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For additional information, write directly to Mr. Robert Carr, Manager of Professional Products Division, Shure Brothers, Inc., 222 Hartrey Ave., Evanston, Illinois.

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October, 1965

Circle Item 2 on Tech Data Card
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How one station checks the RF envelope of the visual output.

Visiting the New Channel Two  James M. Moore  17
All-new full-power VHF stations don't go on the air every day, but one did last month.

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This construction feature describes a device for turning off the unmodulated subcarrier.

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News was made on the banks of the Wabash when WTWO (popularly known as W-2) began broadcasting on channel 2 from Terre Haute, Indiana. For the story, turn to page 17.
Designed for studio or mobile applications, the new TELECHROME Solid State Special Effects Generator, Model 3801A1, produces a multitude of visual effects to enhance scene changes, insert keying for commercials and bulletins, etc. The system comprises a power supply, switching amplifier and waveform generator in a 5¼" high rack mounting frame and remote control units. The waveform generator contains 7 plug-in cards, 6 for the effects and one for the accessory joy stick positioner. A newly designed effects remote control unit provides an illuminated pictorial of the selected effects—plus Thumb-Wheel control for rapid and positive wipe selection.

**FEATURES**

- Occupies only 5¼" of rack space.
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- Plug-in oscillators in positioner remote control unit for modulation of effects.

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Circle Item 3 on Tech Data Card

October, 1965

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LETTERS

to the editor

DEAR EDITOR:

It would appear that a number of corrections, or additions, should be made in the printing of Engineers' Exchange in the July 1963 issue of BROADCAST ENGINEERING. These I would appreciate in a forthcoming issue.

Surely there will be many new engineers who will want the circuit diagram for the article "Warning Operator of Carrier Failure." While many of us old-timers will understand this rather simple device, there may be those who won't. Furthermore, the "Yard" modification diagram was used in connection with the article "Economizing on Tower Lighting Wiring."

I do appreciate the many fine articles appearing in this magazine and look forward to its coming each month.

JOSEPH L. McFARLAND
Staunton, Virginia

DEAR EDITOR:

In your July issue, on page 42, you described a loss-of-carrier alarm. The text refers to various tubes and relays; however, the diagram that was printed near the text does not seem to belong there. We would like to construct such a system for our station and wonder if you might tell us how to obtain a schematic for the unit that is described.

GARY C. MORGAN
Studio Engineer,
WUFM, Utica, New York

We'll be glad to help you, fellows—and all our other readers, too. Our pet gremlin really had a ball with page 44 of the July issue. Here's a step-by-step guide for undoing his handiwork:

1. This is the schematic of the carrier alarm:

   ![Diagram]

   It belongs in the upper left-hand corner of page 44.

2. The diagram that was in the corner goes to the middle of the right-hand column.

3. Just forget the diagram that was in the right-hand column—it appears in enlarged form on page 40, where it belongs!

We hope this will clear up the confusion. We're keeping a sharp watch for that gremlin, and maybe one of these days we'll catch him. We do apologize for the mixup.—Ed.

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And you should. After all, they can increase your program power 8 times. Solid state Audimax is an automatic level control years ahead of the ordinary AGC. By automatically controlling audio levels, it frees engineers, cuts costs and boosts your signal.

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We can afford to give Audimax and Volumax away free. Because we know they're so good, most people can't afford to give them back.
A TV projector should deliver highest fidelity in both picture and sound with uninterrupted performance for thousands of hours.

This is the story of the new EASTMAN 16mm TV Projector, Model 285

Nowhere can you get more dependable 16mm television projector performance. All components in the new EASTMAN Model 285 Projector — projection optics, sound optics and the mechanical system—have been conceived and engineered in the light of what television programming demands.

This projector has evolved from the EASTMAN Model 275 Projector, widely regarded as the quality standard for 16mm TV projectors. The Model 285 incorporates a still frame feature, which maintains the same brightness and color temperature as in normal projection; a flat gate which provides uniform resolution throughout the picture area, from corners to center; a take-up reel mounted near the operating controls; ready accessibility to the projector mechanism; and a contemporary-design cabinet.

Reliability is the prime requisite of a TV projector—and Eastman continues to assure this reliability by separating the film transport system from the Geneva-type drive, thereby isolating shock forces.

Several KODAK Television Projection EKTAR Lenses of exceptional resolving power are available with the Model 285. The projector also allows rapid replacement of a burned-out lamp. Light output is more than enough for black-and-white and color transmission. Sound reproduction, both for magnetic and optical tracks, is unequalled in the 16mm field.

A magnetic sound playback kit and automatic cuing kit are just two of the several optional pieces of equipment that make the Model 285 Projector so versatile. A film reverse accessory will soon be available. With or without these accessories, you'll find this projector an outstanding value.

The EASTMAN 16mm Television Projector, Model 285, is part of a rapid-access 16mm TV film system that takes you from “on the spot” to “on the screen” in minutes. It includes camera, pre-striped films, processor and projector. For a brochure with complete details, write to:

Motion Picture and Education Markets Division EASTMAN KODAK COMPANY Rochester, N. Y. 14650
or the regional sales offices: New York, Chicago, Hollywood, Dallas, Atlanta
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Audio doesn't have to travel to front panel and back. This means you have a lot less wire to pick up noise. (There is no noise, either, from attenuators. They are sealed in protective capsules.)

Module design ends time-wasting troubleshooting.
Simply take out one card and plug in another. Replace attenuator, input switches, and amplifier output switches with one quick shuffle of cards.

The Collins solid state 212S-1 is for stereo and dual-channel operation for FM, AM and TV stations. The companion 212M-1 Console has fewer modules for mono program and monitor outputs.

For details, call your Collins representative. Or write: Broadcast Communication Division, Collins Radio Company, Dallas, Texas 75207.
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[ ] two tape transports provide 12 hours of music without repeating any selection, and you can alternate from tape to tape at any time interval desired. [ ] single cartridge and up to 48 rotating cartridge units can be scheduled to play at any time interval desired. [ ] can be expanded into major Prolog System for unattended programming and logging.

for brochure on Prolog Type 100-2 System, write Commercial Sales, Continental Electronics Mfg. Co., Box 17040, Dallas, Texas 75217 and request Prolog I.

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15 Years Old and Still Ahead of the Times!

It may not look revolutionary today, but fifteen years ago the E-V 655 shown here was unique. Then it was the only truly omnidirectional dynamic microphone on the market. And it offered ruler-flat response from 40 to 20,000 cps, plus plenty of output for critical broadcast applications.

Even today, those specs are first rate. Many of the early 655's are still proving that in dependable daily service. But during the years, E-V has continued to refine and improve so that today's Model 655C can set even better records for performance and service.

Having proved the point, the 655 inspired a complete series of Electro-Voice omnidirectional microphones that serves every need over a wide price range. The full benefit of our fifteen years of design leadership is lavished even on the most modest model in the line.

For instance, every slim E-V dynamic microphone uses the famed Acoustall® diaphragm. This E-V exclusive insures more uniform response while withstanding the effects of high humidity, temperature, corrosion and shock. It makes E-V omnidirectional microphones almost indestructible.

You'll learn the real value of engineering leadership when you put any of these slim E-V dynamics to work in the field. You can do it with the extra assurance of a lifetime guarantee against defects in materials or workmanship. See them now at your franchised E-V microphone headquarters, or write for complete catalog today.
The typical television station has much equipment to be serviced and maintained. Because of the volume of work required, maintenance is usually broken down into categories —transmitter, remote equipment, audio gear, studio cameras, video tape, power supplies and monitors, and film chains. In this article, we will discuss the elements of a film chain that require regular preventive maintenance: vidicon camera, multiplexer, film projector, and slide projector.

**Vidicon Camera**

The daily checkout of a vidicon-camera film chain usually begins when the morning projectionist sets up the camera (Fig. 1), and checks electronic and optical focus, alignment, aspect ratio, linearity, and electronic centering, while keeping a sharp eye out for any smearing or ringing. He accomplishes all these tests with the aid of a slide made from the RETMA or EIA resolution chart.

A separate slide is available, known as the TV lines chart, which contains multifrequency elements and is used to check maximum resolution. Another slide which is quite common in setup procedures is the linear density slide, or “stairstep” slide. The vertical bars on this slide are numbered left to right from 1 to 10 and represent ten separate ranges of density from black to white. In a checkout using this slide, the operator observes an oscilloscope display of the waveform, which should resemble a staircase. Nonlinear steps indicate compression or stretch, which may be caused by a defective tube, plate-load resistor, coupling capacitor, or by misadjustment of a stretcher or clipper control.

Whenever the vidicon lacks resolution or any other quality necessary for optimum performance, and the trouble cannot be corrected on the spot by the projectionist, he notes this fact on his trouble sheet, maintenance sheet, or whatever report goes to the studio supervisor. A maintenance crew will then get orders to overhaul the camera. Monthly or bimonthly tube checks, control cleaning, vacuuming of housings, and test-point voltage measurements are all performed by the maintenance crew. This group will have a record of original performance for comparison with present performance. This record is often made when the chain is first installed, by adjusting the camera and associated monitor for best display of a test chart, then photographing the display. The print is...
Cleaning is required for frequent and regular pre-cleaning, consequently a lot of dirt can accumulate. If the lenses are gently swabbed, picking up residue, dry lens tissue is then used to absorb the remaining fluid until the mirrors are dry. You must exercise extreme care not to scratch the mirror surfaces even slightly, or optical distortion will be the result.

**Multiplexer**

There are various types of multiplexers on the market, but they all do the same thing—switch the optical output of two or more projectors to the same camera. Maintenance of such units (Fig. 2) is quite simple, as there are few things that can go wrong. Cable connections (for switching the mirrors electrically) must be kept clean and tight, and should be burnished perhaps every three months.

The other primary maintenance detail is to clean the mirrors, which should be done several times a week—or even daily if dust conditions are severe. First, the mirrors are brushed off with a camel's hair brush. Photographic-lens tissue is then moistened with a lens-cleaning fluid, and the mirrors are gently swabbed, picking up residue. Dry lens tissue is then used to absorb the remaining fluid until the mirrors are dry. You must exercise extreme care not to scratch the mirror surfaces even slightly, or optical distortion will be the result.

**Film Projector**

The film projector at the typical TV station is used more often than any other program source, with the exception of the slide projector. In addition, the film projector has a lot of moving parts, and there are consequently a lot of things that can cause trouble. For these reasons, it requires frequent and regular preventive maintenance to insure trouble-free operation.

Certain maintenance items are required for projector service:

- Mirror- and lens-cleaning fluid
- Denatured or isopropyl alcohol, or carbon tetrachloride (use with extreme caution)
- Lens tissue
- "Q-tips" or cotton balls
- Wiping rags
- Lint-free rags
- Toothbrush
- Camel's-hair brush, 2" wide
- Orangewood stick
- Oils and whatever other lubricants recommended by the manufacturer

**Cleaning**

One of the most common and necessary maintenance practices for all equipment is the removal of dust. It's practically impossible to prevent some dust accumulation in a plant that runs 12 to 18 hours every day. Dusting ought to be performed each day, although in some cases every other day will suffice. A handy tool for this purpose is a small hand-type vacuum cleaner which can either vacuum or blow. Sometimes it's convenient to blow dust out of a compartment, while at other times it is easier to vacuum it out.

Many stations clean the film path each time the projector is loaded; some do it several times daily. The parts to be cleaned usually include the film gate and aperture shoes or guide surfaces (Fig. 3), pad rollers or film guide surfaces, and tension rollers and sprockets. A toothbrush or an orangewood stick is useful for removing solidified deposits of emulsion or dirt, but be careful in using anything sharp which could scratch a metal surface—the scratches might cause film-gouging. After large deposits have been removed, "Q-tips" or lint-free cloths are wetted with alcohol or carbon tetrachloride and swabbed through the film path.

Reflectors, projection lenses, light and heat filters (where used), and sound-track optical lenses should all be cleaned daily. For nonoil dust, the camel's-hair brush should be used. Oil and greasy contaminants should be removed with a swab made of lens tissue wetted with lens-cleaning fluid. The surface is then dried by polishing with clean, dry lens tissue. Don't use too much pressure, or you may scratch the surface.

**Lubrication**

General lubrication procedures are impossible to describe here, because oiling depends to a large extent on the exact type of projector mechanism; therefore, the manufacturer's recommendations should be followed as to types of oil and/or grease and when to apply them. Generally, daily oiling of oil ports and certain moving parts in the film path is required. Periodic oiling at greater intervals is generally required for chains, shafts, gears, and oil holes under covers. Some motors have "oilite" bearings, sealed for the life of the assembly, and don't require lubrication. It's important that you do not over-lubricate, for this will simply cause oil to be thrown out of the bearing or component; it will then contaminate the film path, sound system, or some similar area. Lubricate only as much as the manufacturer suggests. After oiling, it's best to wipe any excess off carefully with a lint-free cloth dipped in carbon tet.

**Replacements**

Spare projector lamps (Fig. 4), sound-exciters lamps, and sound photocells (Fig. 5) should of course be kept on hand immediately adjacent to the projector, so that they are available for instant replacement. Some projectors have spare-lamp sockets built into the mechanism, with a changeover switch and solenoid that automatically throws the spare into operation in the event of a failure. In any case, re-
Travel ghost (vertical blurring of projected image) and picture jump: Shutter misadjusted or not synchronized with pulldown mechanism; poor film print—check with standard film; improper threading; aperture-plate side-pressure springs weak; dirty side-pressure shoes; misshapen pulldown claw teeth; worn rails or camshaft.

Picture indistinct or illumination low: Projector lens, condenser lens, or reflector dirty; projection lamp blackened; lens iris (where used) setting too low; film print too dense—check with standard film.

Picture okay, sound weak or missing: Improper threading; dirty light aperture; exciter lamp burned out; dirty sound mirror; low or no exciter-lamp voltage; low or no photocell voltage; gain control not properly set; defective photocell; defective tube, resistor, capacitor, or transformer in sound preamp; no power-supply voltage reaching sound section.

Sound, no picture: Both projection lamps burned out; lamp changeover system inoperative (if automatic system is used); "Variac" (if used) set too low; douser (if used) in closed position.

High hum level: AC-powered light shining on photocell; shield on audio line improperly grounded; heater-to-cathode leakage in preamp tube; open grid; open filter capacitor in power supply; hum pot on power supply improperly adjusted (if used).

