabinet arrangement. The new Gates FM-20G provides maximum installation flexibility. Power supply is 100% solid-state and only one 4CX-15,000A ceramic tetrode delivers 20,000-watts output. This brand-new Gates FM-20G Transmitter is another reason why the soundest sound in FM is the new sound of Gates. *Send today for complete description and specifications.*

HARRIS INTERTYPE CORPORATION

GATES

GATES RADIO COMPANY • QUINCY, ILLINOIS 62302, U.S.A.
A subsidiary of Harris-Intertype Corporation

Circle Item 16 on Tech Data Card

DIRECTORY OF STEREO FM STATIONS

The information in this directory was taken from the Howard W. Sams publication North American Radio-TV Station Guide, *3rd Edition (Catalog Number RSG-3), by Vane A. Jones.*

Alabama

Birmingham
WCRT-FM 96.5
WSFM 93.7

Dothan
WOOF-FM 99.7

Huntsville
WAHR 99.1
WNDA 95.1

Mobile
WLPR-FM 96.1

Montgomery
WAJM 103.3
WFMI-FM 98.9

Muscle Shoals
WLAY-FM 105.5

Alaska

Anchorage
KBYR-FM 102.1
KNIK-FM 105.5

Arizona

Phoenix
KMEO 96.9
KNIX 102.5
KOOL-FM 94.5
KRFM 95.5

Sun City
KTPM 106.3

Tucson
KSOM 92.9

Arkansas

El Dorado
KELD-FM 103.1
KRIL 99.3

Fort Smith
KMAG 99.1

Jonesboro
KBTM-FM 101.9

Little Rock
KARK-FM 103.7

California

Alameda
KJAZ 92.7

Bakersfield
KGEE-FM 101.5
KIFM 96.5

Fresno
KCIB 94.5
KXQR 102.7

Garden Grove
KGGK 94.3

Lodi
KCVR-FM 97.7

Long Beach
KNOB 97.9

Los Angeles
KCBH 98.7
KFAC-FM 92.3
KFMU 97.1
KFOX-FM 100.3
KPOL-FM 93.9
KRHM 102.7

Los Banos
KARL-FM 95.9

Monterey
KHFR 96.9

Riverside
KDUO 97.5

Sacramento
KFBK-FM 92.5
KHIQ 105.1
KSFM 96.9

San Diego
KBBW 102.9
KFMX 96.5
KGB-FM 101.5
KLRO 94.9
KPRI 106.5

San Fernando
KVFM 94.3

San Francisco
KBRG 105.3
KFOG-FM 104.5
KMPX 106.9
KPEN 101.3
KSFR 94.9

San Jose
KEEN-FM 100.3
KSJO-FM 92.3

San Luis Obispo
KSBT-FM 93.3

Santa Barbara
KGUD-FM 99.9
KMUZ 103.3

Santa Maria
KXFM 99.1

Stockton
KUOP 91.3

Turlock
KHOM 93.1

Ventura
KUDU-FM 95.1

Visalia
KONG-FM 92.9

Walnut Creek
KDFM 92.1

Woodland
KATT 102.5

Colorado

Colorado Springs
KLST 94.3

Denver
KFML-FM 98.5
KLIR-FM 100.3
KTGM 105.1

Manitou Springs
KCMS-FM 102.7

Connecticut

Brookfield
WGHF 95.1

Hartford
WTIC-FM 96.5

Meriden
WBMI 95.7

New Haven
WNHC-FM 99.1

Delaware

Wilmington
WDEL-FM 93.7
WJBR 99.5

District of Columbia

Washington
WASH 97.1
WGMS-FM 103.5
WMAL-FM 107.3

Florida

Belle Glade
WSWN-FM 93.5

Bradenton
WBRD-FM 103.3

Clearwater
WTAN-FM 95.7

Cocoa
WEZY-FM 99.3

Cocoa Beach
WRKT-FM 104.1
WXBR 101.1

Coral Gables
WVCG-FM 105.1

Ft. Lauderdale
WFLM 105.9
WMJR-FM 100.7

Ft. Myers
WINK-FM 96.9

Ft. Walton Beach
WFTW-FM 99.3

Gainesville
WRUF-FM 103.7

Jacksonville
WIVY-FM 102.9
WJAX-FM 95.1
WKTZ-FM 96.1
WQIK-FM 99.1

Marianna
WTOT-FM 100.9

Miami
WIOD-FM 97.3
WWPB 101.5

Miami Beach
WAEZ 94.9

Milton
WXBM-FM 102.3

Orlando
WHOO-FM 96.5

Palm Beach
WWOS 97.9

Panama City
WMAI-FM 107.9
Pensacola
WPEX-FM 94.1
St. Petersburg
WTCX 99.5
Sarasota
WYAK 102.5
Stuart
WMCF 92.7
Tallahassee
WBGM 98.9
WFSU-FM 91.5
Tampa
WFLA-FM 93.3
West Palm Beach
WPBF 107.9
Winter Haven
WINT-FM 97.5

Georgia

Albany
WGPC-FM 104.5
Americus
WDEC-FM 94.3
Athens
WGAU-FM 95.5
Atlanta
WKLS 96.1
WLTA-FM 99.7
WSB-FM 98.5
Carrollton
WLBB-FM 92.1
Columbus
WRBL-FM 102.9
Gainesville
WDUN-FM 106.7
La Grange
WLAG-FM 104.1
Moultrie
WMTM-FM 93.9
Rome
WROM-FM 97.7
Savannah
WTOC-FM 94.1

Hawaii

Honolulu
KAIM-FM 95.5
KPOI-FM 97.5

Illinois

Bloomington
WJBC-FM 101.5
Chicago
WEFM 99.5
WFMT 98.7
WKFM 103.5
WLS-FM 94.7
WMAQ-FM 101.1
WNUS-FM 107.5
WXRT 93.1
Crete
WTAS 102.3
Decatur
WSOY-FM 102.9
Elmwood Park
WXFM 105.9
Joliet
WJOL-FM 96.7
Loves Park
WLUV-FM 96.7
Mattoon
WLBH-FM 96.9
Quincy
WGEM-FM 105.1
Rock Island
WHBF-FM 98.9
Springfield
WFMB 104.5

Indiana

Columbus
WCSI-FM 101.5
Evansville
WIKY-FM 104.1
Ft. Wayne
WKJG-FM 97.3
WPTH 95.1
Greenfield
WSMJ 99.5
Hartford City
WWHC 104.9
Indianapolis
WFMS 95.5
WIFE-FM 107.9
Kendallville
WAWK-FM 93.3
Lafayette
WASK-FM 105.3
Peru
WARU-FM 98.3
Plainfield
WJMK 98.3
Richmond
WKBV-FM 101.3
South Bend
WNDU-FM 92.9
Terre Haute
WVTS 100.7
Vincennes
WAOV-FM 96.7

Iowa

Ames
WOI-FM 90.1
Cedar Rapids
WMT-FM 104.5
Des Moines
KDMI 97.3
KWDM 93.7
Sioux City
KDVR 97.9
Waterloo
KXEL-FM 105.7

Kansas

Lawrence
KANU 91.5
KLWN-FM 105.9
Leavenworth
KCLO-FM 98.9
Newton
KJRG-FM 92.3
Wichita
KCMB-FM 107.3
KQTY 101.3

Kentucky

Lexington
WVLK-FM 92.9
Owensboro
WSTO 96.1

Louisiana

Baton Rouge
WJBO-FM 102.5
De Ridder
KDLA-FM 101.7
Hammond
WTGI 107.1
Monroe
KMLB-FM 104.1
New Orleans
WDSU-FM 93.3
Shreveport
KBCL-FM 96.5

Maine

Brunswick
WCME-FM 98.9
Caribou
WFST-FM 97.7
Poland Spring
(See Mt. Washington, N. H.)
WMTW-FM 94.9

Maryland

Baltimore
WITH-FM 104.3
Bethesda
WHFS 102.3
WJMD 94.7
Halfway
WHAG-FM 96.7
Towson
WAQE-FM 101.9

Massachusetts

Boston
WBCN 104.1
WHDH-FM 94.5
Lynn
WLYN-FM 101.7
North Adams
WMNB-FM 100.1
Waltham
WCRB-FM 102.5
Worcester
WSRS 96.1

Michigan

Ann Arbor
WOIA-FM 102.9
Bay City
WBCM-FM 96.1
WNEM-FM 102.5
Detroit
WABX 99.5
WBFG 98.7
WDTM 106.7
WGPR 107.5
WJBK-FM 93.1
WLDM 95.5
WOMC 104.3
East Lansing
WSWM 99.1
WVIC-FM 94.9
Flint
WGMZ 107.9
Grand Rapids
WJFM 93.7
WOOD-FM 105.7
Holland
WHTC-FM 96.1
Interlochen
WIAA 88.3
Kalamazoo
WKMI-FM 106.5
WMUK 102.1
Midland
WQDC 99.7
Mt. Pleasant
WCEN-FM 94.5
Saginaw
WSAM-FM 98.1

Minnesota

Minneapolis
KWFM 97.1
WAYL 93.7
WPBC-FM 101.3
St. Louis Park
KRSI-FM 104.1

Mississippi

Greenwood
WSWG 99.1
Gulfport
WROA-FM 107.1
Hattiesburg
WFOR-FM 103.7
Jackson
WWHO 94.7
Pascagoula
WPMP-FM 99.1

Missouri

Crestwood
KSHE 94.7
Joplin
KSYN 92.5
Kansas City
KCMO-FM 94.9
KMBC-FM 99.7
St. Louis
KCFM 93.7
Sedalia
KSIS-FM 92.1
Springfield
KTXR 101.5

Montana

Great Falls
KOPR-FM 106.3

Nebraska

Omaha
KOWH-FM 94.1

Nevada

Las Vegas
KORK-FM 97.1
Reno
KNEV 95.5

New Hampshire

Mt. Washington
WMTW-FM 94.9

New Jersey

Atlantic City
WFPG-FM 96.9
Dover
WDHA-FM 105.5
Long Branch
WRLB 107.1
Paterson
WPAT-FM 93.1
Princeton
WPRB 103.3
Trenton
WBUD-FM 101.5

New Mexico

Albuquerque
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Los Alamos
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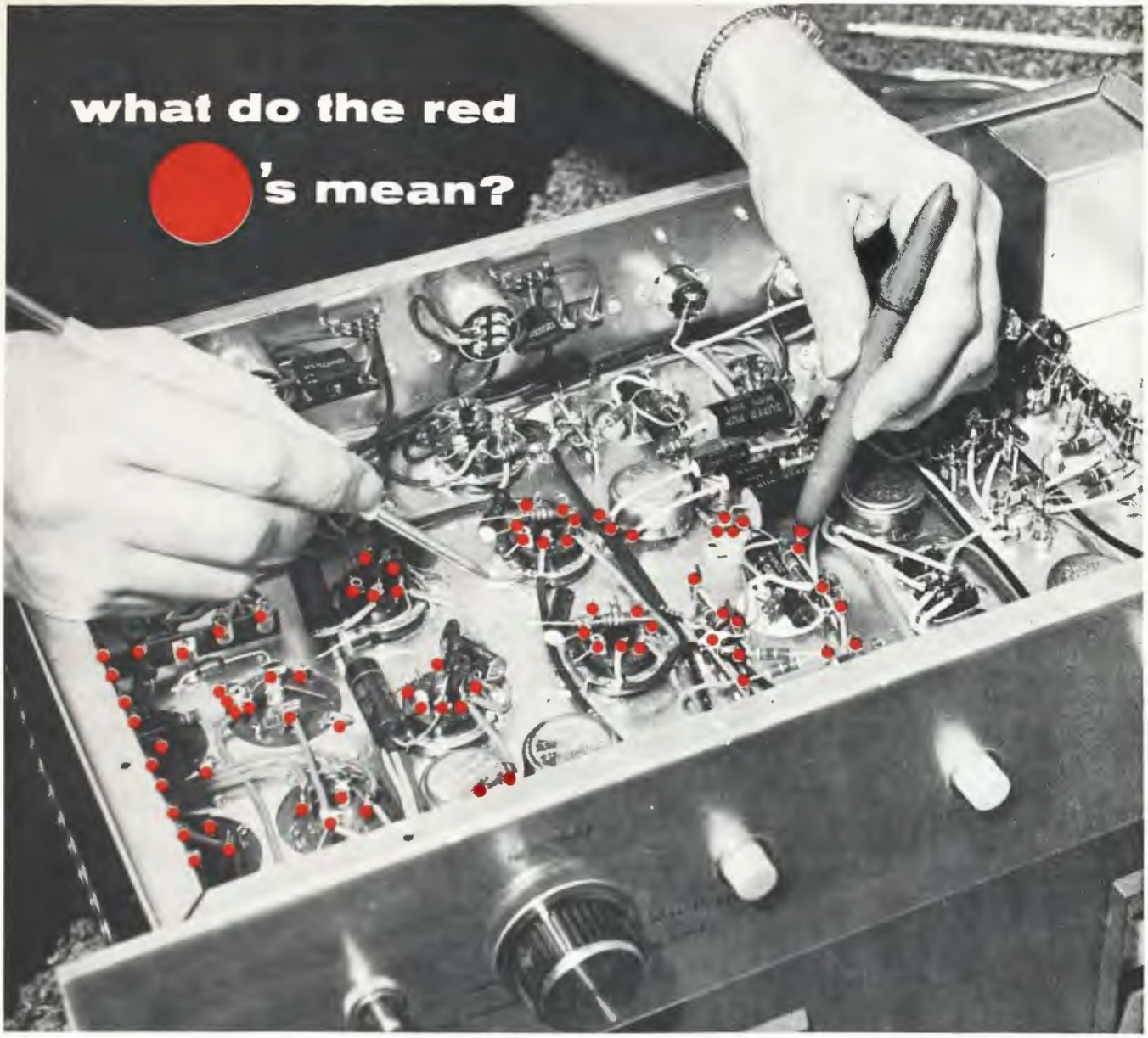

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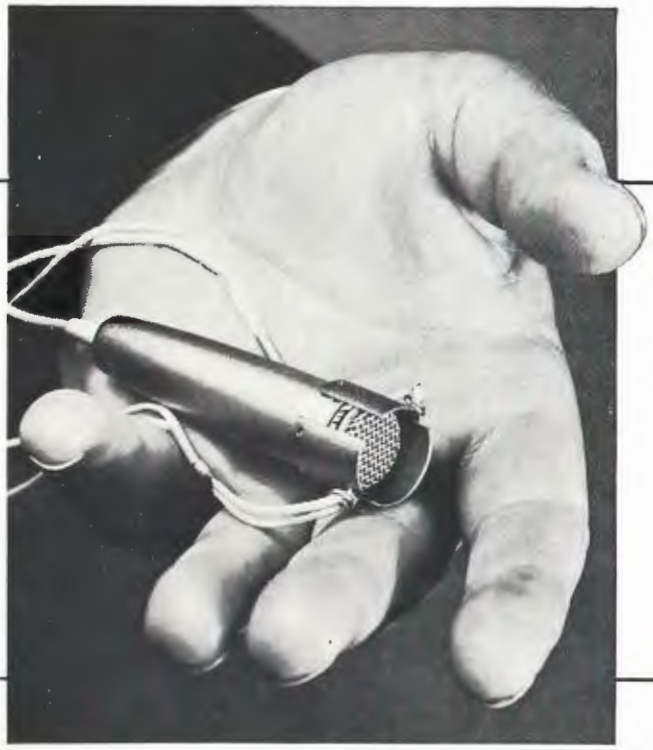

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Circle Item 32 on Tech Data Card

LINEARIZING ANTENNA CURRENT INDICATORS

by C. G. Cunningham, Professional Engineer, Taos, New Mexico—Some solutions, ordinary and not so ordinary, for a troublesome problem.