Sound pitch unsteady: Pressure roller adjusted to wrong tension; sound drum dirty; sound-drum shaft bearings loose; nylon rollers on damping-roller assembly dirty; sound drum damaged; worn or defective sound-drum shaft bearings.

Projector-motor difficulties: No line power; open line switch; input voltage too low; open field winding; excessive load; wrong input-power frequency; motor loose on mounting; unbalanced rotor; motor frame bolts loose; bent shaft; motor coupling loose; motor support loose; motor shaft misaligned; dirty motor; shorted stator coil; rotor rubbing on stator.

Preamp oscillation, microphonics, or distortion: Loose ground wires; defective bypass capacitor; output leads too close to input leads; loose elements in or poor connections at photocell; defective input tube in preamp; low-emission preamp tube; open or leaky coupling capacitor.

Test Films

There are a number of standard 16-mm test films which are available at nominal cost from the Society of Motion Picture and Television Engineers, 40 West 40th Street, New York, N. Y. 10018. Each has a particular use in checking out a film chain.

The Sound-Service Test Film (Code SPSA) consists of high-quality music, both orchestral and piano, as well as spoken dialogue. The 3000-Cycle Flutter Test Film (Code Z22.43) provides an accurate test of flutter but requires a flutter meter. More useful for the average station are the Sound Focusing Test Film (Code Z22.42-7000) which lets you adjust the optical sound system, the 400-Cycle Signal-Level Test Film (Code Z22.45) that is handy for setting levels, and the Multifrequency Test Film (Code Z22.44) which is used for checking overall frequency response. The Buzz-Track Test Film (Code Z22.57) is useful for optically aligning the sound reproducer in the projector.

Please turn to page 26.
Two important parameters of a television transmitter that must be known with some certainty are the power output and the linearity of the system. Conventional monitoring is done by detecting some of the RF in the output transmission line and displaying this on a waveform monitor. By periodically “chopping” or short circuiting the video signal, a reference line corresponding to zero RF input is also displayed, making it possible to set picture white level correctly for intercarrier sound operation. The peak output at sync tips is calibrated by reference to a water-cooled dummy load. For linearity checks, a sawtooth waveform at line rate can be fed into the transmitter and the modulator “stretch” controls adjusted for optimum linearity at the desired power level.

A simple diode detection system has some disadvantages: First, the diode becomes nonlinear at low input levels, so that the zero reference line must be offset in some way. For the same reason, the linearity display may not be correct near black level, and finally there is always the possibility that the probe will be moved inadvertently or the waveform monitor gain will drift, requiring recalibration. More complex demodulators are still more liable to error, and more time may be spent in checking the demodulator than in checking the transmitter.

An alternative method, incorporated by some manufacturers in their transmitters, is to use an RF envelope monitor. Some of the RF is tapped off as before, but instead of being rectified it is applied directly to the Y plates of an oscilloscope. Since the deflection is proportional to the peak voltage developed, it is also proportional to the square root of the peak power. A simple graticule can therefore be engraved showing the deflections corresponding to sync tips, black and white levels, and so on, with no possibility of nonlinearity upsetting the results. Just as with a diode sampling RF at the same point, the deflection will be proportional to the sum of the carrier and its sidebands, so that care must be used in interpreting frequency-conscious measurements if these are made at a point in the system where the sidebands are not symmetrical. If the RF being monitored is double sideband, then the envelope monitor can be used for critical frequency or phase measurements, pulse and bar transients, and so on. The envelope shape corresponds exactly to a DSB diode-demodulated signal with the advantage of eliminating any detector nonlinearities. For a “white up, syncs down” display, the lower half of the envelope waveform is shifted up to the graticule region.

If the RF being monitored is vestigial sideband, the indicated frequency responses will be wrong in the same way as for a DSB diode. If a true “VSB” output is required, suitable filters must be added ahead of the envelope monitor. A sound trap is also required if the sound signal is present at the time measurements are made.

With the emphasis on simple vertical deflection to represent power levels, and a line-frequency display for linearity checking, the circuitry of these RF envelope monitors has been rather rudimentary. By using a modern oscilloscope time base, a much superior instrument can be made that is also useful for vertical-interval test signals whereby many transmitter adjustments can be made while the transmitter is actually on the air with program material.

**Choice of Oscilloscope**

The oscilloscope used for RF envelope monitoring must possess certain features:

1. Direct connection of RF to the Y plates must be possible.
2. Full television triggering facilities are required for the time base.
3. The envelope monitor section preferably should be a plug-in unit so that the oscilloscope is available for routine testing at other times with other plug-ins.

The problem of driving the Y plates is tied very closely to the capacitance of the Y plates and the deflection sensitivity; obviously the higher the capacitance the more energy is required to drive the plates at a given frequency. It is customary to tune the plates to resonance with an external inductance, in which case a high-capacitance deflection system will give a small RF bandwidth unless the circuit is damped; such damping again reduces the deflection voltage available. In some CRT’s, the Y-plate connections are brought out through the base of the CRT. Such long leads cannot satisfactorily be made part of a tuned circuit, particularly for the higher TV channels.

Oscilloscope Y plates normally diverge so that their ends nearest the screen are farthest apart. If the voltage on the plates varies at a high enough frequency, the beam may perform several cycles while...
traveling through the Y plates. The final deflection is then caused only by the extreme ends of the plates which, being farthest apart, produce least effect on the beam. This effect could be reduced by increasing the velocity of the beam, but this is counteracted by a general loss of vertical sensitivity if the beam velocity increases. Some CRT's have split deflection systems driven by delay lines, but these are not normally found in oscilloscopes used in TV stations. Obviously only certain CRT's are suitable for RF monitors at VHF.

**Practical System**

To illustrate the techniques and problems involved in using the oscilloscope for envelope monitoring, a system devised for use at CFCF-TV will be described. The particular oscilloscope used was a Tektronix 561.

The heart of the system is the plug-in unit shown in Fig. 1, C760, a small trimmer near the main chassis connector of the oscilloscope, must be kept in circuit so as not to upset the operation of the unit with its other plug-ins. When the connections to the deflection plates are changed, the setting of C760 should be rechecked according to the instruction book.

The RF circuitry consists of a simple parallel-line tuned circuit, with an adjustable coupling matching the 50-ohm RF input. The short length of 300-ohm ribbon (the small-conductor ribbon in the scope was replaced by the conventional kind) from the Y plates to the connector is not operated in a matched condition and can be considered merely as an extension of the main tuning-circuit lines. The size of the lines depend on the channel to be covered; for low channels a few turns of wire will be required. For channel 12, we used two 2½" No. 12 wires spaced 1" and run from the connector directly to the split-stator tuning capacitor. At higher frequencies these lines can be made of wider material to reduce their inductance. The coupling arrangement also varies with the channel, and either a capacitive-potentiometer (shown) or inductive-loop coupling can be used. Care should be taken with the B+ on the main tuning lines. When the unit is complete, it is very simple to check for correct tuning and sufficient coupling to give about three screen diameters of vertical deflection.

In order to give control of vertical shift, B+ is fed to the shift circuit. Two 1K, ½-watt resistors are used as RF chokes, and two 47K resistors and a .001-mfd ceramic disc bypass capacitor filter the RF out of the shift circuit. Normal VHF wiring techniques must be followed in mounting the components. Between pins 9 and 11 are mounted a diode and load resistor; their leads are not cut short but are bent so as to act as a coupling loop close to the main tuned circuit. The detected video acts a synchronizing feed for the time-base unit. At other channels the pick-up arrangements may need to be modified. It should be noted that the plug-in time-base units normally used with this oscilloscope do not have television-type sync separators built in.

For measurements at line rate, the synchronizing information from the detected RF is adequate. More sophisticated waveforms may require external triggering from the modulating video test signal generator.

For single-channel operation, the main tuning can be preset, but the coupling and vertical-shift adjustments must be brought out to the front panel. If a variable-frequency oscillator is available, it is advisable to check the bandwidth of the unit and to make sure it is flat over the whole TV channel at all coupling settings. For the same reason, the unit should be constructed rigidly to good VHF engineering practice.

**Calibration and Use**

For power measurement, the unmodulated transmitter is run into a water-cooled dummy load, and the power dissipated is calculated from the water-temperature rise. At the desired level of peak sync, the setting of the scope vertical gain control is noted (or a preset control is switched in). If the transmitter will not run at this level continuously, or for other levels such as blanking, the corresponding CW power is calculated for the desired mark-to-space ratio of the pulses, and the graticule reading is noted. For everyday use, a special graticule can be made up showing sync, blanking, and white levels. As long as the tuning and vertical gain controls are not touched, these graticule lines will represent absolute power levels, provided the antenna is as well matched as the test load.

To use the oscilloscope as a waveform monitor, the vertical-gain and vertical-shift controls are moved to permit viewing of either the "positive" or "negative" part of the envelope as desired. (For a test extending from black to white, app.

![Fig. 1. This adapter was developed at CFCF-TV for use with an oscilloscope for checking the RF modulation envelope.](A) Photo of unit

![B Schematic diagram](B)
The opening of a new VHF TV station—particularly a maximum-coverage station—on a previously unoccupied channel assignment is a rare occurrence these days. Such a station, WTWO, did begin program tests on channel 2 from Farmersburg, Indiana (near Terre Haute) on September 1. Here is a word-and-picture tour of the nation’s newest VHF TV station.

From Allocation to CP
When the FCC lifted its freeze on new television-station construction, Terre Haute was allotted only one VHF channel—channel 10, on which WTHI-TV operates. In 1957, however, the Commission decided to “deintermix” (make all-UHF) Springfield, Illinois, and so channel 2 was withdrawn from that city and reallocated to St. Louis and to Terre Haute.

A number of applicants sought the channel in Terre Haute, and a number of hearings were held over a period of years. In December 1963, the Commission directed all the applicants to bring their applications up to date. Three remained in competition and, in December 1964, merged to form the present Illiana Telecasting Corp. The FCC approved the merger, and a construction permit was granted February 3, 1965. Work toward making WTWO a reality was begun immediately under the direction of J. R. Livesay, president of the station, and a 29-year broadcasting veteran.

Construction Phase
It was decided to construct a combined studio-transmitter installation for WTWO. Very little flexibility was allowed in the selection of a site. The FAA had determined that all tall towers in the vicinity of Terre Haute must be located in a small triangular area (measuring about three miles on a side) south of the city. The northern tip of the triangle is near Farmersburg, and so the WTWO tower is located about a mile southwest of Farmersburg and about 13 miles south of Terre Haute. It’s no coincidence, then, that competitor WTHI-TV has its new tower directly across highway 41 from WTWO.

Orders were placed in February for equipment that had to be built or adjusted for the station’s frequency. Orders for the studio and control-room equipment were not placed until April—after manufacturers had displayed their newest wares at the NAB Convention.

A target date of September 1 was set, and, through planning, hard work, and a measure of good fortune, the date was met. Most spectacular, perhaps, was the speed with which the 1000’ tower was erected. On one day, the crew put eighteen 25’ sections in place. The 9-ton antenna was lifted into position and mounted in just three hours. The entire job was completed, except for painting, in three weeks, and when the two painters arrived, they covered 880’ of tower in one day (using mittens).

Technical Facilities
The tower of WTWO rises to a total height of 1000’ above ground, 1549’ above mean sea level. The radiating center of the antenna is 950’ above average surrounding terrain. The station’s peak video effective radiated power is 100 kw; its aural power is 19.5 kw. On channel 2, this combination of power and height gives the approximate coverage shown in Fig. 1.

The steel in the tower weighs 105,000 lbs. The concrete foundation is 13’ square and was designed to support a maximum load.

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Fig. 1. This map shows the approximate signal contours of VHF station WTWO.
in excess of 300,000 lb. The outer guy anchors are 14' deep. Obviously, test borings were made before this phase of construction started.

The six-bay batwing antenna is driven by a 35-kw (video) transmitter. Only 20 kw is required to produce the full ERP, however, so the transmitter "loafs along" at considerably less than its maximum capability. This, of course, is expected to result in increased dependability and tube and component life.

Basically, the transmitter consists of three sections—an exciters, a driver, and the video final amplifier. The FCC's new Rule limiting the aural ERP to 20% of the visual ERP permits taking the aural output directly from the driver without the need for a high-level aural amplifier. This fact resulted in a saving of both dollars and space for W TWO.

The transmission lines in the area behind the transmitter are designed to allow flexibility of operation. The transmitter final can be fed to the antenna or to the dummy load, or the visual driver can be fed to the antenna in the event of failure of the final amplifier.

A 10-hp motor drives a blower that brings outside air into the transmitter room, and there is a ceiling exhaust fan (the driver exhausts its heated air directly into the room). In winter, hot air from the transmitter is used to help heat the building.

Program sources include the NBC network (more about that later), two studio cameras, video tape facilities, and a color film chain. The latter cost considerably more than a black-and-white chain, but with the increasing emphasis on color, station management is not sorry for the added investment.

The control console overlooks the studio area. The console is arranged (Fig. 2) so that one operator can control the station during relatively slack periods. During periods of greater activity, the console layout permits the use of separate audio and video operators. By turning one knob, the controls can be set up either for separate audio control or for an audio-follows-video arrangement. Special effects can be inserted into the video signal electronically at the console.

Audio sources include the usual microphones together with a turntable, tape cartridge machines, and the sound outputs of the two 16-mm film projectors and the two videotape machines.

Network programs come to W TWO by way of its own microwave system. Programs are picked up from the network at W FB M-TV, Indianapolis, and are sent to Farmersburg by microwave relay stations near Danville and Reelsville, Indi-

![Fig. 2. Video, audio consoles are arranged so one or two can operate them.](image)

**Fig. 2.** Video, audio consoles are arranged so one or two can operate them.

The 35-kw transmitter is visible from the control room through a large window. (Fig. 3). Ten-watt transmitters are used in conjunction with 10' dishes; the system operates in the 2-gc band. The relay towers are 285' high, and the receiving antenna is at the 300' level on the station's main transmitting tower.

About the only thing the station doesn't have is a remote unit. For the present, it will make its remote pickups with rented equipment.

Although all of its equipment is of commercial manufacture, W TWO did not buy an equipment package. Instead, they shopped for each item to be sure the one selected met their requirements. Wherever possible, solid-state equipment was chosen. In a few cases, manufacturers loaned tube-type gear to the station until the new solid-state models were ready.

**The Building**

The building was designed and built especially for television broadcasting. Design goals were efficiency, roominess (18,000 square feet of floor space) to accommodate future growth, and provision for adding to the building later.