Getting the readings from a remote antenna-current meter to be a linear function of antenna current has always been a problem. This is especially true for stations that change power for nighttime operation, such as the class IV stations permitted to operate at one kilowatt during daytime hours.

When these stations cut back to 250 watts at sunset, the antenna current is halved. For most detector circuits driving a remote antenna-current meter, this is a strain on their linearity, and the engineer finds himself failing to comply with the FCC regulations concerning accuracy of the remote meters. The problem is especially tiresome when the station is remote controlled and the antenna current is monitored over a telephone pair.

Most detector circuits used to drive a remote meter resemble Fig. 1. There is nothing intrinsically wrong with this detector circuit. It is a time-honored technique. And, when driving a high impedance, it is more than linear enough to meet the requirements. The rub, in this application, is the relatively low load impedance. The detector must deliver current, often nearly a milliampere. Then the natural nonlinearity of the detector diode makes its presence known.

Most diodes have a forward resistance that varies with current (or voltage) as illustrated in Fig. 2. Naturally, when the average current delivered to the load — the remote meter — changes by a factor of two, this means the operating point shifts over a wide difference of forward resistance. The purpose of this article is to review methods, conventional and exceptional, for minimizing the effects of the diode's forward nonlinearity and maintaining the remote antenna-current meter within calibration tolerances.

Fig. 3 illustrates the most straightforward means of minimizing these effects. The theory is to increase R until it is large compared to the change in forward resistance of the diode. Unfortunately, by the time R is large enough to give linear operation, it is often too large to provide enough current to drive the meter. This method is simple and quick, however, and should be tried first.

Another conventional technique is to increase the capacitance of the RF bypass capacitor in Fig. 1. Really increase it — remember, it sup-

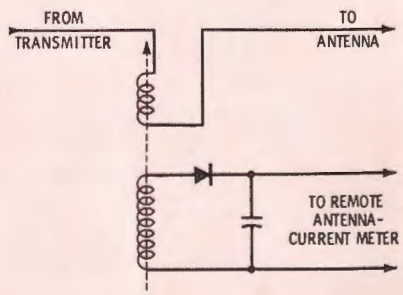


Fig. 1. Rectified antenna-current sample drives meter.

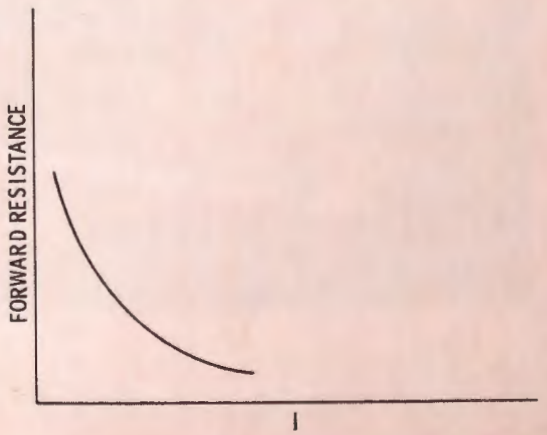
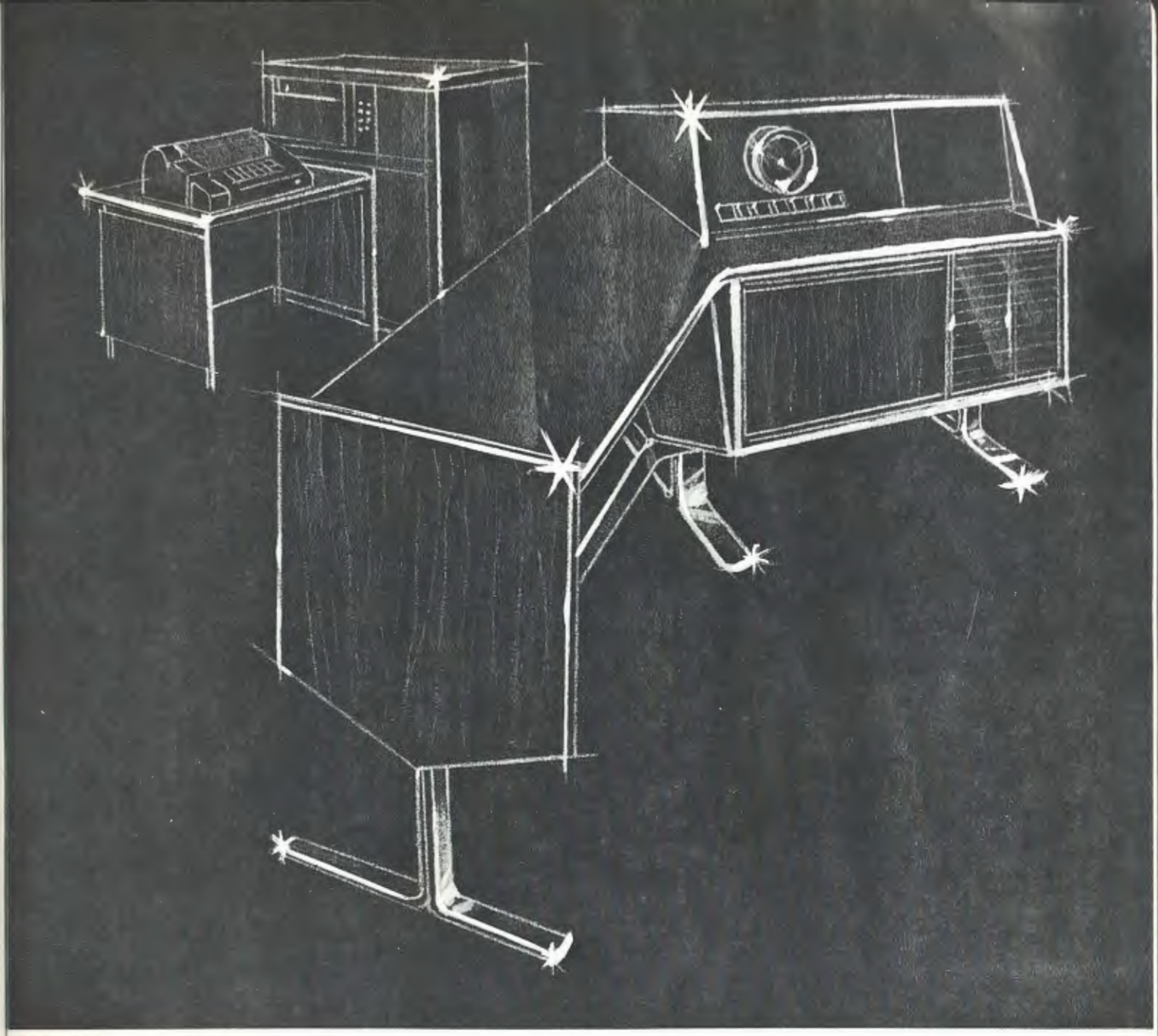


Fig. 2. Current through diode affects its resistance.



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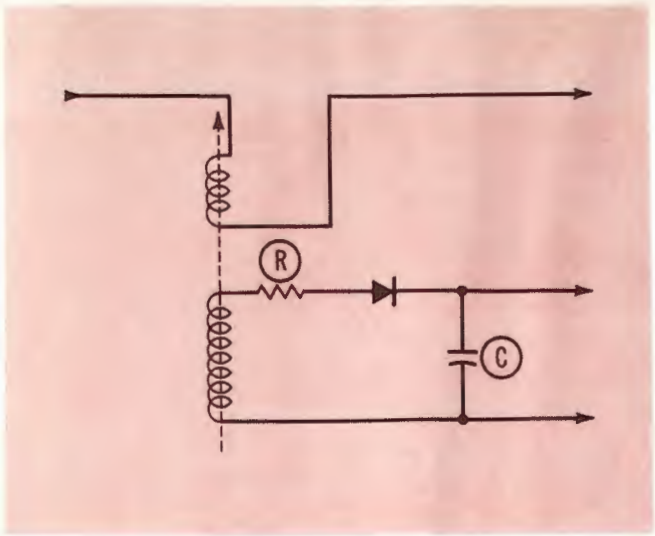

Fig. 3. Greater R reduces diode nonlinearity effects.

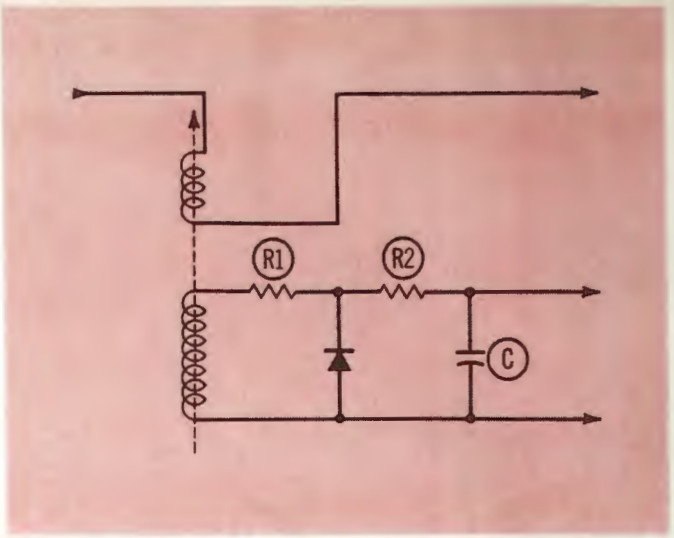

Fig. 4. Load shunts diode reverse-resistance changes.

good-grade paper-dielectric capacitor or equivalent—no electrolytics. The idea is to keep the diode working in nearly the same region of high and more linear conduction. This happens because the diode sees a near short circuit during RF peaks. Very large capacitance serves the additional function of providing an effective source to clear out trapped charge carriers from the diode as it is switched.

Sometimes a combination of the two techniques gives good results and also yields a bit more control over output level. (This, of course, can always be achieved by adding a potentiometer across the output terminals.)

Another conventional detector circuit may be employed. The circuit of Fig. 4 is inherently more linear than that of Fig. 1 since the diode forward resistance is never in series with the load. Variations in reverse-resistance of the diode have little influence, since the reverse-resistance always remains much larger than the load. R1 should be selected to hold the forward peak current of the diode to safe values; for loose coupling, it can usually be eliminated. R2 and C should have

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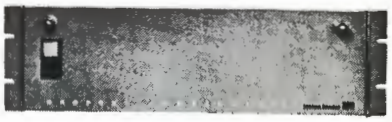

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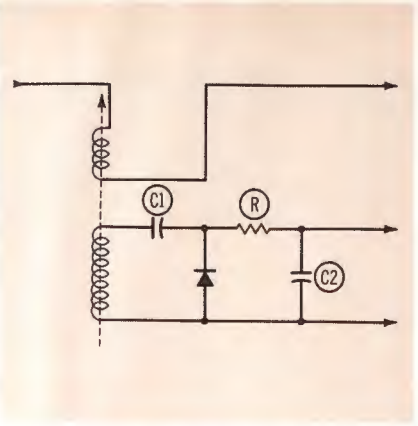

Fig. 5. Circuit depends less on diode characteristics, has improved output.

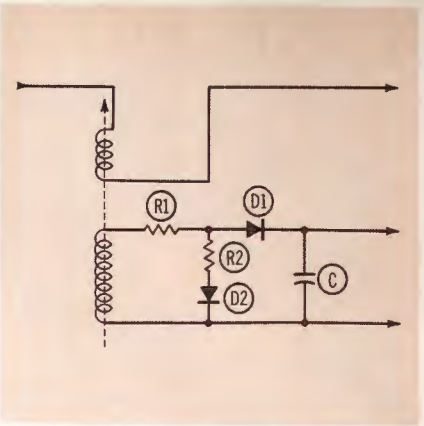

Fig. 6. Second diode gives compensation to control detector response.

a time constant at least ten times the period corresponding to the operating frequency. C should be as large as possible.

The disadvantage of the circuit in Fig. 4 is its low output. Both the output and linearity are improved by the modification shown in Fig. 5. C1 and R are selected to have a time constant something less than the period corresponding to the operating frequency — 0.25 microseconds, with C1 being a few picofarads. Again, C2 is made as large as possible while still obtaining enough meter-driving voltage.

There is always the time, it seems, when nothing works; that is the time to "join 'em" since you can't "lick 'em." When you grow hoarse from shouting back and forth between the transmitter shack and the antenna base-current meter, the time has come to abandon conventional methods and try something else. Specifically, it is the time to make diode nonlinearity work for you. Fig. 6 is an example.

In this circuit, as the forward resistance of D1 decreases in series with the load, so does the forward resistance of D2, on the output side of the voltage divider formed by R1, R2, and D2. The drive voltage to D1 and the meter circuit therefore decreases. R1 and R2 are juggled to achieve the degree of linearity desired — usually R1 is not required; the self-impedance of the pickup coil serves as one arm of the voltage divider. (Also, R2 is usually large enough to limit peak diode current.)

With this circuit, or variations, the input-output curve can be changed at will, even reversed. This idea has also been employed in other metering circuits to correct for the nonlinearity of aging meters.

Whatever the method used, diode nonlinearity in remote metering circuits must be overcome if accurate readings at different power levels are expected. The solution, however, may not be permanent. Diodes age and change characteristics. Periodic checks of remote metering at all power levels must be made to detect this. As accuracy slips, the aging diodes can be replaced or the compensating circuits trimmed to restore it. ▲

May 1966

We interrupt this magazine to bring you...

Late Bulletin from Washington

by Howard T. Head

Inquiry Instituted Into Pay-TV Operations

A Notice of Inquiry has been released by the Federal Communications Commission inviting comments on the possible authorization of subscription television on a permanent nationwide basis. Comments are requested on both the establishment of regular over-the-air subscription television operation and the further investigation of pay-TV operations by cable. Suggestions which have already been proposed include specific limitations on the number of pay-TV stations, the limitation of pay-TV to UHF stations, and limitations on the technical systems employed for pay-TV.

A number of experimental pay-TV operations have been conducted, the principal broadcast test being by UHF Station WHCT, Hartford, Connecticut. This test is still in operation, using "Phonevision" equipment manufactured by Zenith. Pay-TV systems, which originate their own programs and charge a fee for their reception, are distinguished by the Commission from Community Antenna Television (CATV) Systems, which, with few exceptions, distribute only programs received from regular television broadcast stations. The Commission has expressed considerable concern, however, that the rapid expansion of CATV might form a springboard for the introduction of pay-TV. The Commission feels that whatever the advantages or disadvantages of pay-TV, it should succeed or fail on its own merits.