The center of activity is the spacious control room. Large windows give a view of the transmitter, announce booth, studio, and property shop. Doors lead to the news room, film department, transmitter room,

- Please turn to page 32
There are a number of Gates FM-1B's in the field which have only one SCA subchannel. The subcarrier generator which was normally supplied with these units was a fine little unit with only one serious drawback: it had no muting provisions. During periods of silence on the subchannel, any crosstalk in the system was most obvious. If the subchannel could be turned off during these silent periods, the receiver-muting circuitry could quiet the system, and crosstalk complaints would surely be reduced. Crosstalk is not as noticeable if it is covered with legitimate sound. It is our experience that most crosstalk complaints arise during silent periods.

We decided to use the panel space allotted the second subcarrier generator, unused in our case, to install a silence-sensor to mute the subcarrier generator during quiet periods. The circuit had to be simple and reliable; the one shown (Fig. 1) evolved.

The input was bridged across the audio input to the subcarrier modulator. The signal at this point is a healthy 0 VU. The input transformer gives some voltage gain and isolates the chassis ground from the audio line. A single voltage amplifier gives adequate margin against low-level passages. The audio signal from this amplifier is applied to a voltage doubler and is peak-detected. This DC voltage goes from nearly zero without audio to about 30 volts or so negative with normal audio. It is applied to the grid of a tube which operates at zero bias. The voltage at the plate of this tube idles, without audio, at about 20 volts. When sufficient audio is applied to the circuit to cause the plate voltage to rise to about 70 volts, the neon coupling bulb ignites, and a fraction of a milliampere flows through 2.2-megohm resistor R9. V2B, normally held at cutoff by the zener diode in its cathode circuit, then operates at zero bias, and relay K1 pulls in. The relay turns on the subcarrier oscillator and a pilot light.

Note that the device, although only slightly more complex than the usual silence-sensor, does not depend on relay characteristics for its operation. V2B is either at cutoff or saturation.

Other notes of possible interest: R1 isolates the input circuitry from the subcarrier modulator. The input-transformer T1 was a surplus item, but checks show that almost any transformer with a 600-ohm and a high-impedance winding will work nicely. Connect the high-impedance side to the gain control.

The 22K resistor, R2, is installed here for the sole purpose of flattening out the poor frequency response of the particular transformer we used. Adjust R3 so that the lowest audio levels likely to be encountered will hold K1 pulled in. R4 is intended to keep stray RF out of the amplifier circuit. R10 provides a constant current through the zener diode and keeps this diode out of its "soft" region.

Audio and power connections (Fig. 2) were made just as if the unit were another subcarrier generator. We use a 6-pin Jones plug for these lines. The relay output is brought out to a male connector on the front panel and then over to unused pins on the subcarrier-generator input audio pad. This line parallels the On-Off switch on the SCA generator. That switch is now left in the Off position. A front-panel switch, S1, on the silence-sensor was added to override the relay. R11 and C3 reduce a transient click when the subcarrier is turned off.

The remaining set of relay contacts is used to operate green and red lights to show relay status. This unit has performed admirably for us for several months. Crosstalk complaints have been reduced just as expected.
HELICAL ANTENNAS FOR TELEVISION

by William F. Paige, Syracuse, N. Y — A detailed description of one of the important types of antennas for TV transmitting.

The side-fire helical antenna is of the traveling-wave type. It is capable of delivering a gain over a dipole of up to 30 and maintaining a pattern circularity within ±1.5 db, yet it offers simplicity of design and construction. It has the capability of operating over a wide range of frequencies from low-channel VHF through the 2000-mc microwave range, making it ideally suited for television transmission. In addition to these features, it has the capability of producing a certain degree of azimuth directivity and of shaping the vertical beam to distribute the RF energy effectively over a desired service area.

One Section

The antenna consists of a metal cylinder or mast mounted in a vertical position. Two helices having equal but opposite pitch are wound around the mast in opposite directions from a center feed point. The helices are supported from the mast by low-loss insulators.

The input signal may be fed through a coaxial transmission line extending inside the mast to the feed point, or the mast may be used as the outer conductor of a coaxial transmission line, with the feed point probe-coupled to the inner conductor. The feed system extending through the mast to the helix is isolated from the mast by a low-loss insulator bushing. The mast serves as the supporting structure of the antenna. Fig. 1 illustrates the general configuration of the side-fire helical antenna.

Traveling-Wave Principle

The traveling-wave antenna is a non-resonant type that is capable of exciting a large aperture from a single feed point. The aperture of a side-fire helical antenna is the linear length of the mast measured to the ends of the helix. As the wave progresses along the helix, it is highly attenuated because of radiation loss. Consequently, when the wave reaches the end of the helix only a small amount of energy remains, and the effect of reflections from the ends is negligible; therefore, the ends may be left open-circuited or short-circuited to the mast as required in a specific case.

The Helix

The helix must be designed to meet dimensional requirements dictated by the operating frequency. The currents at like points in each turn of the helix must be in phase. Thus, as the current progresses from turn to turn, it is delayed an integral number of cycles. This means that each turn must be an integral number of wavelengths in helical circumference as measured at the velocity of propagation along the helix. The most commonly used helical antenna utilizes two wavelengths per turn and is designated as a second-order-mode antenna. Any order mode can, be used as long as the length of a turn is an exact multiple of a wavelength.

The upper and lower helices are wound in opposite directions around the mast to cancel or minimize the vertically polarized radiation components. This is also referred to as "cross polarization" and is a result of the helix pitch angle. The measured gain of the antenna is reduced approximately 5% to obtain the horizontally polarized gain value.

Current Distribution

As the progressive wave travels from the feed point to the ends of the helices, there occurs an appreciable amount of radiation loss per turn. This loss is a function of the spacing of the helix from the mast. Assume an antenna with a fixed aperture length. If the spacing s/λ is made too small, the radiation loss per turn is also small; consequently, when the current arrives at the end of the helix there still remains a substantial amount of RF energy to be reflected back along the helix. This can cause severe horizontal pattern scalloping or "cloverleaving." On the other hand, if the spacing s/λ is made too large, the radiation loss per turn is large, and radiation takes place only around the feed point. This, in effect, reduces the effective aperture. The total length of the helix is adjusted, commensurate with the loss per turn, so that resonance effects due to end reflections are avoided and yet an effective aperture is maintained. The design center for this radiation loss is chosen as approximately 4 db per turn, and the s/λ spacing used to obtain this optimum value is .13.

As previously mentioned, the
pitch of the helix introduces "cross polarization." Let us again assume a fixed aperture length. If the pitch is kept small to minimize "cross polarization," the length of the helix would be extremely long and require many turns, thus reducing the effective aperture and beaming bandwidth (the total frequency separation between the two points where the half-power beamwidth has increased 1 db). If the pitch is made large, the length of the helix is reduced, cross polarization becomes excessive, and resonance effects due to end reflections become prominent. A pitch of .5 wavelength optimizes the antenna performance. A decrease in pitch on the last two turns of helix permits the use of six full turns of helix within 2½ wavelengths of mast height.

The Mast

The mast dimensions are determined by the electrical parameters of the antenna. The diameter of the mast is easily calculated from the following:

\[
\frac{C}{D} = 0.25
\]

where,

\[
D = \frac{C}{
\frac{\pi}{P} + \frac{L}{P}
\}
\]

L = length of one turn of helix
P = pitch of the helix

The length of the mast is 5 wavelengths, 2½ wavelengths from the feed point to either end. If a high gain is desired, these sections are stacked one upon the other, and the gain of one section is multiplied by the number of sections. If more than one section is required, a series feed system is used in which the distance between feeds must be an integral number of wavelengths to yield in-phase currents.

Insulators

If an insulator is inserted at a point along the progressive wave, a reflection occurs at this point, and a standing wave appears on the helix. The magnitude of this reflection is dependent upon the dielectric constant of the material. It is desirable to use an insulator material with a low dielectric constant and yet one that is mechanically strong and durable under adverse weather conditions. Teflon® meets these requirements and is the most commonly used material for the supporting insulators.

The location of the insulators is another important consideration. The traveling wave along the helix repeats its phase every full wave; consequently, if the insulators are placed at half-wave intervals, the reflections will be in phase and add in magnitude. Therefore, insulators are placed at quarter-wave intervals or any odd multiple of quarter-waves to place the reflections in opposing phase. Three-quarter-wave spacing is used on the second-order-mode antenna to insure good mechanical support for the helix.

Impedance

The radiating helix may be considered as a transmission line which uses the mast to form a single conductor over a ground plane. The characteristic impedance of such a line, with the spacing employed, is approximately 100 ohms. This impedance can be varied somewhat by tapering the spacing of the turns near the feed point. Since the helix behaves as a lossy transmission line, the impedance bandwidth is wide.

This low feed-point impedance and consequent low RF voltage make the helical antenna design inherently immune to moderate icing conditions. On the other hand, this antenna is readily adaptable to de-icing by merely passing a high AC current through the helix, thus eliminating the necessity for additional heating elements.

Directionalizing

The antenna is adaptable to a certain degree of directivity by placing radial stubs of the order of .10 wavelength long on the helix—for maximum effect, usually on the first three turns of helix from the feed.

The helical antenna can be used for suppressing the radiated signal in a specified direction to a maximum of about —10 db. Fig. 2 shows a typical directional pattern. For installations requiring a highly directive pattern to provide better

**Fig. 2.** Typical horizontal pattern of a directional antenna.  **Fig. 3.** Typical vertical pattern of single-bay helical antenna.
and more efficient coverage of populated areas, other types of antennas more suited for the purpose are available.

Summary

It can be seen that the combination of mast size, helix pitch, helix-to-mast spacing, and number of turns must be chosen to utilize the aperture most effectively and at the same time to provide adequate bandwidth. It has been determined that for a second-order mode antenna six turns for each of the helices, a pitch of .5 wavelength, helix spacing of .13 wavelength, and a helix diameter of about .01 wavelength will result in a bandwidth of approximately 5%. This bandwidth is adequate for all high-channel VHF and all UHF channels.

A typical vertical field pattern (Fig. 3) has a half-power beamwidth of 12°, very low side-lobe level, and a low vertically polarized field magnitude to produce a gain of 5 over a dipole. The horizontal field pattern is circular within ±1.5 dB.

High Gain - Second Order Mode

Up to this point, a one-section helical antenna has been discussed to explain the basic construction and operation of the type. Today’s television market is leaning more and more toward high-gain antennas for adequate coverage of principal cities several miles from the antenna site while still contouring the vertical pattern to provide the desired close-in coverage. With the helical antenna, this is accomplished by stacking sections upon one upon the other to obtain the desired gain. Close-in coverage is obtained by proper phasing and current distribution between the sections that constitute the array.

Stacking of Sections

As previously stated, one section produces a gain of 5 over a half-wave dipole; therefore, a series multisection array produces a maximum gain of 5 times the number of stacked sections.

The average UHF station requires an antenna gain of 25. Since close-in coverage requiring null fill-in is a necessity for most installations, a six-section array is necessary to compensate for gain reduction resulting from null fill-in and electrical beam tilt. (Beam-tilt and null-fill-in requirements depend largely on the height of the antenna above average terrain and on local terrain conditions.) Fig. 4 shows a four-section UHF helical antenna. VHF stations usually require two or three sections.

Beam Tilt

As the gain of a standard antenna is increased, the vertical beamwidth is proportionately narrowed. Because of earth curvature, and possibly local terrain conditions, part of the main beam energy will tend to miss the horizon and go off into space. For maximum effective range, the main beam should be tilted downward to or slightly below the horizon (Fig. 5).

Beam-tilting may be achieved easily with the UHF helical antenna by introducing a progressive phase shift between successive sections. This can be accomplished by employing swivel flanges and mechanically rotating each section with respect to its adjacent section. Beam tilts up to 1° are possible without appreciable pattern distortion or loss of gain. Beam-tilting the VHF helical antenna is achieved by introducing phase shift between successive sections by varying the lengths of the feed lines to the sections.

Null Fill-in

In the design of any antenna array there are nulls that appear at calculable angles below and above the antenna’s radiation center. The first null is generally the one most likely to fall in populated areas close to the transmitter site, as illustrated in Fig. 6 which shows a cross section of the vertical beam and the associated nulls and side-lobes.

The first null of a standard helical antenna averages 20 dB or more below the main-beam peak. If additional null fill-in is required, it may be obtained by proper power division between the antenna sections composing the array. For the UHF
Most broadcast operators aren't mechanical engineers, but there are a few mechanical devices which they must understand and maintain. One of these is the familiar reel-to-reel tape transport. It is our purpose here to discuss the routine maintenance of these machines, and the troubles most often encountered.

Maintenance should consist of cleaning, lubrication, and adjustment, in that order. If the machines are properly maintained, the amount of work required in each of these categories should diminish in the order given. Cleaning and lubrication help prevent wear, and adjustments take up the slack when wear takes place.

Cleaning
Start by cleaning the pinch roller and drive capstan. These should be cleaned with ethyl alcohol or ordinary rubbing alcohol. Don't use carbon tetrachloride on rubber parts, since it will cause the rubber to harden or crack. Clean the tape guides to remove all caked oxide, which can be a source of flutter or faulty tape travel. On machines using band-type brakes, remove all traces of oil from the drum on which the bands ride. Whatever type of brakes is used, all oil must be removed from the braking surfaces. If felt or fiber parts show signs of oil, they should be replaced. Where replacements are not immediately available, a temporary improvement may be had by putting the felt between two blocks of wood with blotters on each side and then clamping them firmly in a vise. It may also help to roughen the contact surface with coarse sandpaper. This is especially helpful where the surface is matted with dust and oil.

Clean drive rollers in the same manner as the pinch roller, with alcohol. Be sure to remove all traces of oil. If the surface is badly glazed, it can be reconditioned by using "roller deglazing solution" which may be obtained from printing-supply houses. Rubbing with very fine sandpaper or crocus cloth may also help. Don't use an abrasive on rollers in the capstan drive chain, however, since this could cause speed variations.

A point on disassembly is in order here. When taking apart the bearings on the flywheel or motors, notice the amount of back-and-forth play in the shafts, so that the same amount may be had upon reassembly. Also, since many of these bearings are of the single-ball variety, be sure the ball doesn't roll into a dark corner of the bench and become a spare part! On machines with direct drive (i.e., no belts or idlers between the motor and capstan), it helps to rotate the motor a quarter-turn when it is reinstalled. This helps equalize wear on the sides of the top bearing and prolongs motor life. Often this method may be used to restore life to a dragging motor.