Public May Participate In Renewal Hearings

The U.S. Court of Appeals has recently reversed an FCC decision granting a renewed short-term license to a television station in Jackson, Mississippi, on the grounds that the Commission should have designated the renewal application for hearing and permitted public participation. Local civic groups had charged the station with biased programming, and had petitioned the Commission for the right to have their views aired at a public hearing. The Commission, however, following past precedents, had concluded that the general public had no legal right to participate. The Court of Appeals, essentially making new law in the process, has reversed the Commission and ordered the hearing to be held.

Procedure Simplified on AM Site Moves

In recently adopted Rules, the Commission has provided that applications for changes in transmitter sites of standard broadcast stations may now be accepted by the Broadcast Bureau, even in cases where the move of

transmitter site would cause prohibited contour overlap with stations on the same and adjacent channels in violation of the allocation Rules. The growing congestion in the standard broadcast band, together with increasing pressure on AM stations to relocate their transmitters because of urban growth, has resulted in a number of instances where no really satisfactory transmitter sites were available which did not present interference problems.

Under the new procedure, a showing is required as to the circumstances which establish the need for the transmitter relocation. A move of up to two miles may be approved by the Broadcast Bureau; more extensive changes require the consideration of the full Commission.

Activity in Domestic Space Satellite Relaying

The Commission has returned to the American Broadcasting Company (ABC) its application proposing that it be authorized to launch and operate its own domestic space satellite for television relaying (see November 1965 Bulletin). The Commission stated that the proposal raised serious policy considerations and invited comments on the issues raised. Similar proposals have also been considered by AT&T, which, however, proposes the establishment of a domestic space satellite system using the facilities of the Communications Satellite Corporation (COMSAT). COMSAT is already making plans for six additional space satellites to supplement Early Bird; they are hoped to be operational by 1968.

Applicants Proposing Auxiliary Power To Receive Preference

In a policy statement, the Commission has announced that in comparative hearings a point of preference will be given to AM and FM applicants proposing standby primary power plants. This announcement was occasioned in considerable part by the continued operation during the recent massive northeast power blackout of many AM and FM stations employing standby power facilities. The Commission has also urged radio stations to promote the wide-spread distribution of battery-operated AM and FM transistor receivers for public use in emergencies.

Short Circuits

Federal legislation has established the last Sundays in April and October as the beginning and ending dates for Daylight Saving Time on a nationwide basis; any localities observing DST in 1966 must conform to these dates, and DST will apply nationwide starting in 1967, except where State Legislatures retain entire states (not parts of states) on Local Standard Time... Nonduplication requirements are still being imposed on television broadcast translators, but these have been relaxed to require only same-day nonduplication, bringing the requirements into line with the new CATV regulations... The requirements for 50% nonduplication of AM programming by FM affiliates in cities with populations over 100,000 have been ordered into force by the Commission (see September, 1965 Bulletin); only a handful of stations in special situations were given exemptions...The Midwest Program on Airborne Television Instruction (MPATI), now operating two experimental airborne UHF transmitters over Indiana, has been authorized to shift operations to the 2500-mHz band, employing six instructional television fixed-station (ITVFS) channels...FM stereo monitor standards are expected soon.

Howard T. Head...in Washington

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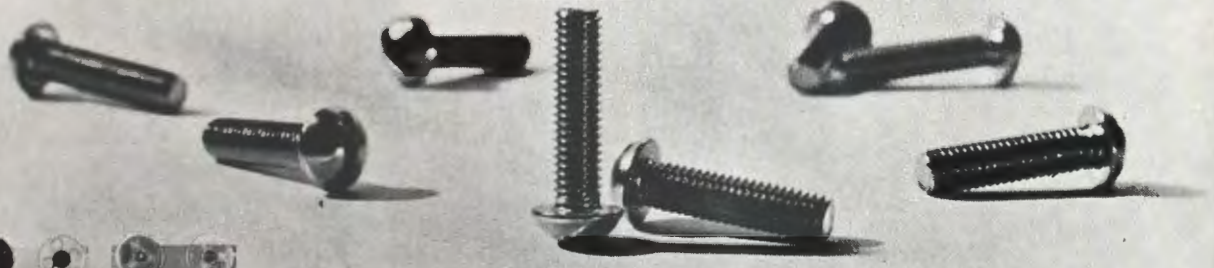

Magnecord's monaural Model 1021 and stereophonic Model 1022 are the most complete tape recorder/reproducers for professional use. Every Magnecord is engineered to mount in standard relay racks and ready to operate! Input impedances and input sensitivity levels are exactly matched to standard broadcast equipment. Ease of operation is built right in, too, insuring gentle tape handling and immediate response through the most difficult production techniques. ☑ Both models are available in relay versions (Models 1021R or 1022R) that provide operation in all modes from one or more remote stations without the use of jumper plugs. ☑ Now Magnecord 8-plus reels increase program capacity over 50% for lengthy network and remote programming without interruption...even operas! At 7.5 ips, 8-plus reels have a capacity for 1.25 hours of recording...at 3.75 you get 2.50 hours recording in each direction. ☑ FREE OFFER! Write for eight standard screws and new brochure on Magnecord Models 1021 and 1022. See your authorized Magnecord dealer for your recorder.

Magnecord
DIVISION OF THE
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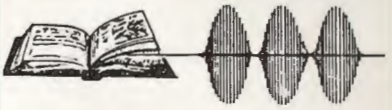
P. O. Box 1526 / Tulsa, Oklahoma 74101

Circle Item 25 on Tech Data Card

BOOK REVIEW



Transistors: Principles and Applications: R. G. Hibbard; Hart Publishing Company, Inc., New York, 1965; 304 pages, 5½″ × 8″; cloth, $5.95, paperback, $2.45.

This book outlines the history of semiconductor development, explains the fundamental principles of the operation, details the manufacturing process, and outlines the application of semiconductors in practical circuits, with emphasis on design considerations. Such semiconductor devices as germanium and silicon transistors, several types of diodes, and silicon controlled rectifiers are explained, and the words planar, zener, thyristor, and tunnel take on real meaning.

The limitations of each type of semiconductor with respect to frequency, temperature, current, and voltage are carefully delineated. Special consideration is given to these limitations in practical applications in oscillators, amplifiers, switches, and power supplies.

Concluding chapters discuss integrated circuits, solid-state components, and recent developments, including the semiconductor microphone and its unresolved problems.

A good working knowledge of vacuum-tube circuits is required for a full appreciation of this volume. The use of mathematics is limited to advanced algebra. In conjunction with manufacturers' semiconductor specifications, the book could be used as a design handbook.

IS YOUR VIDEO ON THE LEVEL?

Solid State Color STABilizing AMPlifier

with A.G.C. model VI-500

Ultra Stable Circuitry
through complete and accurate temperature compensation

AUTOMATIC VIDEO LEVEL CONTROL
Maintains video peaks constant to a preset level, with reference to blanking.

CLAMPING
Sync tip clamps remove hum, tilt and other low frequency disturbances.

SYNC LEVEL
Sync level is maintained at a constant amplitude despite large variations in input.

EQUALIZATION
Accurately compensates for losses in up to 1000 feet of coaxial cable.

REMOTE CONTROLS
Automatic/Manual video gain
Sync Level
White Clip
Black Clip
By-pass switch

WHITE CLIP
Adjustable sharp white clip remains fixed with respect to blanking.

BLACK CLIP
Adjustable sharp black clip for monochrome operation.

WHITE STRETCH
Stretch adjustments provide a high degree of flexibility to compensate for transmitter characteristics.

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Mono. or **Color** non composite output board in lieu of white stretch is available at additional cost.

APPLICATION
Wherever there is video and you want to assure:

• Constant levels • Constant clean sync • Elimination of tilt, hum and low frequency disturbances.

Price for the VI-500 $1,750.00 Remote controls $150.00 . . . Have you placed your order yet?

GOOD ENGINEERING IS VITAL

Write for complete information and specifications.

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Circle Item 27 on Tech Data Card

Frequency-Measuring

(Continued from page 36)

Resolution of measuring equipment is defined as the smallest change in input that the instrument can discern and indicate. EPUT meters or frequency counters have typical resolution of 7 to 9 digits—which means that a frequency can be read to 7 or 9 significant figures. The accuracy of a counter is dependent on the time stability of the instrument and the care with which it is calibrated against a secondary frequency standard and subsequently operated. Such accuracy can be as great as one part in 10^6, but this depends on the unknown frequency and the time spent in counting. At low audio frequencies (consisting of a few events per second), if few seconds are spent in the count, the error will be rather large—0.1% to 1.0% — but at RF, even one-second counts will have quite acceptable accuracy — 0.0001%. Obviously, the more time spent counting, the greater is the accuracy in the final count, up to the limit of the instrument, which is typically 10 seconds.

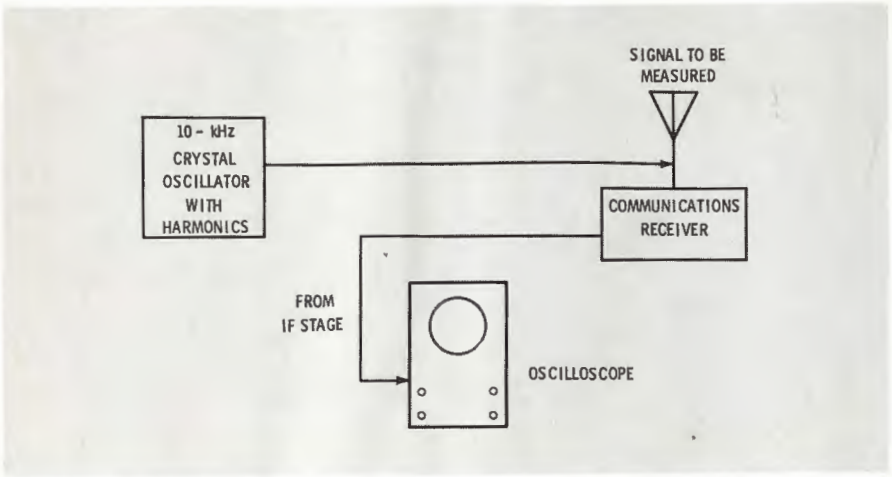


Fig. 1. AM carrier frequency is compared to crystal-oscillator harmonic.

Transmitter deviation measurements are often made in the following manner. Assume the assigned frequency is 1230 kHz. The previously mentioned receiver and antenna are used to pick up signal from the 1230-kHz station. A signal from the last receiver IF is coupled to the oscilloscope, and the output of a 10-kHz oscillator is coupled to the receiver antenna input. (See Fig. 1.) The 123rd harmonic of this oscillator is somewhere near the unknown frequency. The oscilloscope displays an RF trace, and the local 10-kHz oscillator is adjusted until there is a precise zero beat between it and the unknown frequency. The difference frequency is then found by comparing the 10-kHz oscillator with the house standard by the same technique.

D-202ES

THIS NEWEST DEVELOPMENT... PROVES TWO HEADS ARE BETTER THAN ONE!

Rather than have a single microphone respond to the myriad of frequencies imposed upon it at any given time, we sought an alternative.

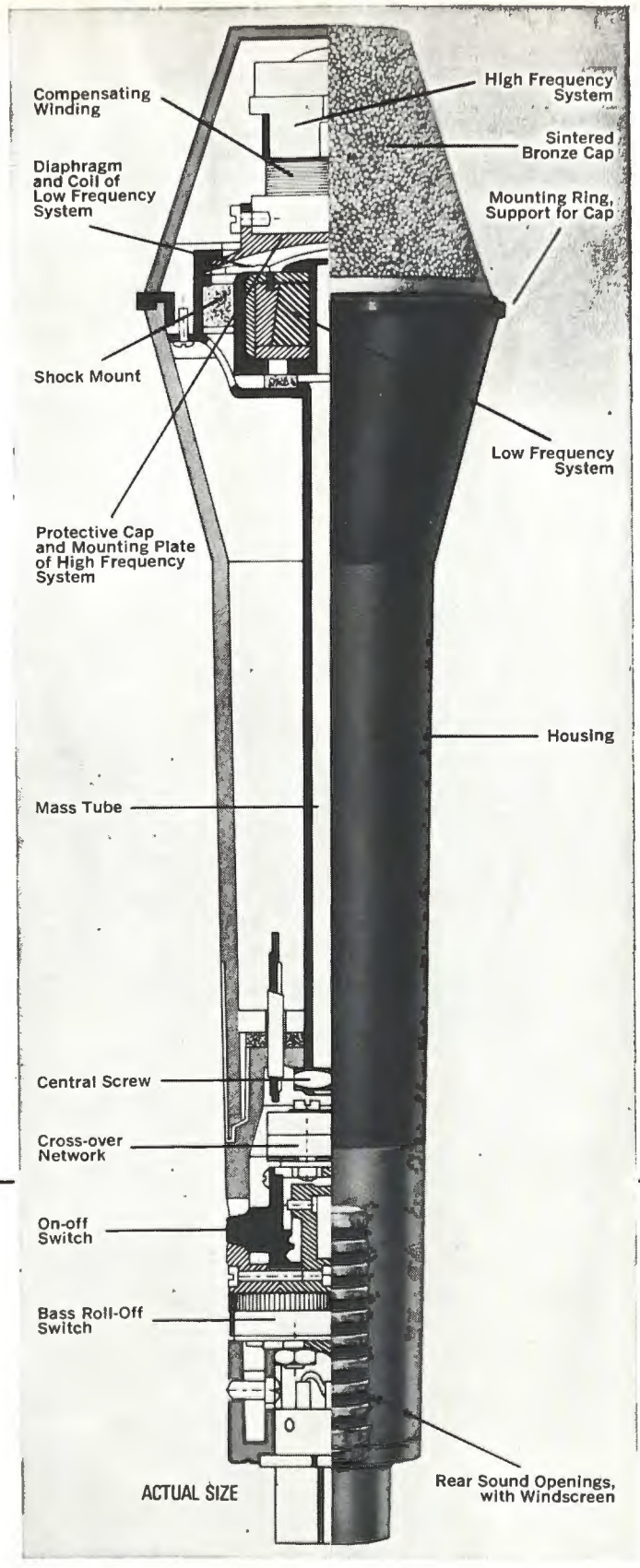
The result is embodied in the new D-202ES microphone. This revolutionary development contains two independent capsules, optimally adjusted to specific ranges. One responds to the low frequency range, and the second capsule—to the high frequency range with a built-in cross-over network at 500 cycles. The frequency response curve is practically linear between 30 and 15,000 cps and is extremely smooth. Front-to-back discrimination is greater than 20 db over the entire frequency range and the 90° curve is completely parallel to the 0° curve.

The D-202ES is ruggedly constructed and includes a new sintered bronze cap which functions as a wind and dust screen. Its specifications follow. Its performance is unexcelled. Need we say more? Send today for more information.