If the machine has become very dusty or oily, practically any part may be cleaned with soap and water. Use a small paint brush soaked in a strong soap solution to wipe away residue from wiring, fans, pulleys, and electrical parts. The water won't hurt the parts if the machine is allowed to dry completely before applying power. Let it air-dry for 48 hours or more. A heat lamp will speed the process. While you're laundering, don't forget the front panel.

Lubrication
Lubrication is important, but should not be overdone. Most manufacturers recommend lubrication every three months or 1,000 hours of operation. Their instructions are usually explicit and should be followed closely. In general, SAE 20 oil is suitable unless the manufacturer recommends otherwise. Extreme care should be observed to avoid over-oiling or spilling oil on drive surfaces. One of the best tools for lubrication is an ordinary hypodermic needle. Your doctor will probably let you have one of the disposable variety, which is ideal for this purpose.

Machines vary widely as to the points which require lubrication. The capstan-drive motor is almost always provided with oiler holes which will accept the hypodermic. Five or six drops in each bearing is ample. The same applies to the flywheel, the takeup motor, and the feed motor. The pinch roller, drive idlers, rotary tape guides, and tension arms should get only one or two drops of oil. Remove any excess oil with alcohol.

Adjustment
If the machine has been thoroughly cleaned and lubricated and is properly reassembled, it is quite likely that no adjustment will be necessary. Again, the instruction book is your best guide. A spring balance reading 0-16 ounces is very helpful in setting feed and take-up tension. Connect the balance to a length of twine, and wrap the twine around the hub of a 7" reel, as shown in Fig. 1. If the reel used
has a 2" hub, the balance will read directly in ounce-inches. The proper torque readings are often given in this form (see Table 1). Three-motor machines use resistors in series with the take-up and feed motors to set the tension in each mode. It should be necessary to change the settings of these resistors only if a part has been changed.

Single-motor transports pose additional problems, and the adjustment procedure is a bit more complicated. The take-up and feed tension is varied by changing the tension on felt clutches. Some machines use a split knob which has a locking screw and is threaded on the rear of the reel shaft. These are adjusted by loosening the locking screw and turning the knob clockwise to increase the tension, or counter-clockwise to reduce it. This adjustment should be made in eighth-turn increments, since it is quite critical. Once the proper setting has been found, tighten the locking screw securely. Other machines use a folded leaf spring which sets the tension. If this spring has been bent, the best thing to do is replace it. It may be bent slightly to secure the correct pressure, but draw its outline on paper before you change it, so it may be returned to its original shape if the trouble is elsewhere.

The pinch-roller tension should be set so it is tight enough to pull the tape reliably, but not so tight that it slows down the motor. A good rule of thumb is to set it for an indentation of about 1/16" where the roller contacts the capstan, as shown in Fig. 2. If the roller is worn, hardened, or has flat spots, it should be replaced. It is also important to be sure the roller shaft is perfectly parallel with the capstan to prevent tape "skewing." This problem is most common on portable machines which have had rough treatment.

Tape guides should be adjusted so that the tape rides directly across the center line of the head gaps. If it is necessary to adjust the guides, it will also be necessary to readjust the head alignment with a standard tape before using the machine.

**Defective Parts**

Fig. 3 shows a functional diagram of the control circuits of a typical transport mechanism. Most of the troubles encountered in these circuits can be traced to bad switches, dirty relay contacts, or a fault in the 110-volt DC power supply. The selenium rectifiers used in some machines are frequent offenders. They may be replaced with silicon units with a rating of 400 peak inverse volts and 500 ma forward current. Poor solenoid or relay operation can be caused by a bad rectifier, but these symptoms may also be caused by an electrolytic filter capacitor which is open or has decreased in value. Check the rectifiers and the capacitors to be sure. If the rectifier turns out to be shorted, chances are the filter capacitors will also be shorted, since they don't work very well on AC.

Motor troubles usually fall into three categories: (1) open windings, (2) shorted turns in the windings, and (3) worn or frozen bearings. If you suspect a bad motor, take it apart carefully, noting the proper position of each part, and inspect it. Look for broken wires or burned

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**Fig. 1.** Spring balance enables operator to measure the torque at the reel hub.

**Fig. 2.** Pressure exerted by pinch roller can be estimated from indentation.

**Fig. 3.** Block diagram shows the control circuits of a typical reel-to-reel tape deck.
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Film Chains  
Continued from page 14

Picture adjustments can be facilitated by using the Television Test Film (Code TV16) which contains geometric patterns designed to test the following qualities: alignment and resolution; low-frequency response; medium-frequency response; storage characteristic; gray scale; brightness control. The Travel-Ghost Test Film (Code TG16) is used to adjust the shutter for synchronism with the pull-down mechanism to minimize travel ghost, and the Steadiness Test Film (Code ST16) permits checking unsteadiness in the transmitted frame.

Magnetic Sound

Magnetic sound heads are serviced the same as heads on a conventional audio tape recorder—by cleaning with "Q-tips" dipped in alcohol and by alignment with a standard multifrequency magnetic test film.

Slide Projector

Much of the advice given already concerning the film projector also applies to the slide projector (Fig. 6)—the mechanism must be kept clean and oiled, cable connections should be checked for tightness, and clean spare lamps must be available immediately.

At most stations, the slide projector is used on the air more than any other program source. Hence it's seldom available for preventive maintenance except when the station is off the air, and it must be given daily care.

Power Supplies and Monitors

The maintenance of power supplies and monitors associated with film chains is usually performed along with maintenance of all the

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The TSA1 Clamping Amplifier employs clamps to remove low frequency deficiencies. The clamping technique, however, is different. Tip clamping is employed which does not disturb burst and other chrominance information in or about blanking or back porch levels. This makes the TSA1 particularly adaptable for color transmission.

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These are just a few of the many new products with unique advantages available for your custom console from the world's largest manufacturer of sound equipment exclusively. Before you build your "dream console," be sure to take a look at the latest and the best—from Altec!

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This unit can serve as preamp, line, booster or program amplifier with no internal changes. All-silicon transistor circuitry delivers 0.5 watt; Frequency response, 20-20,000 cps ±0.5 db; THD, less than 1%; 20-20,000 cps @ +27 dbm; Noise level (unweighted, 10-25,000-cps bandpass), equivalent input noise, -127 dbm (input unterminated); Overload recovery, 5 µs for 100% overload.

NEW ALTEC 9550A POWER SUPPLY

This all-solid-state unit can power up to fifteen 9470A amplifiers at full output! External sensing circuit ensures constant output voltage regardless of line-voltage fluctuations. Under full 2-amp load, output ripple and noise is only 200µV RMS.

NEW ALTEC 9061A PROGRAM EQUALIZER

This passive unit provides continuously variable equalization at selectable frequencies: up to 12-db boost at 40 or 100 cps and 10 kc. Straight-line controls, ready for plug-in mounting.

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Fig. 7. Technician checks output voltages of power supplies mounted in rack.

Monitors and other power supplies and monitors.

Power supplies are usually checked by reading output voltages (Fig. 7) and comparing them with standard values. Improper voltages are usually traced to weak or defective tubes, sometimes faulty filter capacitors. A scope is useful to check output hum level, to make sure filtering is adequate.

Monitor troubleshooting usually consists of checking tubes, perhaps monthly, and regularly checking resolution and linearity (Fig. 8).

Fig. 8. Film-chain monitors must be checked regularly for picture quality.

These checks are made by feeding a monoscope test pattern to the station master monitor and to all other monitors; the pattern on each monitor is then compared to that on the master. The master is first calibrated with a grating generator.
At radio station KDWB, St. Paul, Minnesota, where the disc jockeys are their own engineer and production man, a compact, highly reliable, and flexible broadcasting console was required. For flexibility, a custom console was designed to the critical specifications of the station's chief engineer.

To assure highest operating reliability and facilitate the console's compactness, Belden Beldfoil* shielded broadcast audio cable was used throughout the unit. Beldfoil is "the total shield." For extremely sensitive circuit applications, it is superior to all other types of shielding for guarding against crosstalk and spurious signal impulses. Beldfoil also reduces cable diameters up to 66% . . . increases electrical integrity . . . and provides faster and easier shield termination.

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In the studio, the disc jockey is in complete control. Looking over the installation are (left to right) Dick Halvorsen, Chief Engineer, KDWB; Sam Bridges of Electronic Design Company, console designers and builders; and Steve Gabor, Belden territory salesman. The disc jockey is Don DuChene.

Better Built—Better Buy—

The compact KDWB console is a solid state unit having complete broadcasting features and standby power. It provides mixing facilities for fourteen inputs including five cartridge tape machines, three turntables, microphone, news effects, tape machine, auxiliary, news room, and disc jockey studio.

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Circle Item 15 on Tech Data Card
Oscilloscope
(Continued from page 16)

Fig. 2. Typical displays obtained on the RF waveform monitor from TV transmitter.

proximately 3 times more vertical gain will be required to fill the graticule.) If critical phase or frequency responses are being taken, some thought must be given to the transmitter sideband characteristic at the probe pick-up point. If necessary, an RF VSB filter must be added to the tuned-circuit arrangements. Some typical displays are shown in Fig. 2.

To check the phasing of paralleled transmitters, an identical adapter for the X-side of the scope must be made, and also tuned to the carrier frequency. If the CRT and plug-in connections are symmetrical for X and Y deflections, and if equal lengths of cable feed RF from exactly equivalent points in both transmitters, a Lissajous figure will result in which a phase error of 5° or so can easily be seen.

Conclusion
A simple plug-in unit for an oscilloscope which is commonly available in TV stations makes a useful RF envelope monitor capable of direct power measurements and "DSB-detector" type waveform displays without the disadvantages of real detectors. Additional uses can be made for phasing paralleled transmitters, and with the addition of suitable RF filtering, a VSB-type display could be obtained.

The prototype unit was constructed at CFCF-TV, Montreal, and the author wishes to thank Messrs. Berube and Laporte of that station for their work on the design and construction of the unit.

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Measures common point resistance and reactance while operating at full or reduced power.
Permits minor adjustments of the common point resistance control thus allowing the operator to maintain radiated power at the full license value at all times.
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MODEL OIB-1
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Conclusion

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SPECIAL
REMOTE CONTROL SECTION

Remote Control Systems . . . . How They Work

by Philip Whitney
Consulting Author, Director of Engineering, R. F. Lewis, Jr. Radio Stations, Winchester, Virginia—The most comprehensive explanation BE has ever put together on the basics of controlling the remote transmitter.

Pioneer Remote Control UHF TV

by Patrick S. Finnegan
BE Consulting Author, Chief Engineer, WLBC AM-TV, WMUN FM, Muncie, Indiana — The story of the first commercial UHF-TV station to apply for remote control on a regular basis.
Remote Control Systems . . . How They Work

by Philip Whitney

Transmitter remote-control systems are either wire-line or radio. The latter classification covers operation through a microwave link and, in some instances, control of an FM or AM station by another FM station.

Wire-line systems can be either tone- or DC-operated. In tone-type systems, tuned circuits or resonant relays at the receiving end separate the various functions. Often, a system will embody both tones and DC, with the tone operations controlling transmitter functions and with meter readings returning as DC.

The basic remote-control system needs to perform five basic functions:
1. Turn the transmitter on and off
2. Provide a "fail-safe" circuit that will remove the carrier if trouble develops
3. Adjust the transmitter power control
4. Return selected meter readings to the operating point and display them, and
5. Provide for frequency- and modulation-monitor operation either at the transmitter or at the control point. If monitoring is at the transmitter, readings must be brought back to the control point via the metering line; if at the studio, accurate linear RF amplifiers must be provided for monitor operation. Metering information may be brought back from the remote transmitter:
   1. On a subcarrier
   2. As a subcarrier
   3. As voltage-differentiated DC, or
   4. As signal voltages, either 60-cps or other tones, each representing a different meter indication. In some cases, the control or the metering circuit uses a single conductor with earth-ground return; this system, however, is often subject to problems caused by stray ground currents and by changing ground resistance.

Every station has a different set of requirements and conditions. Some station chiefs want filament voltages monitored for optimum tube life. Others, with directional antenna systems, require multiple antenna-current and phase readings. As with any electronic equipment, the simpler a remote-control system can be, the better. Instead of solving problems, complicated equipment often adds to them.

**Wire-Line Systems**

The earliest wire-line broadcast remote controls were uncomplicated DC systems (Fig. 1), patterned after telephone-company practices. In some, step-switches selected among many meter readings, and each reading was returned back through the line in sequence. These step-switches could be operated by a telephone dial or a push button.

As systems became more com-

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Fig. 1. Single pair of telephone lines can be used to link together parts of a system that will control several transmitter functions.

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Complicated, added functions were accomplished on the same two-wire line, using voltage differentials (Fig. 2). These functions operated in sequence from low-voltage through intermediate- to high-voltage levels, or from about 15 volts to something in the area of 100 volts. Many telephone companies required that potentials be kept below 70 volts; others allowed as high as 150 volts at specified milliamperes of current. The lowest voltage pulled in the filament-control relay, the intermediate voltage operated the plate-voltage relay, and the highest voltage actuated the metering stepper. Relays were made sensitive to various voltage levels by resistors in series with their coils. Today, this voltage-selectivity can be handled by zener diodes.

Next came the polarity-differential system (Fig. 3) using diodes connected forward and backward to allow current to flow through the proper relays. Two power supplies, one positive, the other negative, were part of the studio control equipment. Even newer DC systems control functions by current differential (Fig. 4), time differential (pulses) (Fig. 5), and sequential relay-lockout devices in cleverly designed circuits.

Modern control devices usually embody the best features of all the earlier systems. Most of today’s DC systems combine more than one means of differentiation (Fig. 6), and a few use both DC and tones. One advantage to a dual system is that a DC “fail-safe” voltage can be maintained on the line along with the control tones.

One simple remote-control system utilizes a time clock to switch on transmitter filaments at a predetermined hour. The control-point operator needs only to switch on the transmitter high voltage. More than once, this system has kept a late-arriving morning man from ruining mercury-vapor rectifiers after a cold night. This basic system would return only four meter readings, on a DC line. There would be:

1. Final plate voltage
2. Final plate current
3. Antenna or output indication, and
4. Tower-lights indication.

A geared-down motor, remotely actuated, would raise or lower transmitter power by adjustment of final excitation or of plate or screen voltage, or occasionally by changing final loading. It is possible to hold transmitter output power within a close tolerance.