SPECIFICATIONS

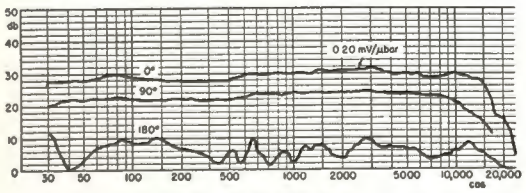
Frequency range	30-15,000 cps.
Frequency response	± 2 db
Directional characteristics	Cardioid
Front-to-back discrimination	—20 db minimum
Sensitivity	—53 db (0.2 mV/μ bar)
Impedance	200 ohm
Bass attention	0 to —20 db at 50 cps.
Connections	Cannon XLR
Dimensions	8½ in. long
Weight	9½ oz.

A product of **AKG** research, Vienna.



10-65

FREQUENCY RESPONSE CURVE



POLAR DIAGRAM

—— 125 cps - - - 1,000 cps ···· 8,000 cps
Recorded at different sound levels.

Norelco® **PROFESSIONAL SOUND PRODUCTS**

NORTH AMERICAN PHILIPS COMPANY, INC.
Professional Products Division, 100 East 42nd St., New York, N.Y. 10017

Circle Item 29 on Tech Data Card

The measurement of FM and TV frequencies presents certain problems. It is difficult to produce and resolve markers at such high frequencies. The most common technique is to zero-beat an appropriate harmonic from a 100-kHz crystal oscillator against the unkown frequency. (See Fig. 2A). An appropriate harmonic from a 10-kHz oscillator is then zero-beat against the output of the 100-kHz oscillator. (Fig. 2B). Finally, the 10-kHz oscillator output is compared with the house standard as in the measurement of a lower frequency. This process introduces an error on the order of 10 Hz, but at the frequencies involved the error is insignificant with respect to FCC tolerances.

Conclusion

To conclude, a word about transmitters and frequency monitors: There is an unfortunate tendency among broadcast engineers to take the word of the frequency monitor as gospel. Actually, modern transmitters are often more stable than monitors. The accuracy of a monitor often depends on the ability and conscientiousness of the maintenance engineer. If the manufacturer's recommended maintenance procedures are followed, monitor accuracy will probably be satisfactory. One other point: Most frequency monitors are designed with a zero-center meter, and if certain malfunctions occur (not related to frequency), the monitor will simply read zero although the transmitter may be off frequency. It is therefore unwise to adjust a transmitter to zero deviation as normal operating procedure. The transmitter should normally operate with some deviation — perhaps a few hertz for AM, a few hundred hertz for FM or TV — then if something goes wrong with the monitor it will read zero, which can be assumed to be an abnormal condition.

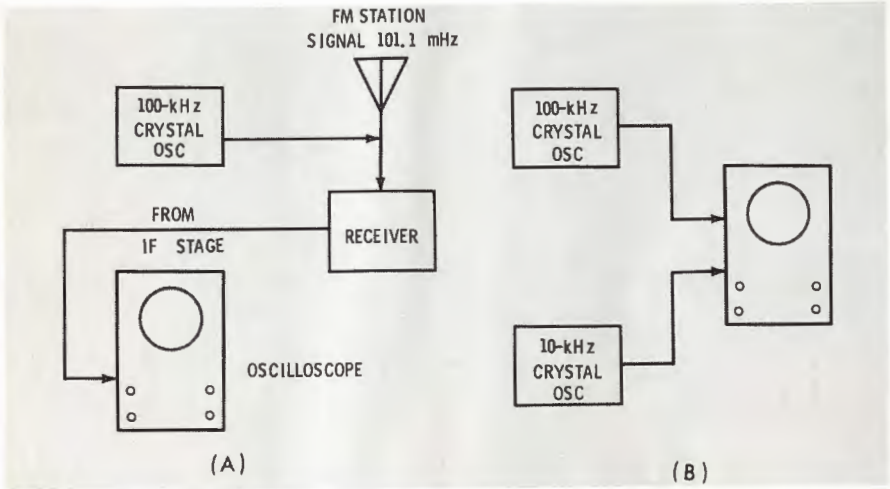


Fig. 2. FM carrier is compared with harmonic from second crystal oscillator.

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Jampro makes antenna effectiveness a certainty with advanced in-plant test methods and a thorough knowledge of your coverage requirements. Choose from a wide range of gains as well as these Jampro exclusive features:

EXCLUSIVE Every high powered Jampro Antenna contains copper jacketed inter bay 7/8" cable for years of trouble-free operation, even in corrosive environments.

EXCLUSIVE All cable connectors are solid brass with TEFLON insulation.

EXCLUSIVE All hardware is stainless steel.

EXCLUSIVE A wide range of power ratings are available from 2.5 KW per bay in the low power L Series, and 20 KW per bay in the high power H Series.

BEAM TILTING & NULL FILL AT NO ADDITIONAL COST!

DE-ICERS: *will be installed at NO ADDITIONAL COST when purchased with the antenna.*

ACCESSORIES: *Harmonic Filters • Co-axial transmission line • Steel Support towers • Tower lighting kits • Hybrid Diplexers • De-Icers*

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6939 POWER INN ROAD SACRAMENTO, CALIFORNIA

Circle Item 31 on Tech Data Card

Inspection and Maintance

(Continued from page 32)

ground screens and the radials should be checked very closely for breaks. It must be remembered that a bonded connection might look tight mechanically but could offer a high resistance electrically. Enough pressure should be applied to make certain it is a tight joint electrically.

As an example of how poor connections can affect an antenna system, the array at WEBR consists of five towers in a straight line, each fed by a separate coax line that was installed in subzero weather. A 2" copper strap was installed from the tuning boxes to the ground screen and silver soldered to each coax line on the way down. When the station went on the air in late winter, the efficiency of the array was greater than expected. By the middle of May the station began getting reports of poor reception from various locations. Field intensity measurements were made, and it was found that the radiation was much lower than when the array was first tuned.

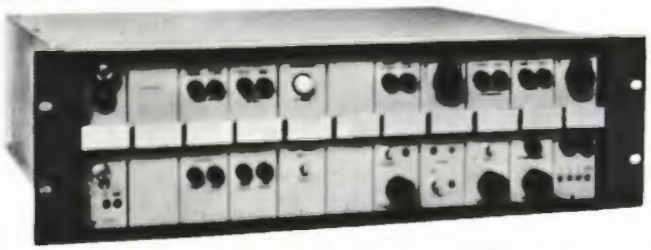
A complete check of the antenna system was made, and everything appeared in good shape. After a few sleepless nights and more inspections, it was found that the transmission lines had expanded in the warmer weather and, while the bonds between the copper strap and the transmission lines looked perfect, they had pulled loose and corroded.

The old straps were removed and a new 6" strap was installed. This time the strap was brought down to the first line, silver soldered, extended out about a foot from the line, doubled back to the second line, etc., making an accordion effect to allow for expansion. The signal returned to normal, and no further trouble has been experienced for fifteen years.

Then there is the example of a two-element array in the South during the depression of the thirties. Tall weeds grew over the ground system of the station, which began getting reports of poor reception from various parts of the city, although everything appeared normal. One evening just before dark, the transmitter operator looked out the window and noticed movement in the weeds. Investigation showed that a "wino" was crawling through the weeds to the base of the tower, cutting three or four radials loose. Since the radials were not buried, he had very little trouble rolling them up to take them to a junk yard, where he could get the price of a cheap bottle of wine. A new ground system had to be installed. —And thereafter weeds were kept mowed! ▲

Even with 100 H pulses missing and a partial vertical interval...

You can still put out perfect EIA sync with Telemet's new Video Process Amplifier.



The Telemet Color Processing Amplifier provides a number of outstanding features which include: (1) Sync locks to monochrome or color (H and V); (2) Allows control over set up (pedestal), (3) Boost of chroma and burst together; (4) Replaces incoming sync with EIA sync—front panel adjustments of pulse widths and amplitude, (5) White clip control and remote control of primary functions.

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Circle Item 33 on Tech Data Card

Pulse-Cross

(Continued from page 17)

vertical sync at half-line position, with a nominal pulse width of 0.45 to 0.50 of horizontal sync width.[2]

9. Six lines of vertical sync (three in each group for each field), with serrations occuring at half-line frequency. The leading edges of the serrations should be in line with the leading edges of the equalizing pulses, and the serrations have a width of 0.07H ± 0.01H (3.8 to 5.1 μsec).
10. Six equalizing pulses after vertical sync, in line with horizontal sync, and with a nominal pulse width of .45 to .5 of horizontal sync width.[2]
11. Six squalizing pulses after vertical sync at half-line position, with a nominal pulse width of .45 to .5 of horizontal sync width.[2]
12. Following the trailing equalizing pulses, normal horizontal sync resumes, and blanking continues for 8 to 23 lines on the display.

[2] Although the FCC standards stipulate that the equalizing pulses have an *area* of .45 to .5 that of the horizontal sync pulse, a linear measurement of .45 to .5 of horizontal sync *width* is a very close approximation.

Color Pulse Widths

Fig. 4. shows the pulse-cross display of a color signal, indicating pulse widths as stipulated by the FCC as follows:

1. Total horizontal blanking width, 0.18H (11.43 μsec) max.
2. Front-porch width, 0.02H (1.27 μsec) min.
3. Horizontal sync width, 0.075H ± 0.005H (4.44 to 5.08 μsec.)
4. Leading edge of sync to end of color reference burst (0.125-H (7.94 μsec) max.
5. Leading edge of sync to end of blanking, 0.145H (9.21 μsec) min.
6. Trailing edge of sync to beginning of color reference burst, (breezeway) 0.006H (0.38 μsec) min.

All other pulses are the same as for "Black-and-White Pulse Widths," numbers 5 through 12. It should be noted in Fig. 4 that color reference burst follows each horizontal sync pulse, but must be omitted following the equalizing pulses and during the vertical sync pulses.

Vertical-Interval Test Signals

Since October 1956, the Federal Communications Commission has authorized the simultaneous transmission of test signals during the vertical blanking interval. These signals are intended primarily for operational monitoring of transmission parameters during programming, and normally include a pulse at reference white level. Test signals may employ any waveforms intended for detailed analysis of specific system performance characteristics, and cue and control signals related to the operation of the television broadcast station.

These vertical-interval test (VIT) signals may be transmitted during the period commencing with the last 12 μsec of the 17th line of each

MASTER COLOR VIDEO TAPE RECORDER Model V/A100G

The new Visual/Allen High-Band Color Video Tape Recorder — The Continental — was an instant success at the recent NAB Convention in Chicago . . . offering these and other broadcaster-approved features: • All Band operation at the flip of a switch, • routinely providing the best in High Band Color performance • long head life • precision tape transport • operations-oriented console housing • full monitoring and playback processing facilities, and more!

ALSO FROM VISUAL/ALLEN . . .
the full line of High Band Color VTR for every station's VTR requirements

TRT/HB High Band your TRT machines . . . with the solid-state Allen "Sync-Lock" Servo and All-Band RF system.

RB1000 Complete rebuilding at the Allen factory transforms old VR1000s into Allenized VTRs with performance second to none.

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V/A50G A completely new High Band VTR economy package with the same high-performance Allen VTR electronic systems used in the best Master Video Tape Recorder.

And remember . . . all Visual/Allen VTR Units are separately available for most existing VTRs for field installation to improve their day-to-day operations.

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LOOK TO VISUAL FOR NEW CONCEPTS IN BROADCAST EQUIPMENT

field and extending through line 20, provided that:

1. No portion of this signal shall appear during the horizontal blanking intervals.
2. At least ½ line shall separate the test signals from the start of the picture signals.
3. The picture signal must commence not later than line 22.

(Line 1 of field 1 is defined as beginning with the leading edge of the first equalizing pulse of field 1. Line 1 of field 2 is defined as beginning with the leading edge of the second equalizing pulse of field 2.)

All these limitations may easily be checked on the pulse-cross display in Fig. 5. Using this display, the 17th line of a field may be found by beginning with the start of the vertical interval and counting the alternate lines corresponding to the field.

Monitor Adjustment and Calibration

Since H may be expressed as a linear measurement of scanning distance, the various pulse widths may be expressed in terms of a percentage of this distance. For any particular pulse-cross monitor, distance H may be readily determined in the following manner:

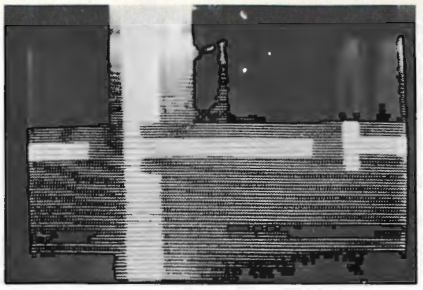


Fig. 5. Vertical-interval test pulses appear near end of blanking interval.

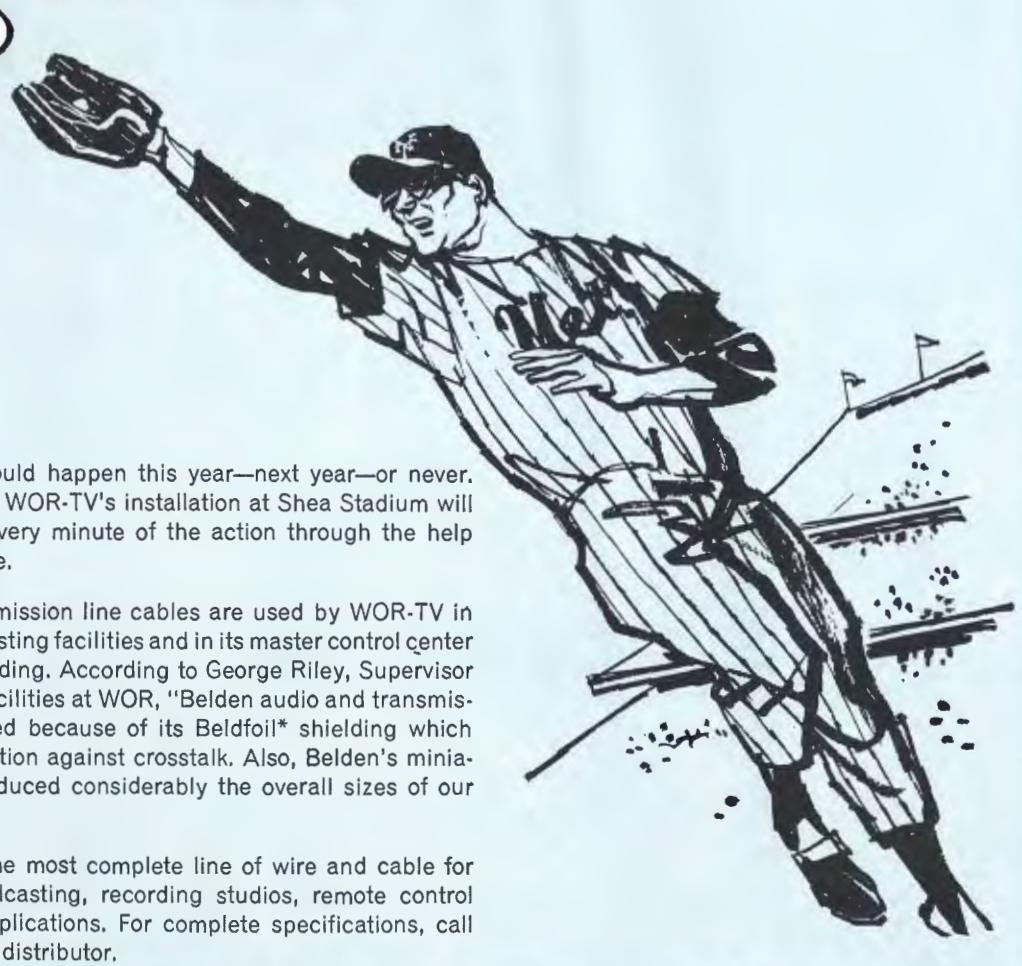
Assume that the horizontal linearity of the monitor has been checked and is accurate. Then it will be necessary to measure the normal picture width of an active scanning line (not including blanking), switch to pulse-cross display, and measure the total horizontal blanking width. The addition of horizontal picture and blanking widths provides the period H, 63.5 μsec.