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automatically. An RF-output sampler feeds a bridge circuit where the resulting DC is compared with a standard voltage. A servo motor can maintain transmitter output to a closer tolerance than could an operator.)

One of the earliest uses of tone methods (Fig. 7) was in the Hammarlund "Fleet Control" tone system—Fig. 8—which was later adapted to broadcast remote control. It used a separate tone in the midrange audio spectrum to control each transmitter function. The Gates RCM-20 was similar to this. Both had stable oscillators at the control end, with tuned circuits, diodes, and relay-control tubes at the transmitter. Each relay closed as its specific tone was sent down the line.

Another frequency-selective control device (Fig. 9) was developed by Link. Still another company designed a control system around the tone-squelch they use in communications receivers, with frequency-sensitive relays. This remote control worked well in communications systems and in model-airplane control, but has never been widely accepted in broadcast work.

**Radio Systems**

Unfortunately, every transmitter location is not blessed with accessibility to telephone lines. This is true most often of FM transmitter sites on mountain tops. This made necessary the first remote-control system to operate through a microwave link.

First development in this area occurred in 1950 when WRFL, a Virginia FM station, worked on an experimental basis with the FCC. The system they devised brought meter indications back as a subcarrier on the main FM transmitter. With some modification, this system still functions today and is the basis for certain other commercial systems.

In the WRFL installation, a 20-kc metering subcarrier, generated by a stable phase-shift oscillator, was amplitude-modulated by DC meter samples (Fig. 10). Metering samples were introduced into the modulator-tube grid circuit to buck the normal negative bias voltage. Both the samples range and the normal bias were chosen so that tube operation remained near the knee of the curve, making possible expanded scale readings.

Plate-voltage sampling was by a simple divider (Fig. 11A) made from 4-watt high-voltage resistors; plate current (Fig. 11B) was sampled across a resistor in the ground return of the final-amplifier cathode circuits. Tower lights were sampled by reversing a heavy filament transformer— Fig. 11C—and rectifying and filtering the output. Transmitter output power was sensed (Fig. 11D) with a small "hairpin" in the transmitter "bazooka" output-coupling loop, which fed RF to a vacuum-tube rectifier. Because heater variations in vacuum-tube rectifiers can distort accurate RF sample readings, modern manufacturers almost universally use solid-state diodes.

Back at the WRFL control point, a simple tube amplifier (Fig. 12) with high-pass filter picked the sub-

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*Fig. 6. Eight remote-control transmitter functions are handled by this complex DC system on a single pair of audio lines.*
Fig. 7. Single-line remote control uses a separate tone oscillator and corresponding tuned relay for each function controlled.

Fig. 8. The basic circuit of this old Hammarlund signaling device can be changed for a broadcast-type remote control system.
carrier from an FM tuner's discriminator, before it reached the de-emphasis circuit. A diode converted the amplitude-modulated superaudible tone into DC readings on a 500-ua meter. The station monitor, a combination monitor for frequency and modulation, was placed in the studio and fed from a five-stage broadband TRF amplifier (Fig. 13).

Systems have been designed which use a carrier-break dialing system on the carrier of the 900-mc microwave link. Using normally closed .1-second telephone dials, the carrier is broken in a short series of pulses which are nearly inaudible. The receiver "Codan" relay responds to these pulses, operating a stepper which is automa-

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Fig. 9. Selective calling device built by Link (company now out of business) could be used for simple remote-control system.

Fig. 10. Sampling system converts readings to amplitude changes.

Fig. 11. Deriving DC samples to be used by metering circuits.
TO DISCRIMINATOR 
OF FM TUNER

Fig. 12. Vacuum-tube model of subcarrier metering section of FM receiver has TV linearity coils as interstage tuned circuits.

physically reset after 15 seconds by a timer.

Since many FM transmitters are situated on mountain tops and FM antennas can be seriously affected by ice formations, some stations add weather-sensing devices to their meter readings. One system brings back all the necessary transmitter operating parameters, plus an intrusion alarm and temperature, humidity, and an indication of the presence of rain or ice. Temperature can be sensed with a thermometer, and humidity sensors are readily obtainable from electronics-supply houses. Rain gauges have been standard weather equipment for years.

When a transmitter is required to operate at some distance from the control point, it is good practice to install as many automatic protection and recycling devices as possible. Silicon rectifiers have often been substituted for vacuum-tube rectifiers, after special care is taken to suppress lightning surges. This means surge capacitors on the line, with Thyrite arresters and special grounding to kill steep waveform that develop on long power lines.

At WRFL, all silicons in the small equipment were installed with a 300% or better rating. Mercury-vapor rectifiers were retained in the transmitter, but the 8008's were changed to 673's. Circuit breakers were substituted for fuses in the main supply lines, and sensing circuits were installed to detect when

Fig. 13. Booster used to operate frequency-and-modulation monitor must be capable of furnishing several watts of RF power.

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the breakers were open. If they opened for any reason, a timing device recycled them five times; if the overload persisted, the breakers remained open. Automatic recylers (Fig. 14) were also installed for transmitter overload relays.

When a new transmitter was purchased for WRFL, the old one was retained as a standby; it can be switched on by remote control, too. A second emergency antenna, which is mounted on a power pole at the transmitter site, was also installed.

A 26-mc System

The FCC provides a licensing provision whereby a two-ray radio system may be used for remote control. The frequencies allowed for this type service are in the 26-mc remote-pickup broadcast band. No frequencies are available in the 150-mc and 160-mc bands. The 26-mc band can also be used to bring meter readings back from the transmitter site by telemetry; however, tropospheric skip effects make such systems somewhat unreliable.

In a radio system, the “fail-safe” device is generally a “Codan” relay in the link receiver. “Codan” stands for Carrier Operated Device, Anti-Noise. It is a relay control circuit actuated by the voltage which appears on the first limiter grid in the receiver. When there is no signal, limiter voltage disappears and the relay opens. The contacts are wired to hold the transmitter plate relay on throughout the broadcast day. When the link carrier is shut down at the conclusion of the broadcast day, the transmitter carrier is automatically cut off. If the link fails for any other reason, the transmitter is likewise shut down.

Other Systems

One interesting remote-control system evolved in New York State from the original WRFL supersonic system. There, a complete network of FM transmitters were operated from one another, with one transmitter controlling all. Each station had a tape recorder for its own station identification on cue, but otherwise all carried the same program. One interesting feature of this system was a set of triple-conversion frequency monitors, one for each station, but all driven by one RF amplifier with an 815 tube in the output stage.

Another unusual remote-control system operated experimentally in Pennsylvania some years ago. An AM location was selected, and, after construction began, it was found impossible to provide telephone line service to the location. Subsequently, the station applied for an FM grant, and then fed the AM transmitter programs through the FM transmitter, which was located at the studios. Supersonic tones on the FM station controlled the AM functions. The FM receiver at the AM transmitter was outfitted with a “Codan” relay so that when the FM left the air, so did the AM. The biggest obstacle was in getting the AM meter readings back to the studio. This was accomplished finally by using a 12-kc subcarrier on the AM which, when cued from the studio, automatically sequenced through all meter samples during a period of a few seconds.

![Fig. 14](image-url)
Remote Metering

The FCC, in their Rules and Regulations, specify that transmitter metering must be accurate within 2%. They further describe scale and division limitations for the meters. In remote-control work, it is not always an easy task to retain this 2% accuracy when the metering system involves a sampler, an oscillator, a modulator and transmitter, a radio receiver, a metering amplifier and detector, and finally, the panel meter itself. All of these components are necessary in a radio remote-control system; therefore, a great amount of care is necessary in design and construction of such a system to bring the transmitter meter readings back to the control point accurately.

The problem is somewhat less when a wire circuit is used, but this, too, has its drawbacks. Wires have a way of changing resistance with temperature — Table 1. unwanted AC and DC currents can be induced into the lines and, the longer the line, the greater the problem. AC develops when lines run parallel to power lines; DC components appear with leakage, especially from dampness or water in a cable. Strange ground currents accompany solar storms and displays of Northern Lights, and are affected by the proximity of electric trains and other phenomena.

Therefore, it is almost mandatory that any remote metering system be self-calibrating or have provision for calibration, so that the sequence of meter readings can be verified each time they are made. To check calibration in most systems, the first metering position is used for a measurement of the overall system by comparing a system reading with a standard cell or a mercury-type calibrating battery. The system is adjusted to this known voltage; then all other parameters can be read with accuracy as they appear in sequence.

Generally, all transmitter meter readings are sampled independently and presented as a DC voltage. Several means of deriving these DC metering samples were shown in Fig. 11. In a wire system, the metering voltage is fed through the line back to the meter. In a radio system, this voltage modulates the telemetry system. Fig. 10 illustrated a vacuum-tube subcarrier generator and AM modulator. This device automatically sequences through all needed meter samples, remaining on each reading a predetermined number of seconds necessary for reading by the control-point operator. Since each meter reading is normally somewhat different from the preceding one, there is no trouble detecting when the sequence switches from one sample to the next. When the device has cycled through all readings, it returns the stepper to "home" and shuts itself off to await the next cycle.

The subcarrier frequency is about 20 kc. At the control point, the metering information is picked off the air with a crystal-controlled FM broadcast receiver. The 20-kc subcarrier is removed before the deemphasis network and fed into the amplifier diagramed in Fig. 12. The recovered DC operates the meter (preferably a 7" or larger), which has several scales calibrated on its face.

Some DC wire-line remote controls offer separate meters for each transmitter meter. This necessitates providing a separate wire circuit for each meter. It can also be done by simplexing and providing phantom circuits from the telephone pairs between studio and transmitter. Such a system is illustrated in Fig. 15. This system carries both tone and DC metering signals in the same line, separated by chokes and capacitors.

Some DC wire systems provide separate meters that cannot be read simultaneously. A step-switch at both ends of the line synchronizes each metering sample at the transmitter with its appropriate meter at the control point. A little-known system of this type was developed by a Maryland station using a synchronous commutator.

![Fig. 15. System for program, control, and four metering samples on two wire pairs.](image-url)
Fig. 16. Subcarrier transmitter used at WRFL for FM telemetry couldn't overcome problem of frequency shift with temperature.
the transistors quite seriously altered oscillator frequency. The overall system held calibration during the period while a metering sequence was being read, but it was felt that more stability would be desirable.

The FM/FM system was picked up for its advantages over an AM/FM system: Noise could be limited out. Harmonics of the audio program, which sometimes cause slight meter movement, could be almost eliminated in FM/FM by limiting and by using sharply tuned input circuits in the receiver (Fig. 17). System linearity is not such a problem with FM telemetry as with AM. Part of the system's ability to recognize the differential - excursion from the resting frequency - lies in the two tuned circuits at the receiver's input, although part is also due to action of the counter circuit in the output stage. Between the two, a satisfactory meter indication can be obtained with a comparatively small frequency shift in the oscillator.

When the system's frequency-shift-temperature weakness was discovered, it was necessary to decide whether a more stable type of FM circuit should be designed or the system should be returned to the old AM system, which is insensitive to frequency problems. After considerable thought, simple changes were made in the FM/FM system to change it to a transistor AM/FM system with certain refinements over the old tube-type setup.

Fig. 18 shows the final circuit. Modulation of the 20-kc output of the oscillator-buffer circuit utilizes the way a diode's resistance changes with applied voltage. The bypassing effect of capacitor C1 in the circuit is made greater or lesser by the varying resistance of the 1N60 diode in series with it. The diode's resistance is controlled by application of the positive sampling voltages through isolation resistance R1. Resistor R2 was installed across the diode to minimize resistance variations among the sampling circuits, which can distort the true effect - caused only by voltage variations.

Added refinements are the two zener diodes - X5 and X6. These keep the input carrier constant at the modulator device. One zener regulates the DC voltage on the oscillator collectors, the other levels off variations of oscillator output so that errors from signal variation are minimal.

Using the AM system, meter readings have held within 1% over a 5-hour period without the necessity to recalibrate. Since subcarrier modulation is kept constant at the transmitter, and thus subcarrier recovery at the discriminator output of the FM receiver at the studio is also constant, the AM system has proven stable enough to meet present needs. At WRFL, however, it is still felt that an FM/FM system would be preferable if an oscillator could be designed which is stable enough and at the same time easily frequency-modulated by sampled voltages. There is little doubt, of course, that such a system would be somewhat more complicated than the simple system which is now in use.

Tube burnouts and deterioration no longer are problems, because of the transistor equipment; on the other hand, the equipment is somewhat more susceptible to lightning-induced surges which have sometimes opened diodes and transistors in an unexplained manner. Therefore, extra protection is used to keep line surges to a minimum.

**Conclusion**

Many other remote-control arrangements are possible. Those shown in the two articles in this book section are only a few of the possibilities. Careful and adequate design and calibration can solve almost any remote-control problem.
Most important in these articles, however, are the principles of remote-control systems — in particular, the ideas that introduce this first feature. Keep them in mind when you are designing, building, specifying, choosing, buying, or installing a remote control for your station.

Table 2, at the right, lists some of the systems that have been developed. There are others, and a careful study of the ads in BROADCAST ENGINEERING will regularly give you information on the most modern systems.

### Table 2 — Remote Control Systems

<table>
<thead>
<tr>
<th>Manufacturer</th>
<th>Type No.</th>
<th>DC or Tone</th>
<th>Meters at Control Point</th>
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<tr>
<td>Hammarlund</td>
<td>RCR5, 10</td>
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<td>Tone System</td>
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<td>Gates</td>
<td>RCM-20</td>
<td></td>
<td>3</td>
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<td></td>
<td>RDC-10</td>
<td>DC</td>
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<tr>
<td></td>
<td>RCM-12</td>
<td>Dial Tone System</td>
<td>3 plus remoted meters</td>
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<td>Rust</td>
<td>R1-108-10, 0C, 1C</td>
<td>DC Dial System</td>
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<td></td>
<td>108-S-1</td>
<td>DC System</td>
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<td>Schaeffer</td>
<td>Economy</td>
<td>DC Dial System</td>
<td>1</td>
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<td></td>
<td>Deluxe</td>
<td>DC Dial System</td>
<td>4</td>
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<tr>
<td>Continental</td>
<td>TRC-5 and S</td>
<td>DC System</td>
<td>1 plus remote monitors</td>
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<td>Mosely</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bionic Instruments</td>
<td></td>
<td>DC-AC</td>
<td>4</td>
</tr>
</tbody>
</table>

Development engineering opening in broadcast studio color equipment design.