Since H is now a known distance expressed in inches, and the pulse parameters given by the FCC as explained previously are expressed as percentages of H, it requires only simple arithmetic to compute all pulse limitations for the monitor. If it is desired, a pulse-cross ruler may be constructed for any particular monitor, and pulse-width limitations measured directly on the face of the monitor. This provides a most rapid method of evaluating synchronizing information.

Conclusion

The broadcaster who originates synchronizing information will find it desirable to establish his own fixed optimum pulse-width specifications well within FCC limits so that any small variations encountered will leave pulses within limitations. By use of the pulse-cross display, operational personnel can easily check these pulse widths with a minimum of set-up time, resulting in a more efficient quality control for the broadcaster. ▲

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

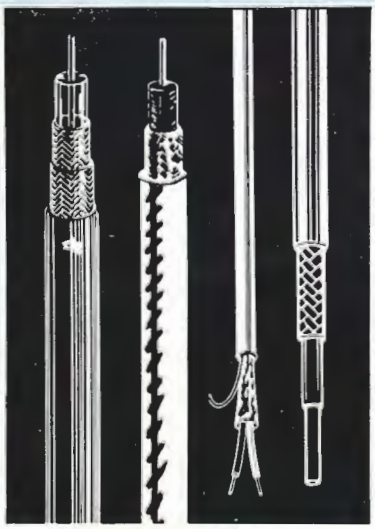


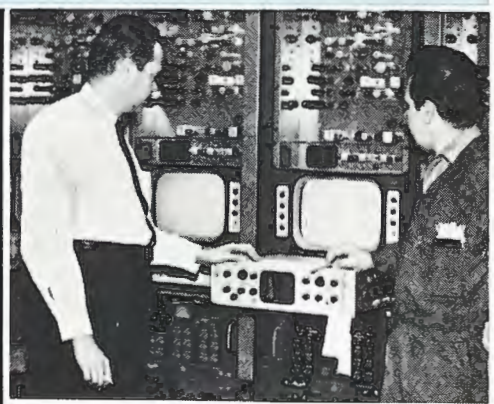
Such a phenomenon could happen this year—next year—or never. But if and when it does, WOR-TV's installation at Shea Stadium will record and broadcast every minute of the action through the help of Belden wire and cable.

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

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

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





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

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power supply cords • cord sets and portable cordage • electrical household cords • magnet wire • lead wire • automotive wire and cable • aircraft wires • welding cable **Belden trademark—Reg. U.S. Pat. Off.*

8-3-4

ENGINEERS' EXCHANGE

Turntable Switch Modification

by Harley R. Drew
WBBQ
Augusta, Georgia

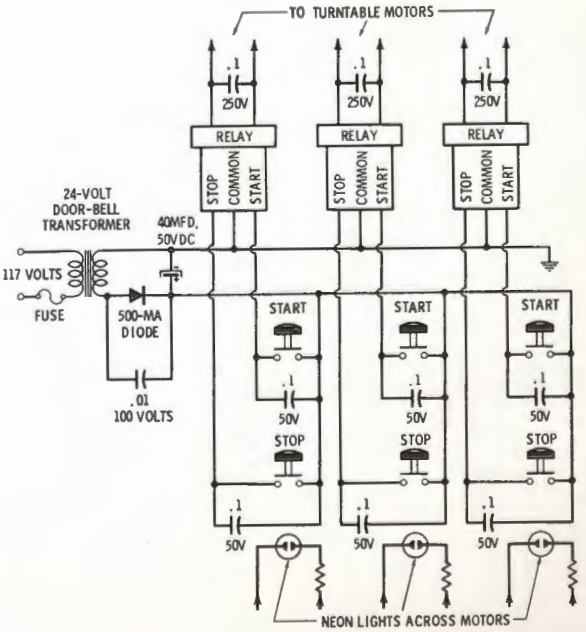
Recently we at WBBQ considered replacing the mercury-type switches on our three control-room turntables with something more modern. We decided to "go push-button." When we compared the price of lighted push buttons and associated relays with our mercury-switch budget, we discovered the whole thing would cost over a hundred dollars. This is what we did to get our push buttons — and keep our money too!

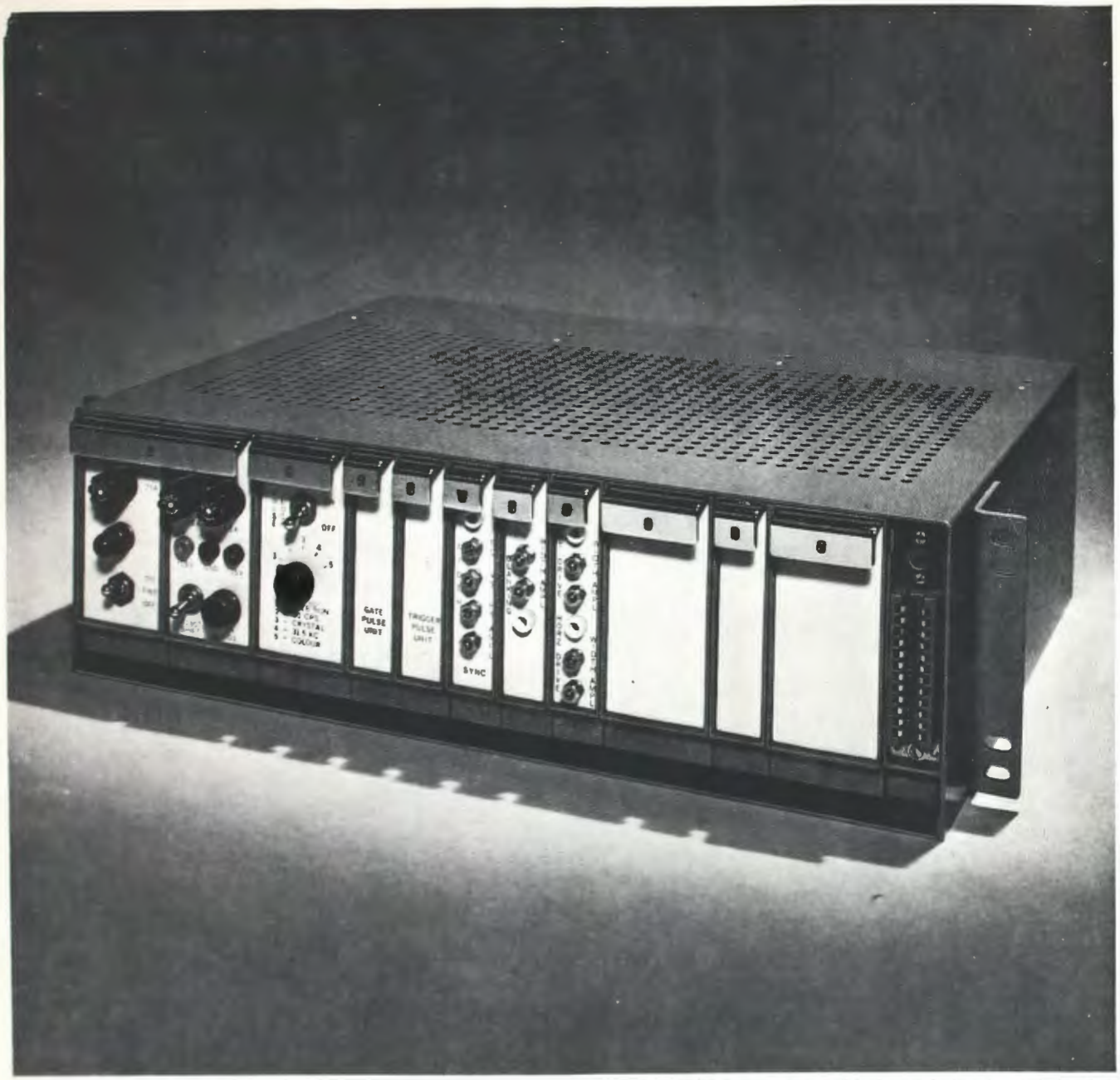
While shopping around for inexpensive parts for this project, we spotted a display panel in an electrical-supply house which showed how any number of lights in a house could be operated from one panel located in a central area. We started playing with the thing and found that its operation was remarkably fast and quiet. A check with the salesman revealed that it used General Electric RR-4 remote-control house-lighting relays. These relays are rated considerably higher than required to handle our Collins turntable motors and are operated by a 24-volt supply.

The relay units were mounted in a box-type chassis by inserting them through half-inch rubber grommets. The construction of this relay unit lends itself to this purpose, because the relay-contact end is much larger (about an inch in diameter) than the coil end. The rubber grommets absorb much of the relay noise.

An ordinary door-bell transformer (24 volts) was used for the power supply. The output was rectified with a 500-ma top-hat diode from the parts box. The power supply, with filter capacitors, was mounted inside the relay chassis.

The relay and power-supply chassis was mounted under the console desk where switching noise would not be heard on the air. Since the relays have momentary make-to-start and make-to-stop sides with a common return, we were able to use inexpensive (75¢) momentary-contact button switches. These switches were supplied with protector cups which prevent accidental activation. We used six switches—START and STOP for each turnable — and mounted them in a piece of aluminum cut from a 19" rack panel. Between the START and STOP buttons for each turntable, we inserted a neon indicator bulb. This bulb, in series with an appropriate resistor, is connected across the turntable





U S. funds, FOB Toronto, duty and brokerage included: merely $1,990.00

Still wishful syncing?

Now you can stop feeling wishful — and *wistful*. Here's a *second-generation* solid state monochromatic synchronizing generator with optional plug-in modules for complete colour operation.

It uses special patented coincident gate solid state circuitry for exact timing, producing rock-solid stability and superbly shaped pulses. Provides all standard EIA pulses — and these pulses are impeccably clean, with virtually no overshoot or cross-talk. The quality-controlled solid state components are all mounted on epoxy-glass printed circuit boards, contained in diecast aluminum frames. Every module is plug-in — and you even have a plug extender when required for easy maintenance on all components from the front of the unit.

At a mere $1,990 for the monochromatic version you may well wonder just *how* good is it? For starters, remember that it's designed and manufactured by the same team that built the video routing system for CBS, New York. Then remember that this is a *second*-generation solid state unit, already thoroughly field-proven on network originations under the most critical conditions. For the definitive clincher, just write us for complete specifications on our R-22240B. You'll discover, incidentally, that our delivery dates are just as attractive as performance and price.

1065-4

Northern Electric
COMPANY LIMITED

For specifications, write: Department 9950, Belleville, Ontario, Canada

Circle Item 41 on Tech Data Card

motor. The relay provides contacts for this purpose, but we elected not to use them. The bulb is lighted when the turntable is running.

Capacitors were used across all contacts ot make the unit pop-free. Without them, the electrical "pop" always got into the audio.

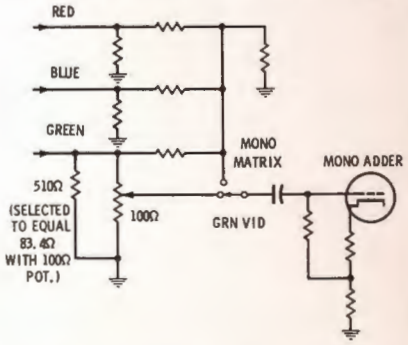
The design of the switching system is very simple. Most important is its low cost, about $17. The turntables can be remotely operated with only the 24-volt DC supply running through the interconnecting lines.

This system has been operated 24 hours a day for about eight months without a single failure. Switching is essentially instantaneous.

This item is our May contest winner.

Improved 3-V Color Film Chain Operation

by Rodger D. Herring,
Engineering Supervisor
KARD-TV, Wichita, Kansas



The operation of a 4-vidicon color camera can be closely simulated in a 3-V camera by substituting the green camera output for the monochrome matrix output into the aperture - compensator and mono-adder circuits. This is possible because the green video follows the monochrome very closely; only on rare, very highly saturated red or blue scenes is there any significant difference. The deviation is of negligible concern, because it means only the luminance signal is slightly lower than it should be, and this occurs so seldom we have found it to be no problem.

The changes are simple: a gain control to set the level of the green camera video to match the mono matrix output, and a switch to return the colorplexer to normal for setup using the color-bar generator.

The accompanying partial schematic of the RCA TX1D colorplexer shows the changes. ▲

If you think all video tapes are alike, feel this one*

*You're feeling the smoothest, longest wearing video tape you can find today

or better yet, try <u>using</u> it

MEMOREX
PRECISION MAGNETIC TAPE

TO MEMOREX CORPORATION:

I have not tried Memorex precision video tape. Please see that I get a free sample reel of ☐1″ ☐ 2″ tape.

My Tape Recorder is a:_____

Serial Number_____

NAME_____

ORGANIZATION_____

ADDRESS_____

CITY & STATE_____ ZIP_____

When you put a reel of Memorex precision video tape on your recorder, you can expect a number of performance benefits from its superior surface smoothness. Low initial dropout and slow rate of dropout build-up give you freedom from streaking over a significantly greater number of re-plays; reduced headwear and low head-clogging give you greater reliability and longer life from your recorder. Behind this reel of smooth-surfaced tape is the industry's most advanced tape-making technology — a depth of technical know-how and experience which has long since made Memorex the number one supplier of precision broadband tapes for instrumentation recording and premium digital tapes for computer data processing.

MEMOREX

PRECISION MAGNETIC TAPE

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NEWS OF THE INDUSTRY

INTERNATIONAL

Microwave Relay

A microwave relay system to carry television programs between London and Birmingham, England, has been ordered from **Selenia S.p.A.,** an affiliate of **Raytheon Company.** Under terms of a $150,000 contract issued by the British General Post Office, eight portable relay units will be installed this year to span the 100 miles between the British cities. The relay equipment, which operates in the 11- to 12-gHz frequency band, will be produced at the Selenia manufacturing plant near Naples, Italy.

Canadian TV Broadcasters Order Color Cameras

Canadian television broadcasters have ordered 23 **Radio Corporation of America** color TV cameras in preparation for the start of experimental color broadcasts later this year. Sixteen cameras will be delivered to the **Canadian Broadcasting Corporation** and seven to **CFTO-TV,** Toronto, one of Canada's largest privately owned TV stations.

Five of the cameras will be used in a broadcast studio CBC is erecting for the 1967 World's Fair in Montreal. After the fair closes, the building will serve as one of the publicly owned network's color studios.

The cameras scheduled for delivery to CFTO-TV will also be suitable for mobile use in covering football, hockey, and other public events. March 1, CFTO-TV exhibited Canada's first color program, "Canadian Talent Showcase," on closed-circuit TV for the press.

Beginning July 1, Canadian TV stations with government approval may broadcast color programs experimentally during the hours between normal sign-off and normal sign-on time. Daylight experimental broadcasts are allowed after October 1, and regular color programming begins January 1, 1967.

NATIONAL

Educational Scholarship Announced

In commemoration of the company's 10th anniversary, **Visual Electronics Corporation** President James B. Tharpe has announced the establishment of a $10,000 educational scholarship.

In making the announcement at a special 10th Anniversary Banquet held in Chicago just before the NAB Convention, Mr. Tharpe outlined the scholarship's purpose as that of "stimulating the development of the future leaders of the broadcast industry."

Scholarships in the amount of $1,000 in each of the next ten years will be awarded to eligible college or university students taking courses leading to a degree at an accredited institution, with studies specifically related to the broadcast industry. To be eligible to receive the scholarship, the student must be in his or her Junior or Senior year.

Under the terms of the scholarship, the annual student selection will be made by an independent committee of industry leaders and educators. The committee will be comprised of a member each of the National Association of Broadcasters and the National Association of Educational Broadcasters, and a president or dean of an institution of higher education offering communications courses.

Color TV News Seminar

"Within the next three to four years, 90% of all TV stations will be showing color news coverage — either network produced, or on their own films." This was the prediction heard recently by 25 news directors, news photographers, and laboratory technicians from eleven southwestern U.S. TV stations. They were attending a 6-hour seminar on the requirements of color film products for TV hard news and news in depth. The seminar was sponsored and conducted by **General Aniline & Film Corp.** in Dallas, Texas.

"The rapid growth of color TV programming has been forcing the television news industry to move faster than was planned toward the color coverage of hard news and news in depth," said Paul DeGraff, GAF Southern Regional Manager.

One of the biggest problems in the changeover to color news programming has been the lack of properly disseminated data on both the exposure and processing of color film. Through this seminar and others to follow, GAF is giving technical information on the production of color newsfilm, both behind the camera and in the processing tanks.

New Broadcasting Center for Cincinnati

WCPO-TV's new broadcasting center, now under construction at 5th Street and Central Avenue in the new Queensgate redevelopment area of Cincinnati, will have a visual rhythm of its own. Designed by **The Austin Company,** WCPO's new facility has been planned to provide maximum efficiency in production of color programming.

Its two-story office wing will be featured by deep frames of precast concrete with an exposed aggregate finish to emphasize its three-dimensional character. An alternating arrangement of these divided box-like frames will intercept the continuous bands of bronze solar glass at the first- and second-story levels. The stepped nature of the office roof line, where the building wall between frames will be higher than the frames themselves, will stand in contrast to the studio wing.

Because the first floor windows will be set back as much as ten feet from the face of the concrete frames and the second-story windows will be set back less than five feet, there will be substantially more floor space on the upper floor. Management and business offices and a large client conference room will occupy the perimeter space, while the interior will be shared by the TV master control, studio directors' booth, announce booth, projection room, and TV sales and traffic.

One studio, 50′ ×70′, will be used for most audience-participation programs, and with another studio 65′ × 40′ will form a right angle around the high studio storage bay. Provision has been made for substantial expansion of studio space.

Special provisions are being made for the expeditious handling of all news operations. A complete film processing and screening layout is being provided directly adjacent to the news room, just across from the announcers' and directors' offices, which share the first-floor perimeter space with the promotion and commercial-relations departments.

Architectural Firm Selected

Mills, Petticord, and Mills, a Washington architectural firm, has been commissioned to draw preliminary plans for a new $1,838,000 headquarters building for the **National Association of Broadcasters.** The building is to be constructed at 1771 N Street, N.W., site of the present headquarters, and at 1775 N Street, an adjoining lot owned by NAB.

John F. Dille, Jr., president of the Communicana Group of Indiana and chairman of the NAB Executive Committee, and Clair R. McCollough, president of the Steinman Stations, Lancaster, Pa., and chairman of the Building Committee, jointly announced the selection.

Moves Offices to Increase Capacity

The **Jerrold Corp.** has announced plans for further expansion of its facilities. Its plant at 15th and Lehigh Ave., Philadelphia, Pa., will now be devoted exclusively to manufacturing. All sales and administrative offices will move to 401 Walnut Street, where seven floors, totaling 63,000 sq ft., have been leased effective March 31.

The manufacturing facilities will expand into the vacated office space to increase production space substantially.

Expands Facilities

Broadcast manufacturing facilities of **Collins Radio Company** have been consolidated and significantly expanded. All company broadcast equipment is now made in Dallas, Texas, location of the corporate headquarters. Greater flexibility is a key accomplishment of the larger facility. Component, subassembly, and final assembly areas can be altered, with maximum efficiency, to handle peak loads in any product area.

New Home-Study Course

A new home-study program was recently introduced by **Sams Technical Institute, Inc.,** subsidiary of **Howard W. Sams & Co., Inc.** The home-study program is an extension of STI's technical training services to those who cannot attend classes in any of the Sams Technical Institute resident centers.

The initial course now available is a Second Class FCC License Course designed for practicing technicians and those who have had basic electronics training. Additional courses are now being prepared. The course was closely planned around the new FCC examination. It is expected to be attractive to present license holders who want to update their technical knowledge.

Controlling Interest Acquired

An 80% interest in **Skycrafters, Inc.,** manufacturer of aircraft communication and navigation equipment, has been acquired by **Dynair Electronics, Inc.** E. G. Gramman, president of Dynair, announced the acquisition.

Skycrafters will operate as a subsidiary in its 7000-square-foot Long Beach plant. J. Lynn Brown will continue as president, and A. W. Lupien as executive vice-president of Skycrafters. Mr. Gramman has been elected board chairman.

Los Angeles Pay-TV Franchise

Kaiser Broadcasting Corp., subsidiary of **Kaiser Industries,** has announced a major move toward bringing over-the-air subscription television service to the Los Angeles area with the signing of an option agreement for the Los Angeles franchise for **Zenith Radio Corp.** systems of subscription TV. **Teco, Inc.,** the Chicago company which granted the option, is licensed by Zenith to develop its Phonevision systems of subscription TV in North America.

Future development by Kaiser of the Los Angeles Phonevision franchise under this option is contingent upon the FCC's decision on a Zenith-Teco petition now pending before the FCC, and on the outcome of litigation concerning the legality of subscription television in California. The petition to the FCC, based on three years of subscription test operation in Hartford, Conn., seeks authorization of subscription TV on a nationwide basis.

Richard C. Block, vice-president and general manager of Kaiser Broadcasting, said that Kaiser, which is constructing KMTW, Channel 52, Corona, Calif., would plan to utilize Phonevision subscription TV as a supplement to the service to be provided on this new area UHF-TV station. Mr. Block added that KMTW would devote a part of the day to regular commercials and public-service telecasts. Regular commercial broadcasting over KMTW is planned to begin June 15.

Lighting Company Sold

ColorTran Industries, Inc., a designer and manufacturer of quartz-iodine lighting equipment for the motion picture and television industries, has been acquired by **Berkey Photo, Inc.** ColorTran will now have access to the engineering, manufacturing, and marketing facilities of Berkey Photo. The firm will continue operations at its 30,000-sq-ft plant in Burbank, California, under its present management team, headed by President Milton Forman.

PERSONALITIES

A new organization, **Melvon G. Hart and Associates,** has been formed by Mr. Hart to offer an inspection and reporting service to aid station owners and managers in knowing whether their stations meet the technical requirements of the FCC. The service includes a complete inspection of the technical facilities, following FCC and NAB guidelines, and a detailed report to the station manager suggesting changes or corrections that may prevent a citation or forfeiture.

Mr. John G. Russell has joined **TeleMation, Inc.,** Salt Lake City, Utah, as national CATV Sales Manager. Mr. Russell's background includes a degree in business administration from the University of Oklahoma and more than six years of sales engineering with Hoerner, Inc.

In addition to serving the CATV system and multiple-system operators, Mr. Russell's responsibility will include close liaison with OEM accounts.

Mrs. Marianne B. Campbell, general manager of radio station WJEH, Gallipolis, Ohio, has become the first woman to be elected to the Board of Governors of the **National Association of Broadcasters.**

Mrs. Campbell was elected March 15 by mail ballot to fill the vacancy created by the death of Gene Trace, executive vice president of WBBW, Youngstown, Ohio.

Effective immediately, Mrs. Campbell will represent District 7, composed of Ohio and Kentucky. Her term ends April 5, 1967.

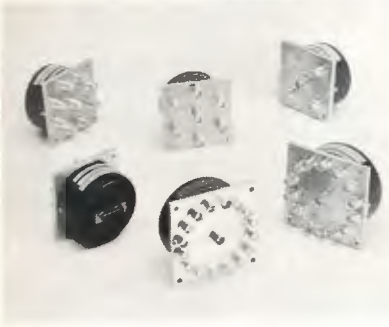
Spencer-Kennedy Laboratories, Inc., Boston, Mass., has announced four new personnel appointments. **Charles H. Wright,** president, has been named chief executive officer. **Donald Spencer,** chairman, will devote his full time to the management of the company-owned CATV systems.

George Green has been appointed vice-president, marketing and finance. Formerly, Mr. Green was vice-president, marketing for Ameco, in Phoenix, Ariz.

Hy Triller has been named marketing manager for Spencer-Kennedy Laboratories. Prior to assuming this new position, Mr. Triller served as general manager, Cable-Vision, Lafayette, Calif., and of Wisconsin Video Corp., Eau Claire, Wis. ▲

NEW PRODUCTS

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



Remotely Programmable Coaxial Switches

(70)

Seven remotely programmable coaxial switches now available from **Automated Measurements Corp.** range from 1-pole, 4-position to 1-pole, 16-position configurations. Each pole may be actuated independently and in any closure combination.

The switches employ reed relays set in machined channels to achieve a high degree of impedance continuity. They are designed to handle signals from DC to better than 500 mc with negligible pulse aberration, and cross-talk between channels better than —47 db. Other specifications include parasitic capacitance from less than 1.5 pf for the 4-pole version to less than 10.5 pf for the 16-pole model, operating voltage of 15 volts DC per coil at 50 ma, pull-in time less than 1.5 milliseconds, and drop-out time less than 75 microseconds.

The units are supplied with BNC signal connectors (TNC optional) and are designed for easy panel mounting.

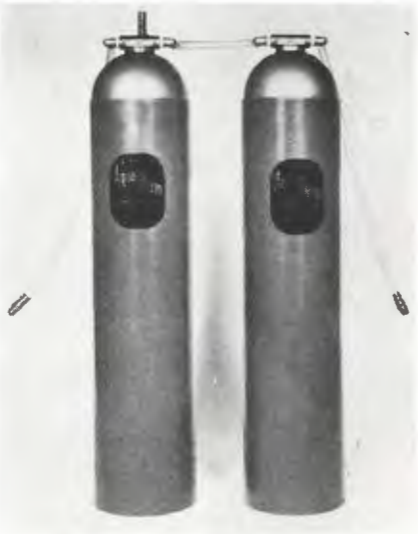
Condenser Microphone

(71)

The "S-10" pressure-gradient-type

condenser microphone operates on a Mallory TR-126 mercury battery of 1,000 hours life and employs a field-effect transistor. A *Mylar* diaphragm is employed.

Syncron Corp. lists the frequency range at 40 to 20,000 cps with a deviation of less than 3 db. The cardioid pattern gives effective front-to-back discrimination of approximately 20 db. Sensitivity is rated at −53 dbm with a sound pressure of 10 dynes/cm² and a 200-ohm load. The XLR-type 4-pin connector serves as an on-off switch, eliminating unnecessary battery drain. The microphone measures 7⅜" in length and ⅞" in diameter; it weighs nine ounces with battery. Battery change is accomplished without tools. The S-10 is delivered with 20′ of cable, swivel mount, battery, and carrying case for $240. Wind screens, desk stands, and elastic suspensions are available as accessories.



Demineralizer System
(72)

A new dual-tank ion-exchange demineralizer, Aqua-Deem (marketed by **Crystal Research Laboratories**), converts ordinary tap or industrial water into mineral-free water for coolant use in power tubes, or other applications. The system is an engineered packaged unit utilizing Deeminite, a controlled mixture of strongly basic anionic and strongly acidic cationic ion-exchange resins treated by a proprietary process to provide maximum adsorptive capacity and consistent quality. Ionized minerals and dissolved solids such as sulphates, chlorides, bicarbonates, fluorides, silicates, carbonates, silica, iron, nickel, calcium, manganese, and sodium are removed at flow rates as high as 400gph.

The dual glass-fiber tanks contain three cubic feet of activated resins. They are connected in series to assure full utilization of removal capacity, which is 40,000 grains (calcium carbonate or equal).

A signal light indicates when the level of ionization reaches a predetermined point. When the lead tank is exhausted, it is removed for regeneration and the downstream tank moved into its place. A regenerated tank is then placed in the downstream position. Where necessary, extra tanks can be connected in line. A wheeled stand and flexible hose permit convenient transfer of tanks if desired.

Lightweight Headset-Microphones
(73)

Standard components and subassemblies are being used by **Roanwell Corp.** in its new line of lightweight headset-microphone assemblies. These are designed to offer maximum comfort; circumaural earcups surround the ear instead of pressing against it. Vinyl-covered, foam-filled ear cushions form an acoustical seal against the head with minimum pressure.

Miniature dynamic earphone elements are supplied in impedances of 20, 150, or 300 ohms. Sensitivity is 105 db at 1000 cps (0-db reference is .0002 dyne/cm² with input of 1 mw). Frequency range is specified as 100 cps to 4500 cps with harmonic distortion less than 2% with 1 mw applied.

Six types are available. These include dynamic and carbon microphones with cardioid, directional, and nondirectional configurations. Transistorized preamplifiers and matching transformers can be offered to meet a variety of circuit requirements.

A through-cord miniature switch includes SPDT or DPDT with or without locking action. The headsets are designed to permit hands-free operation by staying on the wearer's head when he is moving about or stooping. Retractile cords are provided; clothes-clips act as strain relief.

Four-Way Lever Switch
(75)

The Series 4705 is a 4-way, or X-Y, lever switch providing for independent selection of any one of four groups of contacts from a center neutral lever position.

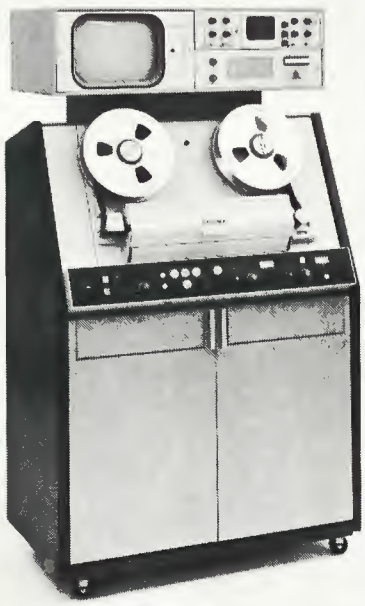
The switch occupies the panel space of a conventional ⅜" bushing-mounted lever switch and can perform the same switching function as a fire-station push-button switch, or two three-position lever switches. Behind-panel depth is 2-7/16".