If you are capable of electronic design or have sufficient station experience and technical background to learn, tell us about yourself.

Opportunities also for field service engineers.

Reply Box No. 140
BROADCAST ENGINEERING
4300 W. 62nd St., Indianapolis, Indiana.

1. "LINE SELECTION" AT TV FIELD RATES
2. OSCILLOSCOPE TRACES DIRECTLY ON THE SCREEN OF NORMAL TV PICTURE MONITORS

The CVI model 301 Video Analyser uses modern digital television techniques to generate a clear, single trace, easy-to-interpret, video waveform which for the first time allows vertical analysis of TV image. No sync problems or faint traces due to low duty cycles either.

**2 breakthroughs in video waveform display**

Tired of squinting at the "grass" on tiny scope screens? Lean back and enjoy a bright, easy-to-look-at, waveform superimposed on the picture of your favorite 14 to 27 inch monitor. Direct correlation between picture and trace, too, plus remote control of the "line selector" positioning and a second marker providing 'cross-hair' identification of picture elements.

Clamped waveform, internal calibration, a reference grating generator, and silicon design are among the other features. Rack space only 3½ inches. Write or call for full information.

CVI MODEL 301 VIDEO ANALYSER . . . $875

COLORADO VIDEO, INCORPORATED • 2991 PEAK AVENUE • BOULDER, COLORADO • PHONE (303) 444-3972

Circle Item 68 on Tech Data Card
Live couldn't.
Scotch® Brand Video Tape did.

Kept ice cream from melting for KAKE-TV!

Video tape makes sure the ice cream always looks its most appealing on tv. Pleases the sponsor, Steffen's Dairy. Brings in the customers. And makes the commercials less expensive to produce.

Used to be at KAKE, Wichita, the ice cream dishes were set up under the lights prior to the 10 p.m. news. But began to melt before the mid-program commercial. Adding an extra man to put the ice cream in place at the last second was considered. But going to video tape proved both more convenient and less expensive.

KAKE now tapes virtually all evening commercials by local clients in advance. Less crew is needed during the evenings. The advertiser enjoys greater control over his commercials. And the commercials themselves have live picture quality without danger of an on-the-air goof.

KAKE is among more than 200 stations throughout the country that are utilizing 3M's video tape program to show advertisers that taped commercials best show their merchandise. Stations near you are now offering a variety of helpful reference materials as well as production service. Give them a call. Or write 3M Magnetic Products, Dept. MBX-25, St. Paul, Minn. 55119.

Circle item 69 on Tech Data Card

October, 1965

3M COMPANY

Magnetic Products Division

3M COMPANY

October, 1965

Circle item 69 on Tech Data Card
Once the decision was made at WLBC-TV to increase UHF transmitter power, a number of problems immediately presented themselves.

The major problem was sufficient space to install the new equipment. Space was already at a premium. Expanding the present building was ruled out; not only would this idea be prohibitive in cost, but we did not wish to disrupt our AM and FM operations.

There were a number of reasons for ruling out expansion in the present transmitter area. On the outside of the building, numerous conduits carried AC power to the tower lights, emergency power circuits, and the emergency power generator, not to mention the coaxial transmission lines for the AM and FM transmitters. Far from least of the reasons was the utility pole which supported our highline, the main power transformers, and the telephone company's audio and video coaxial lines.

An additional space somewhere other than the present transmitter room seemed to be the best alternative. However, such a choice could increase operating costs through the additional personnel needed to operate a separate transmitter site. Fortunately, there were two factors which made the room-addition idea practical: the recent FCC Rule changes which permit UHF stations to operate by remote control, and the "new generation" UHF transmitters which are built for remote control.

And so the decision was made to build a small room attached to our present building, accessible by a small corridor, to house the new equipment. Also, we would apply to the FCC for remote-control authority along with our CP for the new transmitter.

A quick glance through the catalogs of commercial remote-control units available at that time did not turn up a model that was suitable for the particular system we had planned. We therefore decided to build our own and specified this in our application.

Fig. 1. Schematic of remote-control system built by WLBC-TV station engineers.
When our decision to go remote on UHF was made known, there were raised eyebrows in various circles, including some at the FCC. We also discovered that we submitted the first request for a commercial UHF station to operate by remote control on a regular basis. There have been several experimental authorizations in the past, for evaluation purposes, but ours was the first regular application.

Control Unit

Basically, our system is a directwire remote control. All the required metering and essential control functions operate through a cable between the remote unit and the transmitter itself. Such a system is simple and offers many operating advantages. One such advantage is that all the metering can be done simultaneously on individual meters, rather than via some sequencing method on one meter. Naturally, this increases the basic cost and number of circuits required. However, our system with all its meters and multiconductor cable priced out at about $500 plus a few meters we already had on hand. We thought this reasonable enough, considering we could get constant metering information and the unit was custom-made for our installation—the price was in fact lower than adapting a commercial system for our use.

Components

Obtaining the various meters was something of a problem, mainly because we had difficulty obtaining information on what energy would be available from the samplers in the transmitter (the transmitter we were buying was a brand-new model). After a number of phone calls to the transmitter manufacturer, we learned that the basic meters would require 200-ua DC movements, and that the power meters should have 20-ua DC sensitivities. We also were told the full-scale readings of the regular transmitter meters. We did not have the transmitter on hand during this design period, but we had to have the control unit ready so that the transmitter could be set up with it at the very beginning.

We wanted our remote meters to have the same scale readings as the meters on the transmitter itself; that is, if the transmitter meter reads 5.5 kv at full scale, our remote meter should also read 5.5 kv, instead of some arbitrary figure such as 100%. (Naturally, this voltage is not present at the remote meter, but the scale is drawn with the same designations as are used on the transmitter meters; the basic movement is 200 ua DC, and only a very small actual voltage is present.) Having these special scale designations applied to standard DC meters was not very expensive. In our case, we obtained four of these meters at a cost of $18.35 each—the total cost for the meter plus the special scale. Scales of different colors cost more.

The meters for indicating output power for the visual and aural transmitters were no problem at all; we could use the same standard meter as is used for the transmitter reflectometers. We had two of these on hand which were spares for the old transmitter. One was new, while the other was used but had been sent away for calibration. Although these spare meters were somewhat different in styling than those on the new transmitter, the basic movement was identical, as were the scale markings.

Carrier-frequency and modulation monitoring of the aural transmitter and carrier-frequency monitoring of the visual transmitter is necessary. For these meters, we used the standard remote meters supplied by the manufacturer of the monitor. Here again, we already had these; they had been in use at the control position for the old transmitter.

Monitoring the visual modulation was simplest of all. As we were already monitoring the old transmitter at the control position, the chopper, waveform monitor, and picture monitor were already in operation. All we had to do to put this setup into use for the new transmitter was to run a video coaxial cable from the diode of the new transmitter to the old control position.

The control cable joining the remote unit to the transmitter did present a problem; it was difficult to find a suitable cable and source. We could have laced a number of smaller cables together to form a larger cable of the correct number of conductors; however, we preferred to have a single cable. We finally did find such a cable, somewhat expensive, costing approximately $1.33 per foot. This cable was completely shielded, which was another factor we favored.

Our original estimate of how many conductors we needed proved to be wrong. This was because the new transmitter used some common control functions which we had not anticipated. We had already built the remote-control unit and wired up the cable before we learned of this, so we ended up with several spare conductors and switches. We originally expected to have a dual monitoring unit—one for the aural

---

![Fig. 2. Addition placed new transmitter out of view from TV control room.](www.americanradiohistory.com)
and one for the visual—with separate meters, switches, and relays. As it turned out, we have two separate 38-conductor cables from the transmitter to each unit, with some circuit functions in each cable. A single 38-conductor cable doesn't provide enough circuits for all the functions required.

**Circuitry**

The circuitry throughout is simple and straightforward. Sampling devices in the transmitter supply low-voltage, low-current DC to operate the meters as with most remote-control systems. The 200-ua meters have 5000-ohm potentiometers in series for calibration.

The meters that indicate frequency and modulation are wired in series with the meters in the monitor itself, the normal practice for this sort of application. No calibration resistors are needed, for calibration is done at the monitor itself. These meters must have the same scale and movement characteristics as those in the monitor, so we used regular monitor meters.

All the switches are momentary-contact types. We used the double-pole type with which both a normally open and a normally closed circuit are available, because we were not certain at that time if the switch functions for this new transmitter would be normally open, closed, or a combination of both. As it turned out, all functions needed a normally open switch, with only momentary closing for operation.

Adjustment of transmitter output power to overcome power-line variations, etc., is accomplished in the new transmitter by two motor-driven RF potentiometers, one in each transmitter. This required four switches, two to raise and two to lower power. As all our remote-console switches are momentary-contact, nonlocking types, it is necessary to hold the appropriate power-control switch down until correct output power is obtained from that transmitter.

We used small neon lamps for indicators at the remote unit. These operate on 120 volts AC, which was picked up from a terminal board in the transmitter so that each lamp operates only when its counterpart on the transmitter is on. Actually, we found it unnecessary to repeat all the control lamps which are on the transmitter; we used only three: Plate Ready, Plate On, and Overload.

A small filament transformer was built into the remote unit, with the 120-volt primary AC supplied from the transmitter. The secondary supplies 6.3 volts AC for all the other pilot lamps and meter lamps in the remote unit. The primary voltage will be applied to the remote console only when the transmitter is turned on; thus the pilot lamps indicate that AC power is applied to the transmitter even though the plate circuit may not be ready.

FCC Rules require that any remote-control unit must be so designed that the transmitter will shut down if anything happens to the control circuits to the remote unit. In our unit, we carried the transmitter interlocks through both the cables and back, so that the transmitter will shut down if either control cable parts.

**Operation**

Although all the necessary functions of starting the transmitter can be accomplished from the remote control point, we don't use this procedure. Our sign-on technician fires
up the transmitters out in the transmitter room. This measure is somewhat precautionary, since the transmitter is a new model. Should any overloads occur, he can observe at first hand anything out of the ordinary, as well as see quickly any meter readings that are normal or abnormal. This startup procedure works no real hardship, since the transmitter is only in an adjacent room, even though it’s out of sight from the control point.

Prior to actual use of the new transmitter, we had misgivings about its stability. We expected our control operator would be making trips to the transmitter room throughout the day, as he did with the old transmitter, touching up the cavity tuning of each stage to keep output power within range and the several stages in tune. But our fears were unfounded: the only time it has been necessary to retune a stage has been at tube-change time. We occasionally go out to the transmitter and rock one of the PA cavities through resonance, just for old-times’ sake. The tuning is always right where it belongs—in tune. Such stability of the tuning circuits does make remote-control operation a very practical matter.

Naturally, with the first of any new-model transmitter, bugs will develop from time to time, and we have had our share. However, the only one that affected remote control was a sampler. This particular sampler, for the aural plate current, was hastily designed during installation so that we would have all the required meter readings. It worked okay, except that it was sensitive to temperature changes in the cabinet. This caused the remote meter to have to be recalibrated several times during each day. A new sampler has since been installed, which is very stable. It is a magnetic amplifier, which has no direct connection to the high-voltage circuit, but instead senses the magnetic field of whatever current is flowing in the plate lead.

Any remote-control system must be calibrated at least once a week, as required by FCC Rules. Our calibration checks have proved very close every time, and only an occasional touchup of one or the other meter calibration has been necessary.

The transmitter room is kept locked at all times—both the outside door and the door into the regular building. This is also an FCC Rule (and a good one). Its purpose is to prevent unauthorized people from tampering with an unattended transmitter. The key to this room is kept at the control position, and the technician can get to the transmitter immediately if anything goes wrong out there. As a safeguard against someone locking the key in the transmitter room (the door locks automatically without a key), a spare key is kept inside the remote console cabinet.

As this is written, we have had the new transmitter operating on remote control, under Program Test authority, for over four months. We have decided we made a wise choice in this method of operation. The metering and control functions have proven effective, and the transmitter has been stable. We have not had to increase our technical staff at all to operate the transmitter in a separate location. There has also been another bonus feature: Both the noise of blowers and the heat from the transmitter have been removed from the transmitter control room.

Conclusions

Some people contend that our method of operation is not really remote control. But it is. Although we can imagine the problems that may arise in trying to situate an unattended transmitter out of town or on a mountain far separated from the studio, we are happy we did not have to face and solve those particular problems. But for any location where the transmitter can be controlled over a direct cable, as we are doing, our installation has proven that it can be done, and very successfully.

STOP

you lost your turn by missing our ad in the September issue. Go back and look at page 26 for NEW REMOTE CONTROL from BIONIC INSTRUMENTS, INC.

Circle Item 25 on Tech Data Card

\[ \text{SR-24-15} \]

Replaces the 869B

- Plug-in No Rewiring
- Nonencapsulated
- Each Diode Replaceable
- Safe and Self Testing:
  Each Diode Has a GO-NO-GO Light to Warn of Failure and High Volts on.

SPECIFICATIONS

<table>
<thead>
<tr>
<th>PRV Repetitive</th>
<th>24 kV</th>
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<tr>
<td>PRV Transient</td>
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<tr>
<td>Max. Current</td>
<td>22 A</td>
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<tr>
<td>Surge Current</td>
<td>200 A</td>
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<tr>
<td>Max. DC PS Volts</td>
<td>16 kV*</td>
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* In 3 phase full wave bridge

Wilkinson Electronics, Inc.
1937 W. MacDade Blvd.
Woodlyn, Pa. 19094
Telephone: 215-874-5237

Circle Item 24 on Tech Data Card

October, 1965
"Listen to me!" it says, "things are happening! Good things!" Things that make the public turn the dial—to your station if you're quality-ready. For today's FM audience is a selective group, largely of mature tastes and preferences, with the means to enjoy them. And they want quality—all the way.

Today there are more FM radio frequencies, more good high-fidelity receivers for listeners to choose from, and RCA system-matched "New Look" equipment to put your station out front in quality... New full-fidelity FM transmitters designed to transmit stereophonic signals, an SCA multiplex sub-channel; also new transistorized tape recorders and turntables; consolettes to meet NAB standards for highest performance and programming efficiency. Also newest in FM antennas—Horiz...
IN TODAY'S FM OPERATIONS!

horizontal, Vertical and Directional—for spreading the signal where it counts most.

Your RCA Broadcast Representative will be glad to tell you all about these fine new opportunities for moving ahead in quality. Two Brochures are available . . . Planning for the "New Look" in FM and FM Stereo; and RCA "New Look' FM Equipment. Send for your copies. RCA Broadcast and Television Equipment, Building 15-5, Camden, N. J.