Lever action may be locking or non-locking in the four operated positions, each of which may actuate up to four or five contact springs. Contacts are rated 3 amps, 110 volts AC, noninductive.

The Series 4705 is a product of **Donald P. Mossman, Inc.**

1000-Watt Broadcast Transmitter
(76)

The AM-1KA transmitter, displayed at the NAB convention, incorporates as standard features supply-voltage regulation, built-in dummy load, automatic recycling with overload indicators, power cutback, three tube types (total eight tubes), and silicon rectifiers. This **AEL** transmitter is ready for remote-control operation. The list price is $5295.



High-Band Color Video Tape Recorder
(77)

Ampex Corp. demonstrated its VR-1200 high band color video tape recorder for the first time at the Na-

tional Association of Broadcasters convention. Announced in March, the recorder is designed primarily to provide color recording capability for medium to small television stations.

In high-band color or monochrome operating mode, the VR-1200 has a specified signal-to-noise ratio of 44 db, a maximum color-phase error of 3%, and a moire of 35 db maximum. In low-band color, the VR-1200 has a signal-to-noise ratio of 38 db and a maximum color-phase error of 3%.

The VR-1200 is 74" high, 42½" wide, and 27" deep. It weighs a maximum of 900 lb. It provides 96 minutes of recording time on a 7200' reel of tape at 15 ips, and 192 minutes of recording time on a 7200' reel of tape at 7½ ips.

The new recorder is offered in several configurations and in both 60-Hz and 50-Hz versions. Prices range from $46,500 to $70,000, depending on accessories. Accessories offered include the *Colortec* adapter, *Intersync* control system, *Amtec* time element compensator, *Electronic Editor*, and *Editec* programmer.

Microwave Equipment
(78)

A line of solid-state microwave transmitters and receivers was displayed by **Jerrold Electronics** at the 1966 NAB convention. Designated the 440 series, this equipment is engineered for broadcast, CATV, ETV, and right-of-way microwave users. The units are packaged to provide a complete transmitter or receiver, including power supply, in 10½" of rack space.

The completely solid-state receiver uses a crystal-controlled oscillator, which eliminates the need for a klystron and AFC circuitry.

A solid-state / high-power-klystron type transmitter makes it possible to use smaller antennas with resulting savings, or to maintain higher fade

margins on longer hops, with maximum reliability.

Video units are designed to provide ± 0.25° differential phase and gain uniform within ± 0.25 db. Other features and specifications include: 12-mHz baseband flat within 0.25 db, frequency stability of ± 0.005%, individual self-contained power supplies, RF-shielded plug-in modules throughout, and vapor-phase-stabilized transmitter klystron.

Gain Set
(79)

The 9704 gain set is designed to measure the gain, loss, frequency response, and signal level of audio devices. It consists of two separate systems; one for Send (source), the other for Receive (output). Complete systems and/or individual components may be measured. Simultaneous input and output measurements may be made, and two VU meters permit simultaneous readings to be taken. Both Send and Receive impedances are selectable, and the set may be used for balanced or unbalanced circuitry.

Specified accuracies are as follows: All resistors are adjusted to ± 1%. All attenuators and meter readings are accurate to ± 0.2 db at any setting. Frequency response is ± 0.1 db from 10 to 50,000 Hz (except for meters which are matched and have a calibrate-adjust pot). All circuitry is passive. Distortion is less than 0.2%.

The gain set, shown at the NAB Convention by **Altec,** is designed for standard 19" rack mounting; it measures 7" × 19" × 6¼". A notch in the case permits wiring in the rack with terminals at the rear for oscillator input, send, receive, and ground. All jacks on the front panel have normal contacts so that when they are used, the external (rear) connections are lifted.

"Matched Line" of Broadcast Equipment
(80)

A complete "matched line" of broadcast station equipment, the end result of a multimillion dollar engineering and product development effort, was displayed for the first time at the NAB convention by the **Radio Corporation of America.**

The line includes the TK-42 four-tube color camera, TK-27 color film camera with projectors and associated equipment, and TV tape recorders. Tape units include the TR-70 high-band machine, the TR-22D low-band machine, TR-3 tape player, TR-4 compact recorder/reproducer, and TR-5 transportable recorder. Other units include control equipment for the cameras, the TS-40 color switching and effects system, and distribution equipment.

Transmitting equipment includes VHF (25-kw) and UHF (55-kw) transmitters, AM (1-kw) and FM (40-kw) radio transmitters, and an all-solid-state, 6000-mHz microwave system, type TVM-6, for STL or intercity relay service.

TV Tape Camera

(81)

A flat-top metal cone turned upside down is a vital element in the "Coniscan" system of recording introduced at the NAB convention. In both the new **Westel** television recording camera and the color-compatible TV recorder produced by the company, a flat-top cone provides a circular path for the one-inch wide magnetic tape. As the tape spirals once around the cone, it actually overlaps itself. The midsection of the cone contains the single magnetic recording head which revolves against the tape. Because of the overlapped tape path, the single head never leaves the tape. Thus, each revolution of the head records or plays back one uninterrupted TV picture field (each occurring 60 times per second), plus the extra synchronizing information necessary in broadcasting.

The Coniscan design is combined with integrated circuitry in the new Westel machines, one of which can be carried by one man.

Encoded Color-Bar Generator

(82)

Among new products shown by **Riker Industries** at the NAB show was the company's encoded color bar generator. The generator is built in two Riker Industries modules. This sim-

plification results in greater stability and a reduction in cost over the standard method of using a color-bar generator and encoder to produce encoded color bars. The device is intended to be useful as a standard for aligning monitors and recording on the leader of video-tape color presentation.

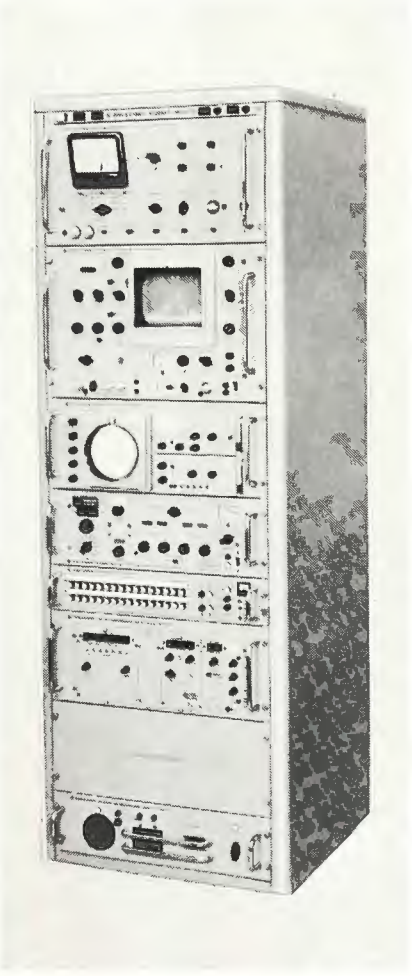
Time-Weather Service
(83)

"Weatherama" is a 1-station, 24-hour time-weather origination device for use with video or RF television distribution systems. The TV camera in this **Viking Industries** system is in a fixed position and focuses on each of ten subjects for 4.8 seconds, with a refocusing time requirement for the next gauge of 1.2 seconds. The time-clock gauge is televised every 60 seconds to assure accurate timekeeping. The ten subjects are: calendar, local time, rainfall, humidity, wind velocity, wind direction, barometric pressure, temperature, ad card or live action, and a slide-projector slot which can automatically display 80 messages on standard 35-mm slides. The system measures 30" × 40" × 57". Fluorescent illumination is provided with remote ballasts. All mechanisms are enclosed to insure a minimum of maintenance. Price is $6100.

All Solid-State TV Relay
(84)

At the NAB convention, **Microwave Associates** featured the MA-7A ½-watt baseband all-solid-state TV relay. The photo shows the receiver housing and panel features. The MA-7A includes self-contained power packs available for 12V DC, 24V DC, 28V DC, 110V AC, and 230V AC use.

A similar system is the 2-watt all solid-state MA-2A also featured at the convention. Both the MA-2A and MA-7A are now in full production status for STL, intercity, and TV-pickup point-to-point and air/ground applications. No tubes are used in any of these systems.



Video Transmitter Test Assembly
(85)

An assembly providing for all measurements on video and RF circuits in television transmitters, radio links, and other active and passive four-terminal networks was shown at the NAB convention by **Rohde & Schwarz Sales Co. (U.S.A.), Inc.** The test assembly features a built-in video sweep generator with selective receiver and oscilloscope. It is movable and can be brought close to the stage being tested. The VF test signals comply with CCIR recommendations, and the entire test assembly is designed to be suitable for color signals that meet

the standards of NTSC, PAL, or SECAM.

The complete assembly includes a video noise meter (Type UPSF); a Videoscop (Type SWOF); an oscilloscope (Type OMTF); a sideband adapter ; a video test signal generator (Type SPE); and control, power, and blower switch panels.

Tracking Zoom Lens for Vidicon Cameras

(86)

This tracking zoom lens is rated at T 9, has a zoom range of 3.5″ to 18″ and focuses from 75″ to infinity. The **Zoomar, Inc.** system complies with the applicable environmental Mil Specs for relative humidity, ambient temperature, spray tight test, salt spray, shock and vibration, and electrical specifications. Remote operation will not cause any interference on the TV monitor.

In this tracking Zoomar, the reticle image does not move with relation to the target during changes in focal length, and remains in focus throughout the zoom. Other features include: control of zoom, iris, focus, and built-in filter wheel; built-in thermostatically controlled heater; an automatic sun shutter to protect the vidicon tube; pressurization at 4 psi; solid-state components consolidated into one potted assembly; non-fungus nutrient materials; heat-treated and corrosion-resistant aluminum-alloy parts; and stainless-steel inserts. The entire unit is mounted on an azimuth and elevation platform which can be adjusted to boresight the unit to within ± 1.5° in azimuth and elevation. The system is resistant to severe outdoor conditions.

Drafting Aid

(87)

This instrument is intended to permit the student, hobbyist, or professional to (1) measure any length and angle, (2) transpose inches into millimeters, and vice versa, (3) draw straight or perpendicular lines of any length, (4) draw horizontal, vertical, or oblique parallels, and (5) draw circles or arcs. The "Caroll" ruler, from **Value Incorporated,** is made of slightly tinted transparent, unbreakable plastic. Price is $6.00, postpaid.▲

ENGINEERS' TECH DATA

AUDIO & RECORDING EQUIPMENT

90. MEMOREX — Eight-page brochure lists complete specifications for type 77V magnetic tape for video applications.
91. QUAM-NICHOLS—General catalog lists speakers for new installation and replacement in public address, background-music, hi-fi, and automotive systems.
92. SWITCHCRAFT — New Product Bulletin 159 covers "Mix-Amp" high-power miniature preamplifier Models 503 and 504. Models offer higher signal-to-noise ratio and higher gain. Offer includes New Product Bulletin 158 which describes recently introduced "Multi-Slide" switches.
93. TAPECASTER — Spec sheet for Model A-100, three-channel transistorized remote amplifier which works on self-contained battery or external AC.
94. VIKING OF MINNEAPOLIS — Brochure describes new Series 235 tape-duplicating system.

COMPONENTS & MATERIALS

95. ALFORD — 128-page catalog "N" provides photogrophs and detailed descriptions of AMCI RF instruments and components. Listed are slotted lines, precision connectors, RF bridges, dipoles, power dividers, and many other products.
96. ANADEX — Short-form catalog describes complete line of electronic counters and analog instruments.
97. INDUSTRIAL DEVICES — Pictorial brochure details "Mini-Slide" pilot-lamp assemblies.
98. POMONA ELECTRONICS — New General Catalog 11-66 displays variety of molded banana-plug patch plugs, test leads, test probes, shielded "black boxes," and socket adapters for standard tubes and CRT's.
99. TEXWIPE — Folder includes sample of "Optic Cloth," designed to clean and polish coated optics.
100. TROMPETER ELECTRONICS—Catalogs illustrate and provide specifications for coax patches, cords, jacks, cable, and switches. Offer includes free patch-panel and jack selector slide rule.

MOBILE RADIO & COMMUNICATIONS

101. MOSLEY ELECTRONICS — Catalog lists complete line of 1966 Citizens-band equipment.
102. ROUND HILL — Data sheet and schematic features CS-10 wireless cuing system. Receiver is shirt-pocket size.

POWER DEVICES

103. HEVI-DUTY — Bulletin 7-22 supplies data on line-voltage regulator using saturable-core reactor.

RADIO & CONTROL ROOM EQUIPMENT

104. AUTOMATIC TAPE CONTROL — Spec sheet gives information about new "customer-designed" automatic programmer.

REFERENCE MATERIALS & SCHOOLS

105. CLEVELAND INSTITUTE OF ELECTRONICS — New pocket-size plastic "Electronics Data Guide" includes formulas and tables for: frequency vs. wavelength, db, length of antennas, and color code.
106. GATES — Eight-page "Broadcast Studio Planning Guide" emphasizes technical "core area" principle of station layout. Covers small, medium, and large broadcasters with alternate "core area" plans.

107. GENERAL RADIO — Often humorous 36-page booklet explains noise and loudness, describes measuring methods and devices, and catalogs instruments with specifications.
108. HOWARD W. SAMS — Literature describes popular and informative technical publications; includes latest catalog of technical books.

STUDIO AND CAMERA EQUIPMENT

109. CLEVELAND ELECTRONICS — Data concerns modifications using new yoke assembly to update 3" image-orthicon cameras.
110. COHU ELECTRONICS — Available are Bulletin 8-57, "A New Approach to Election Coverage by TV"; Bulletin 8-53, "Portable TV Camera Gives Golfing Complete Coverage"; and Bulletin 8-49, "Miniature Camera Used in Broadcast TV." A four-page technical data sheet, No. 6-415, gives both specifications and details on sync generators, genlock, color standard, dot-bar generators, and automatic change-over switch.
111. ROANWELL — Brochure describes new family of lightweight, cushioned headsets with microphones. Features include choice of subassemblies and impedances.
112. TELEVISION ZOOMAR — Literature is offered on low-cost 10 x 40, 10:1 image orthicon zoom lens, and on Autocam programmed remote control for TV cameras.

TELEVISION EQUIPMENT

113. AMPEX — A six-page brochure, No. A-044, lists audio, video, and tape products useful in broadcast applications. Included are information and pictures on closed-circuit television, low-cost video tape recorders, language-laboratory equipment, professional audio recorder/reproducers, TV cameras, audio and video tape, and audio and video systems.
114. BALL BROTHERS RESEARCH — A four-page pictorial brochure describes the AGC-V111 Automatic-Gain-Control Video Amplifier. Specifications on the amplifier are included.
115. COLORADO VIDEO — "Slow-Scan" television equipment for communications is described in data sheets.
116. INTERNATIONAL NUCLEAR — Booklet gives information on "Reed-Relay" video switchers.
117. VITAL — Data sheets give specifications of model VI-500 stabilizing amplifier, Model VI-10A video distribution amplifier, and Model VI-20 pulse-distribution amplifier.

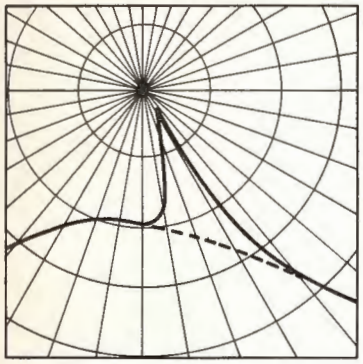
TEST EQUIPMENT & INSTRUMENTS

118. AMPROBE — Literature explains and provides specifications for push-button, ten-channel "Direct-O-Log" strip recorder. Unit records on electro-sensitive paper.
119. EICO — 48-page short-form catalog lists test instruments, Ham and CB equipment, and stereo/hi-fi components in both kit and factory-wired styles.
120. MARCONI INSTRUMENTS — 24-page Booklet discusses nonlinear distortion in audio amplifiers. Contains tables and methods of measurement.
121. TEKTRONIX — Brochure offers detailed information on Model 526 vectorscope, designed especially for color-television use. Scope features electronically switched dual-channel facility.

TRANSMITTER & ANTENNA DEVICES

122. ANDREW CORP. — New catalog No. 24 presents detailed product information on UHF, VHF, and microwave antennas for commercial and military applications. Heliax, flexible coaxial cables and elliptical waveguides, antenna positioners, RF switching devices, pressurization equipment, rigid transmission lines, and waveguides for complete and integrated antenna systems are described.
123. BAUER — Brochure illustrates new product line exhibited at 1966 NAB Convention. Products include AM and FM transmitters, and dual-channel and stereo consoles.

Next Month in Broadcast Engineering



Bob Jones tells the story of

The Unwanted Pattern Null

Larry Gardner discusses considerations in

Choosing and Using a Microphone

George Sitts describes

Broadcasting the Variety Show in Color

plus

Other articles of interest, including an examination of the new CATV Rules

and

Letters to the Editor
Engineers' Exchange
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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

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Classified

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

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

USED BERLANT — Concertone 20/20 stereo recorder in carrying case. New Heads, 2 sets electronics — 3-3/4 or 7-1/2 I.P.S. Slight Mechanical trouble in transport. FOB, Washington State. Write or call KOFE Radio, P.O. Box 259, Pullman, Washington. Phone LO 4-5251. 5-66-1t

AMPEX AG 100 CUE MAT, Complete set, two players on record center, excellent condition. Priced for quick sale. Dept. 154, Broadcast Engineering. 5-66-1t

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

Tape Cartridge reconditioning and rewinding. Reloaded with 3M 151 tape and minor parts replaced for as little as 90¢ on a 40 second tape. Average savings over new cartridges: 60%. New cartridge warranty. Special pricing for rewinding only. Southwestern Cartridge Service Co., Box 121, San Angelo, Texas. 5-66-3t

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

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

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

New and Reconditioned Remote Pickup and 2-way radio equip., Fire and Police Receivers. All brands and models. Sales Manager, Box 238, Phone 817-594-5171, Weatherford, Texas. 5-65 12t

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

NEW CAPSTAN PRESSURE IDLERS FOR AMPEX 300's, 350's, and 354's, $15.00. TABER MANUFACTURING & ENGINEERING CO., 2619 Lincoln Ave., Alameda, California. 4-66-6t

AMPEX HEADS replaced in your 3 head 300, 350, 351 assembly. Our heads are manufactured under controlled laboratory conditions and are guaranteed to meet or better original equipment specifications. Full track and half track $97.50. We will send free brochure. TABER MANUFACTURING & ENGINEERING CO., 2619 Lincoln Ave., Alameda, California. 4-66-6t

AMPEX HEAD RECONDITIONING SERVICE for 300's, 350's, 351's and 354's, includes the relapping of worn or grooved heads, and the same complete alignment and quality control testing as new head replacements. Full and half track assemblies $45.00, two track $60.00. TABER MANUFACTURING & EQUIPMENT CO., 2619 Lincoln Ave., Alameda, California. 4-66-6t

AMPEX VIDEO TAPE RECORDER AUDIO HEAD ASSEMBLIES REBUILT. Assemblies with cue track lapped $100.00, without cue tracks, $80.00. New heads for assemblies without cue track $220.00, with cue track $310.00. Assemblies without cue converted with four new heads $350.00. TABER MANUFACTURING & ENGINEERING CO., 2619 Lincoln Ave. Alameda, California 4-66-6t

EQUIPMENT WANTED

We need used 250, 500, 5K & 10K Watts AM Transmitters. No Junk. Broadcast Electronics Corp. 1314 Iturbide St., Laredo, Texas 78040. 3-66-tf

Position Wanted

College student desperately needs summer employment. Experience w/NBC owned and operated, and others. Third endorsed ticket. Age 20. Call Henry Navin 271-7116; write 9325 Beacon Avenue, Cleveland, Ohio. 5-66-2t

Employment

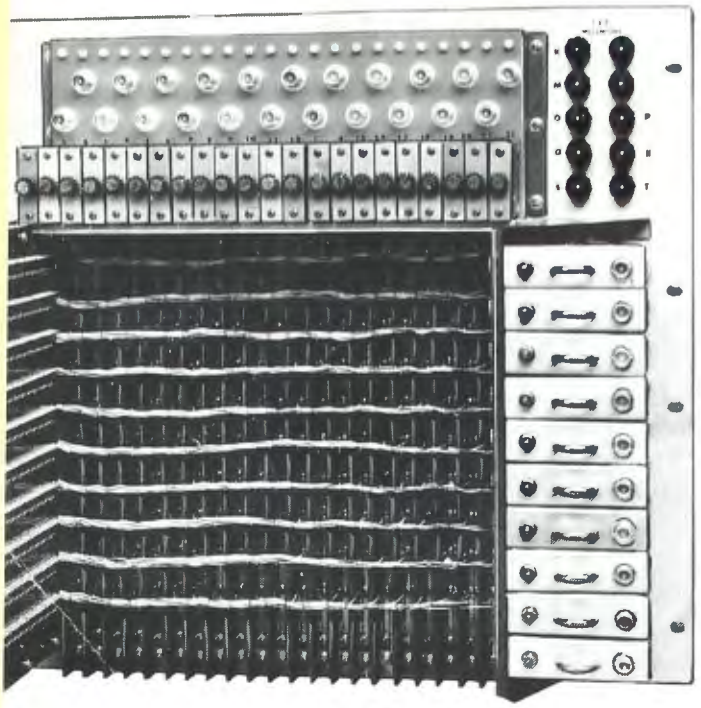
Immediate Openings with radio and TV stations in all parts of the country for chief engineers, and both transmitter and studio engineers. Send resume today to: Nationwide Radio & TV Employment Agency, 645 North Michigan Avenue, Chicago, Illinois, or call Area Code; 312-337-7075. 5-66-tf

WANTED—Technicians for closed circuit systems planning — closed circuit — color television — video tape maintenance or supervision of installations of RCA equipment. 630 Fifth Avenue, Rockefeller Center. 757-0677 or 297-3336. G. Whiteford. 2-66-tf

America's largest Radio and Television Employment Agency has immediate openings with stations in all parts of the country for experienced Engineers. Send resume today to: Nationwide Broadcast Services, 645 North Michigan Avenue, Chicago, Illinois. 1-66-tf

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

Chief Engineer For Alaska. Excellent wage. Practical experience in color TV necessary. Assume responsiblity to layout, install, maintain new TV-FM. Studios-Xmtr on existing AM site. Airmail application, references to Bill Harpel — KHAR, Anchorage. 4-66-2t



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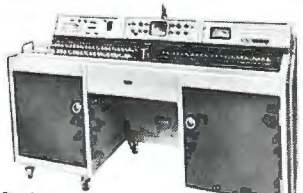
e completely solid state. A single
is used throughout the circuitry.

All components are readily accessible and operate well within their rating. Custom switchers handle double re-entry switching as well as composite or noncomposite switching. *We can custom make your switcher.* The new reed-type relays which we use are metal contacts operating in a glass sealed atmosphere. Control of these relays is accomplished by an external push-button and tally light console. Telephone companies and space programs have proven that this type of relay is the only reliable method of switching video. *Yes sir, we can custom make your switcher.*



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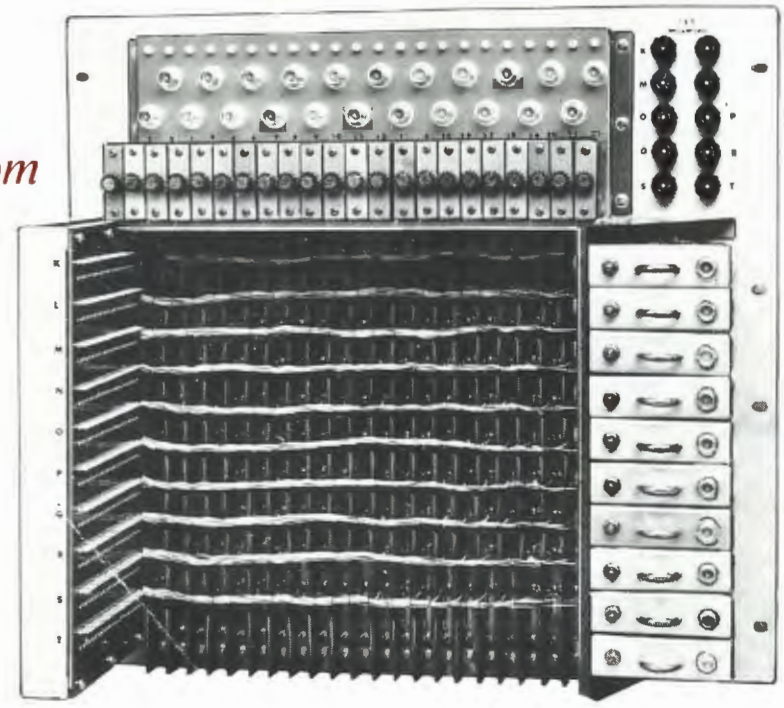
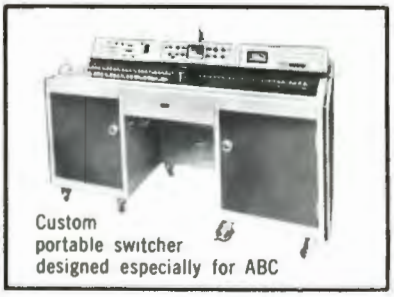


We can custom make your switcher. If you have special switcher requirements that demand custom manufacture, then International Nuclear can be of service to you. An International Nuclear audio and video crossbar switcher can be assembled to house any number of inputs or outputs. Each input line is a printed circuit. All amplifiers and power supplies are completely solid state. A single standard type transistor is used throughout the circuitry. All components are readily accessible and operate well within their rating. Custom switchers handle double re-entry switching as well as composite or noncomposite switching. *We can custom make your switcher.* The new reed-type relays which we use are metal contacts operating in a glass sealed atmosphere. Control of these relays is accomplished by an external push-button and tally light console. Telephone companies and space programs have proven that this type of relay is the only reliable method of switching video. *Yes sir, we can custom make your switcher.*



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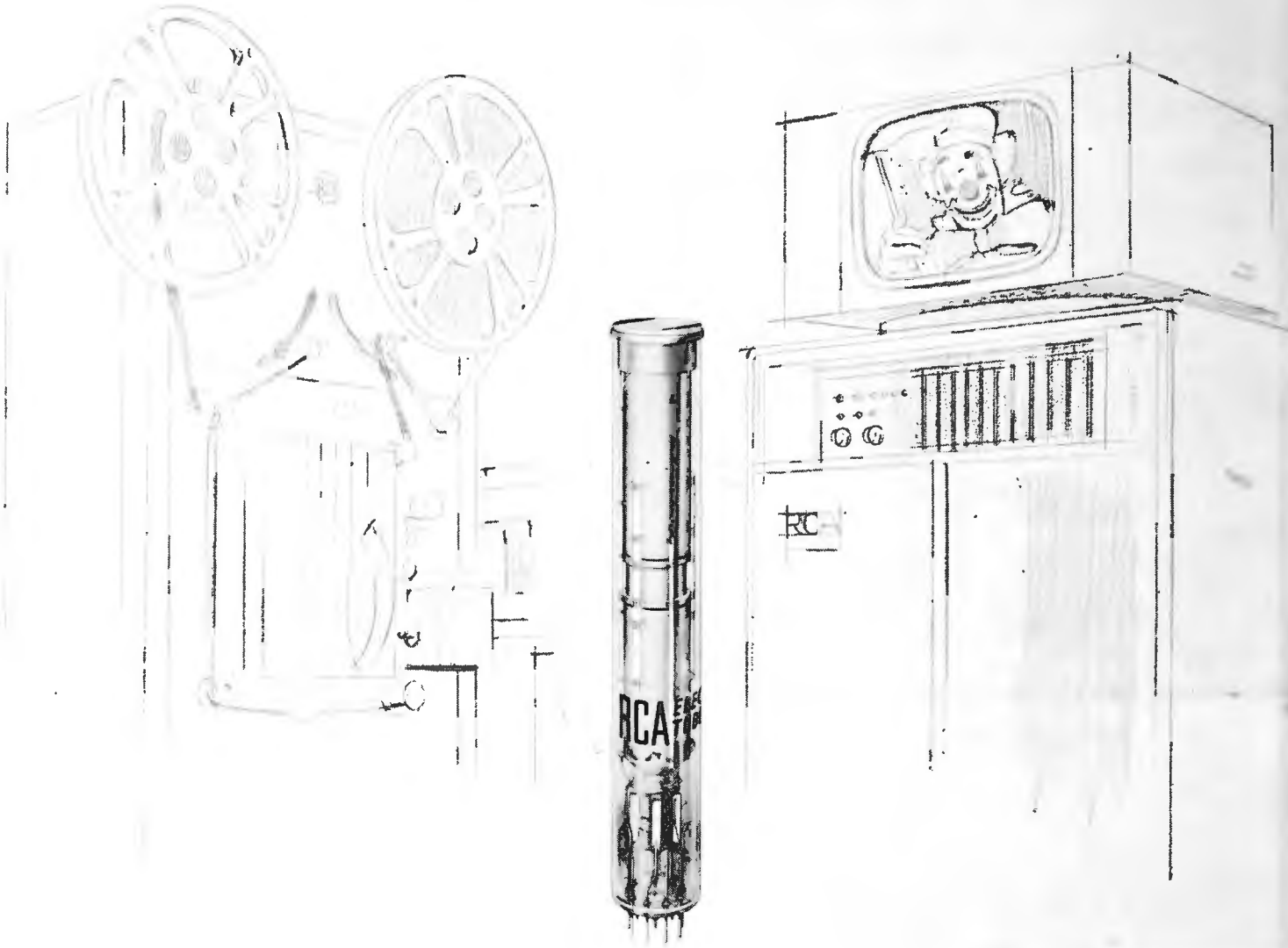

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