RCA "NEW LOOK" CONSOLETTES & TRANSMITTERS

The new consolettes, turntables, transmitters and antennas are designed for today's demanding operating requirements. Transmitters have all new circuitry, new exciter.
solid-state television intercom system

performance-proven by broadcasters throughout the world

Literally dozens of McCurdy Solid-State Television Intercom Systems are in use by large and small TV stations. Each McCurdy intercom system is one of a kind — custom-designed for a station's specific applications — yet is turned out with the efficiency and economy of a mass-production item. The secret is in McCurdy's advanced design concepts and the use of standard modular components which can be completely assembled, wired and tested prior to installation...saving the high cost and headaches of on-site construction!

Couple this with minimal maintenance requirements, low power consumption and solid-state space savings...and you can see why McCurdy is proud to offer this as part of their complete line of audio products for the television industry.

Why not let McCurdy mass-produce your one-of-a-kind Television Intercom System?

Helical Antennas

(Continued from page 22)

antenna, the power distribution is adjusted by the probe spacing to the inner conductor. For the VHF antenna, it is accomplished by employing power-divider tees in the transmission lines between sections.

Large degrees of null-fill-in will reduce antenna gain; however, the advantage of a higher signal level over the close-in areas usually justifies the loss in gain.

Conclusion

Though merely scratching the surface of the subject, this article has sought to point up the general mechanics and operation of the side-fire helical antenna. The antenna offers simplicity of construction for the high gain achieved through excitation of a large aperture by a single feed.

Bibliography


MOVING?

Don't Lose Touch...

Receive B-E as usual at your new address
Write:

BROADCAST ENGINEERING
Circulation Dept.
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Indianapolis 6, Ind.

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356 west 40th street • new york, n.y. 10018 • (212) 736-5840

keeps you in view!
To what lengths must a cable manufacturer go to prove his product is better?

As long as the distance between your amplifiers - even up to one-half mile continuous lengths.

When Times Wire and Cable decided to build a CATV cable to outdistance any other in length and performance, we really went all the way: We built a cable that can span the entire distance between your amplifiers.

However, it's not just that Times JT-1000 CATV cable is longer that makes it better. It's also continuous. It's seamless for the entire length. And it's aluminum. Put them all together and you have continuous seamless aluminum tube sheath CATV cable in lengths up to 1/2 mile long - a feat nobody else has yet been able to match!

Here's what these new longer lengths mean to your CATV operations:

- Easily saves you 16% installation and shipping costs. Longer lengths mean fewer splices - 8% saved. Another example: Only 1 reel needed for 2,500 feet of cable instead of 1 reel for each 1,000 feet - another 2% saved.
- Times seamless cable is waterproof. Puneture it, splice it, apply as many pressure taps as you like. Water vapor and/or water can't travel in Times self-sealing solid sheath cable. Complete dielectric adhesion to center conductor and complete compression seal to outer conductor eliminate longitudinal vapor or water paths.
- Times cable gives you minimum return loss guarantee. Your choice of guaranteed 26 db or 30 db minimum return loss - a must for minimum ghosting, true color reproduction.
- Increases profit by decreasing splices and scrap. Fewer splices means less material wasted (fewer tailings), less maintenance needed, too. Less maintenance means less labor cost and more profit.
- And don't forget: long after so-called economy cable has been replaced (it starts deteriorating the day you install it), Times continuous seamless aluminum tube sheath CATV cable will still be a top performer, keeping pace with your system's planned potential.
- There you have it: the longer the cable, the fewer the splices, the lower the maintenance, the better the performance... and the higher the profits. Times did it all, with its new longer CATV cable... and we're shipping it right now!

Presenting the Times Family of Firsts — The Standards of the CATV Industry

First to design a long-life cable specifically for CATV. First with foam dielectric cables for CATV. First with cable that made all-band CATV systems economically feasible. First to offer 26 db minimum return loss guarantee for CATV. First again with 1/2 mile lengths of seamless aluminum sheath CATV cable.

TIMES WIRE & CABLE
DIVISION OF THE INTERNATIONAL SILVER CO.
Wallingford, Conn.

Transmission System Design and Engineering/Standard & Special Coaxial Cable/Multiconductor Cable/Complete Cable Assemblies/TeNoa Hook-Up Wire *A Du Pont Trademark

Circle Item 30 on Tech Data Card
FAIRCHILD RECORDING EQUIPMENT CORPORATION has been supplying to quality-oriented broadcast studios throughout the world, the ultimate in "engineered-in-depth" turntables. The continuing search for better quality has rewarded FAIRCHILD with a reputation for unsurpassed performance.

Realizing the vital fact that your station's turntables are the heart of your station's sound has prompted FAIRCHILD to introduce a series of unique belt drive turntables. These turntables provide truly inaudible rumble, wow and flutter coupled with a minimal moving parts design for low maintenance and high reliability.

Now FAIRCHILD offers three distinctively designed quality turntables to serve the broadcast industry...three new FAIRCHILD turntables unsurpassed in quality, performance and durability to give your station the sound that sells!

---

**New Vice-President for Engineering of NAB**

Vincent T. Wasilewski, president of the National Association of Broadcasters, has announced the promotion of George W. Bartlett from manager of the Engineering Department to vice president of the NAB.

---

Since succeeding to the top engineering spot at NAB, Mr. Bartlett has successfully conducted annual engineering conferences as part of the NAB conventions, has worked to update engineering rules of the Federal Communications Commission, and has guided the development of new technical requirements for disc and tape recordings. He serves on various industry committees and represents the American broadcasting industry at national gatherings.

Mr. Bartlett joined the NAB staff in September 1955, as assistant manager of the Engineering Department. He became acting manager in May 1961 and was named manager on September 21 of that year.

Before joining the Association he served for nine years as chief engineer at WDNC (AM-FM), Durham, N. C., during which time he acted as technical consultant to several TV stations and applicants.

Before World War II, he served with the Federal Communications Commission. During the war, he was a radio officer with the United States Maritime Service.

A native of New Bedford, Mass., Mr. Bartlett attended Brown University, Providence, R. I., and is a graduate of the Massachusetts Radio Institute. Boston. He is a senior member of the Institute of Radio Engineers, a member of the Society of Motion Picture and Television Engineers, and a licensed radio amateur.

---

**SOUND THAT SELL... START ON FAIRCHILD TURNTABLES!**

For over 25 years FXIRCHLD RECORDING EQUIPMENT CORPORATION has been supplying to quality-oriented broadcast studios throughout the world, the ultimate in "engineered-in-depth" turntables. The continuing search for better quality has rewarded FAIRCHILD with a reputation for unsurpassed performance.

Now FAIRCHILD offers three distinctively designed quality turntables to serve the broadcast industry...three new FAIRCHILD turntables unsurpassed in quality, performance and durability to give your station the sound that sells!
peak stereo performance
for FM STATIONS
with the aid of a Tektronix Oscilloscope

At Moseley Associates, Inc., an engineer uses a Tektronix Type 561A Oscilloscope to check performance characteristics of their FM Stereo Generator and Ten Watt FM Transmitter. Making adjustments and observing the waveform displays, the engineer tests generator transmitter operation quickly and conveniently, monitors equipment performance simply and reliably, and thus effectively evaluates operational features of the stereo instrumentation. High in performance, moderate in cost, the Type 561A ideally suits test applications of the FM Stereo Broadcaster. Whatever your broadcast equipment test needs, the Type 561A can very likely meet them.

For your test needs, there is a Tektronix Oscilloscope to fit every quality-assurance program — and comprehensive field services to back it up every instrument. For information, call your Tektronix Field Engineer or representative now.

You can use any of 17 amplifier and time-base plug-in units for many different types of applications. You can display single or multi-trace presentations. You can observe no-parallax displays and sharp trace photography over the full 8-cm by 10-cm viewing area. For the CRT has an internal graticule with controllable edge lighting.

Type 561A Oscilloscope

Plug-ins illustrated:

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15 other plug-ins available.

For rack mounting, in 7 inches of standard rack height, order Type RM561A

U.S. Sales Prices t.b. Beaverton, Oregon oscilloscope prices without plug-in units

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Tektronix Ltd., Edinburgh, C. I.

Tektronix U. K. Ltd., Harpenden, Herts.

October, 1965

Circle Item 28 on Tech Data Card
Radio Operators License Handbook: Edward M. Noll; Howard W. Sams & Co., Inc., Indianapolis, Indiana; 136 pages, 3½” x 8½”, paperback; $2.95 (Catalog No. RON-1).

As every manager of a radio station knows, the FCC operator requirements have been changed; holders of a Restricted Radiotelephone Permit may no longer operate a broadcast-station transmitter. Persons doing the routine operating must now hold a valid third-class license with a broadcast endorsement. This means that anyone who wishes to be a broadcast operator must pass FCC examination elements I, II, and IX. In addition, there are a number of types of stations that can be operated by holders of third-class licenses without endorsement (elements I and II only).

This text is designed to provide the student operator with the information needed to pass the appropriate examinations. Therefore, it does not go deeply into the technical aspects of radio transmission, but rather discusses the operating aspects.

The first chapter explains the requirements for licenses below second class. It also discusses the duties and privileges associated with each class of license and the Rules and Regulations applicable to all radio operators. Chapter two describes the various radio services and the grade of license required for each. Chapter three is devoted to radio broadcast operation. Enough basic technical information is included in this chapter to provide a background for the enumeration of the third-class operator's duties. Chapter four details the procedures necessary for obtaining each class of license below second class. Excerpts from Part 13 of the FCC Rules and Regulations (the Part applying specifically to radio operators) are included along with the addresses of the Field Engineering Offices. Chapters five, six, and seven contain questions and answers on elements I, II, and IX, respectively. Excerpts from the 1959 Geneva Treaty, the Communications Act of 1934, and the Rules and Regulations of the FCC are contained in four appendixes that conclude the book.

The author has written his text with a two-fold purpose. First, of course, it is designed so that mastery of the question-and-answer section will enable the reader to pass the examination elements for the license he seeks. In addition, background information is included which, if studied, will enable him to understand somewhat the why as well as the what of radio operating. This is not to say studying this book will make the reader a qualified maintenance technician—that is not its purpose. It does offer some extra knowledge that can help him be a better operator.

Scala Precision Antennas

* OFF-THE-AIR PICKUP — FM or TV
* LOW POWER UHF, VHF TV TRANSMITTING
* STL AND TELEMETRY ANTENNAS

Engineered to meet rigid FM and TV station specifications, and to endure the tests of weather and time.

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Circle Item 35 on Tech Data Card
To audio engineers

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This console designed and engineered for International Recording, Inc., Dallas, Tex.

Happiness is:
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recording console built in

module form.

It’s 16 microphone channels,
two echo channels and one

master control module.

It’s 16 Langevin MX113 slide

faders, plus four color coded

channel selector push buttons

for instant switching, and a

fifth button for reset which
disengages the microphone
from the system.

Happiness is more:
it’s a level

control and selector switch

on each microphone that al-

lows the echo to be fed either

before or after the mixer.

It’s 16 Universal Audio equal-

izers that gives individual mi-

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cessity in modern recording

techniques.

And it’s four A.P.I illuminated

VU meters and six West-

ton VU’s that show gain/re-

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composite output.

SPECIFICATIONS:

Frequency Response: ±0.5 db 20 to 20 KC

Distortion: .05% at +24 dbm

Signal to noise ratio: Equivalent to an input

signal of —123 dbm

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Circle Item 36 on Tech Data Card
We interrupt this magazine to bring you...

Late Bulletin from Washington

by Howard T. Head

New Program Form Adopted for AM and FM Applications

After more than four years of study and conferences with industry, the Commission has adopted a new programing section for its AM and FM broadcast application form. The new form requires detailed program information with each application for a new station, license renewal of an existing station, or transfer of control. The forms must also be submitted whenever major changes in station programing are undertaken.

In the new form, applicants are required to state the methods relied on to determine local programing needs. The Commission has emphasized that it expects broadcasters to ascertain community needs and desires, and to consult not only with the general listening public but also with leaders in community life and professional and civic organizations. Such efforts must be reported in the new application form.

The form is to be used for new applications beginning November 1, 1965. The same form will be used for all renewal applications which are due on or after November 1, 1966.

Considerably more detail concerning past programing is required than was the case with the previous application form, and it will be necessary to institute new program-logging methods to compile the statistical data required by the form. Consequently, the Commission has also changed the Rules on program logging to require the additional data. The effective date of the new program-logging Rules is set for December 1, 1965.

The new form relates to AM and FM stations only. Similar forms for television stations are in preparation, but are not expected to be ready before the end of the year.

Conference on TV Propagation Curves

At the request of the Association of Federal Communications Consulting Engineers (AFCCE), the Commission has scheduled a series of engineering conferences to study new television field-strength-vs-distance curves proposed for adoption by the Commission (July 1965 Bulletin). The
Commission wishes to obtain the views of all interested industry engineers, with particular emphasis on whether the proposed new curves represent any improvement over the existing curves in terms of correlation with available field-strength measurement data.

The consulting engineers' preliminary studies have raised a number of questions which should be resolved before adopting the modified propagation curves. These include the possibility that for most heights the new curves, like the old, predict average UHF field strengths greater than those indicated by actual experience. For extremely high antennas, there is some indication that the actual fields at both VHF and UHF are greater than the new curves indicate.

**Directional-Antenna Licensees May Get Relief**

Continuing to accumulate in the files of the Commission's engineers are field-strength measurement data indicating that in many areas of the country there are significant variations of fields with the season of the year. These reports have now become so numerous that the Commission's staff has under study some means of taking these variations into account. Recognition of this effect is of particular importance to licensees employing directional-antenna systems with close tolerances. In many instances, seasonal variations have been sufficient to raise monitor-point field strengths above tolerance values, requiring either continual readjustment of the directional antenna or the risk of a citation for out-of-tolerance operation.

Although the general pattern of variation indicates higher field strengths in the colder months, attempts to correlate the variations with such influences as temperature and rainfall have met with limited success. The existence of the effect, however, is by now generally well established, and there appears to be a reasonable prospect that the Commission may acknowledge the variations in establishing maximum permissible field values at directional-antenna monitoring points.

**Telephone Companies Active in CATV**

An increasing number of reports tell of instances where local telephone companies are undertaking to supply distribution circuits for CATV systems. Typically, the telephone companies propose to install all needed circuits which are then leased back to the CATV operator. Not only are the telephone companies seeking this as a source of revenue, but the companies and the CATV operators involved are taking the position that local CATV franchises are not needed, that the telephone company can operate under existing franchises.

The Commission's staff has moved to investigate various reports concerning CATV activity by telephone companies. A recent FCC staff letter was sent to the Attorney General of California, with copies to the Attorneys General of the other 49 states, requesting information concerning a recent California ruling on the subject. In the same letter, the Commission's staff also summarized the Commission's CATV policy, and expressed the hope that local authorities would take into account the fact that the Commission has under consideration federal regulation of all CATV (June 1965 Bulletin).

Howard T. Head...in Washington
Tool to Burnish
Phone Jacks

by Ernest Schaufler, Staff Engineer, WHN, New York, N. Y.

How many times, while manipulating a patch cord in and out of the jack strip, have you wished for a simple burnishing tool to get between those elusive normal points? Here is such a tool made from junk-box materials. It consists of a scrap of brass rod cut from a volume-control shaft, a 6-32 screw, and a small strip of thin metal. When the tool is inserted in a jack, the screw head lifts the upper leaf allowing the burnishing strip to slide between the points.

 Mono Playback From Stereo Cartridge

by John M. Rhodes, Rochester, New York

A monophonic FM station, with a library of mono records, was considering conversion to stereo and wished to start building a stereo library, to be played monaurally with a stereo cartridge until switch-over. They had been using Gates turntables with G-E mono cartridges. The station installed high-priced stereo cartridges, but the results were somewhat unexpected: stereo lights flickering, high-frequency response too sharp, etc.

In the Gates turntable preamp, RIAA bass equalization is achieved by a frequency-selective feedback loop. The high-frequency rolloff is produced by the cartridge load resistor, in this case 6.2K for the G-E units. The new cartridges incorporated built-in matching transformers, and the recommended load was 47K.

Out came the AC VTVM and RIAA test record. The 1-ke reference tone was adjusted to 0 db on the meter; next the 10-ke tone was played and the meter read ±14 db! Needless to say, this was the cause of all the trouble. After a trial-and-error search for a value of load resistance that would correct the response, the idea of a shunt capacitor struck. A decade box was used to make the 10-ke level the same as for 1 ke. Another frequency run was taken, and an exact match to the first curve was obtained. The solution to the problem was to install a ceramic capacitor inside the headshell.

It appears that the higher output of the cartridge at high frequencies (due to the higher stylus-tip velocity) was overloading the preamplifier. Hence, equalization ahead of the preamplifier solved the distortion problem. Experience with other cartridges, however, indicates that this idea can only be applied on cartridges having a fairly low output impedance with low inductance.
A well informed individual usually makes the wiser decision

INFORMATION:

Shown below is the rear of the rack mounting frame used with our video and pulse distribution amplifiers and other plug-in units. You will appreciate the easy accessibility afforded by the connector configuration. Note that no connector is closely surrounded by several other connectors, as is the case with many other frames. As a result, cables may be plugged or unplugged with greater ease and speed.

The pulse distribution amplifier, model VI-20, pictured above, offers superior performance with many desirable features. A few of these features are:

- Self-contained, regulated power supply in each amplifier.
- Four plug-in amplifiers mount in a 1⅜” rack frame providing a total of 16 outputs.
- High isolation between outputs during and between pulses.
- Maintains constant output levels.
- Indicator lamp shows presence or absence of output pulses.

Price: One complete frame with 4 pulse amplifiers...................................................... $1100.00

Write for complete information and specifications

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Circle Item 38 on Tech Data Card

October, 1965
Tower Light Indicator
by James W. Thweatt,
Staff Transmitter Technician,
WPSD-TV, Paducah, Kentucky

We wanted an indicator in the control room to let us know whether or not the tower lights were on. We came up with this simple but effective system. In addition to serving as a visual indicator, it also provides an audible indication of when the tower lights go on or go off. It also acts as a reminder to make the daily tower lighting inspection.

Our tower lights are supplied from two phases of our three-phase power source. A relay with a 230-volt winding was chosen for K1 and connected across the two 115-volt lines, on the load side of the tower-light relays, so that failure of either of the 115-volt lines would be detected. One set of K1 contacts operates the green and red “on” and “off” indicator lamps. The other set of contacts operates the bell circuit. When K1 energizes, the bell hammer strikes the bell one time as capacitor C1 charges to the DC supply voltage through the bell winding. When K1 deenergizes, C1 discharges through the bell winding causing the hammer to strike the bell one time.

Portable Radio Checks Lines
by Al Roberson, Chief Engineer.
WHOU, Houlton, Maine

That transistor receiver in your station is very handy for checking lines without using a tone oscillator. Just attach a couple of alligator clips to the earphone leads, tune to a competing station so you won’t become confused, set your volume, and hook up to the line being traced or checked for continuity. The impedance mismatch doesn’t matter. We use our receiver in this manner because of its easy portability in checking our permanent remote loops and line tracing in the studio.

Stereo-FM Off-Air Relay

When the Mid-States Broadcasting Corp. began an off-the-air FM relay network for their four Michigan stations using WSWM, East Lansing, as the originating station, everything at first seemed to go well. Pickup of stereo programing by WQDC, Midland, and WCMZ, Flint, was accomplished through the use of commercially built FM tuners; WABX, Detroit, because of its distance and the terrain over which the signal travels, received monophonic signals using similar commercial equipment. Output
It takes an alert supplier like Harvey's...

to bring you an advanced mike like the E-V Model 635A.

In many ways, a supplier of broadcast and audio equipment is like a doctor. He must keep up with the latest advances in his profession to practice it efficiently. We like to think that's the way we are at Harvey's. And when Electro-Voice came out with an advanced microphone like their 635A, Harvey did its homework. We studied it. We stocked it.

The E-V Model 635A is a modern prototype of the famous 635 known to all as "old dependable"... but with these refined advances: Lighter and slimmer. A stronger steel case to reduce hum pickup. A new four-case filter to eliminate pops and wind noises.

Get the Electro-Voice Model 635A from Harvey's. We're "always on hand" with the newest and best in broadcast and audio equipment. Just call collect or write.

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Circle Item 40 on Tech Data Cord

October, 1965

www.americanradiohistory.com
The SPARTA TC-12 Custom includes the latest advances in the industry. Its rugged capability insures years of trouble-free performance and automatically puts the TC-12 turntable at the top of your list of equipment purchases. Write or phone for latest information. Area Code 916, 421-2070.
KHIQ-FM Scores Another Sacramento First! A New JAMPRO Antenna!

Pardon us for sounding off like this, but frankly, we're a little bit excited about our revolutionary "Dual Polarized" Jampro antenna! What's so revolutionary about it? Number one: It beams 2 (dual) signals instead of one Horizontal — like before — and Vertical — never before now! And two: We're the first (and only) FM Station in Sacramento to have one! Further: Although all FM stations (including us) have HORIZONTALLY powered antennas, the signal transmitted, at its strongest, does not always reach every receiver within the station's coverage pattern. Differences in terrain cause it to deflect thus producing interrupted or weak reception in some areas. This is where our new JAMPRO comes in. It eliminates horizontal "fade-out" by filling in the gaps with a vertical signal. Result: More power and vastly improved reception — six times as much for your table receiver, 40 times as much for your car radio plus better-than-ever KHIQ stereo!

NEW JAMPRO "DUAL POLARIZED" ANTENNA FORMULA:

HORIZONTAL
- power assures you almost no variation in signal strength

VERTICAL
- power added, assures you no variation in signal strength

Vastly Improved RECEPTION for Table Receivers, Car Radios Plus Better-than-ever Stereo!

Circle Item 43 on Tech Data Card
customer complaints about "swimming." When a local distributor exhibited stereo receivers at the Saginaw Fair, several of the receivers motorboated when receiving signals relayed by WQDC from Lansing; locally originated stereo broadcasts were okay. The distributor was advised to use a better antenna. When a good FM receiver antenna was pointed at the station antenna, the motorboating in the receivers changed to slow channel reversal—or "swimming"—also, the stereo-indicator light blinked with the phase reversal. An engineer representing the manufacturer of the radios affected suggested that the station replace the receiver used at the reception site. A different receiver completely eliminated the "swimming." Further investigation revealed that the receiver initially used had been leaking WSWM's 19-kc pilot signal through the audio circuits. The original 19-kc pilot signal was then beating with the 19-kc pilot generated at the WQDC transmitter which caused pilot phase reversal. Superior audio filtering in the new receiver solved the problem of channel reversal.

At all three stations it was noticed that distortion would momentarily occur on certain high frequencies; this was most apparent on trumpet notes—yet there seemed to be no evidence of overmodulation. A test was programed with WSWM, Lansing, and WGMZ, Flint, to determine the cause of this distortion. Initially, WSWM broadcast a monophonic 400-cps signal at 100% modulation to allow proper adjustment of the receiver and scope. Then, WSWM turned on their 19-kc pilot. The receiving-station engineers connected their receiver's left-channel output to the scope vertical input and the right-channel output to the horizontal input. Two equal in-phase signals were transmitted by WSWM to produce an L-R signal, and care was taken to prevent overmodulation. As the transmitted frequency was swept from 40 to 15,000 cps, the engineers noted that the scope trace shifted from a line slanting rightward to an ellipse. The same test was repeated with an L-R signal, and the same phase shift was again noted. A land-line test from WSWM disclosed no phase shift or beating at the stereo generator output. Because there had been previous problems with 19-kc pilot contamination of the audio, low-pass filters were placed at the receiver output. A repeat of the test using the filters showed a significant decrease in phase shift at all frequencies.

A research file maintained by the company was quite useful, as these stations had no prior experience with troubles of this type. Magazine articles and manufacturers' literature proved invaluable in helping to diagnose and eliminate the problems.
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Circle Item 49 on Tech Data Card

INTERNATIONAL

TV Recording Techniques
at SMPTE Conference
Electron-beam recording will be the
subject of at least four technical papers
at the 98th SMPTE Technical Confer-
ence and Exhibit at the Queen Eliza-
beth Hotel, Montreal, October 31 to
November 3.
Unlike previous recording methods
using mechanical stylus, photographic re-
recording, or magnetic recording, electron-
beam recording, or "EBR," depends on
the direct action of a stream of electrons
upon a recording tape or film. The
information capacity of the system is enor-
mo us, but there are serious practical
difficulties because of the need to run
the recording film in a vacuum. If
these problems can be overcome, EBR
is expected to supplement and possibly
eventually replace present video-tape
systems for recording pictures.
Other topics of major interest to be
discussed at the Montreal Conference
include UHF and color transmission
problems, vertical-interval testing and
monitoring, automatic video switching,
and quality-control procedures.

500,000-Watt Transmitter
for Nigeria
Factory tests of a 500-kw medium-fre-
quency AM broadcast transmitter have
been completed by LTV Continental
Electronics Division of LTV Electro
Systems, Inc. The transmitter was built
for the Nigeria Broadcasting Corpora-
tion, Enugu, Eastern Nigeria, Federation
of Nigeria.
Completion of factory tests ends the
first phase of a $1,228,374 contract be-
tween the manufacturer and the Nigerian
Broadcasting Corporation. Under the
terms of the contract, Continental is
supplying the transmitter, directional an-
tenna system, spare parts, installation,
and supervisory services. The new facil-
ity is part of the Nigerian Government's
long-range plan to improve communica-
tions and educational programming
throughout that country.
The transmitter is made up of two
250,000-watt transmitters which are com-
bined to deliver full carrier power of
500,000 watts. The directional antenna
system consists of coupling and phasing
equipment and three 840' towers.

TV in Africa and South America
The Ghana television service has been
officially declared open by President
Kwame Nkrumah. Designed, built and
installed by The Marconi Company, in
collaboration with the Ghana Broad-
casting Corporation, the new service has
three television transmitting stations at
Accra, Kumasi, and Sekondi-Takoradi.
These stations cover approximately one
quarter of the country including the
Atlantic seaboard, the most heavily pop-
ulated part of Ghana. Each of the three
stations is served by a central studio
complex in Accra, the capital.
All three stations use 5-kw picture
transmitters and 1-kw FM sound trans-
mitters. Three-bay turnstile antennas are
mounted on 400' towers at Accra and
Kumasi and a 300' tower at Sekondi-
Takoradi. At each station the trans-
mitters are located in a central trans-
mitting area with a control room and
adjoining workshops, stores, engineers'
rooms, and generator buildings. In ad-
dition, at Accra and Kumasi there are
transmitter/receiver terminals for the
microwave link which joins Accra and
Ejura.
On the other side of the world, the
company is installing a new station at
Mar del Plata, the principal seaside
resort and one of the largest cities in
Argentina. It will be run by Mar del
Plata Television S.A.
The station will use a 5-kw picture
transmitter and a 1-kw FM sound trans-
mitter in conjunction with a high-gain
omnidirectional antenna system.

Circle Item 49 on Tech Data Card

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THE BBRC MARK VII: AN ADVANCED DEVELOPMENT IN COLOR SPECIAL EFFECTS GENERATORS

The Mark VII, designed for the most critical studio and van applications, assures low maintenance and trouble-free operation.

The Mark VII is capable of color inserts (color matting). The output video of the Mark VII is the combination of background video and artificially generated color inserts. Any color within the range of the NTSC spectrum may be generated by the settings of the manual controls. The basic system can handle a variety of monochrome or color signals of either composite or noncomposite format at the inputs.

A non-additive mixing technique, insensitive to variations in video brightness levels, is incorporated for a new effect with lap-dissolves. The Mark VII systems consist entirely of transistorized plug-in modules, expandable on a building block basis to allow for a variety of pattern cards. Control panels can be selected for present needs or future requirements.

Priced from $1810.00. For immediate information call your local distributor, or write to BBRC Video Marketing.

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October, 1965
NATIONAL

New ETV Tower

The last section of what are believed to be the first UHF and VHF helical television antennas ever combined in a single tower has been put into place. When in operation, the antenna will transmit two television broadcast signals from the top of the new 1000 Lake Shore Plaza building in Chicago. It will serve both the city's educational television stations, WTTW, channel 11, and WXXW, channel 20. The 250' tower atop the 55-story, 590' apartment build-
ing will enable the two stations to transmit without interference from any building in the Chicago area.

The largest section to be raised was a 30'-high, 36"-diameter, 6-ton pipe mast that serves as a base for the antenna. It was raised by a crane attached to the top of the building. The crane was then shifted 15° to allow the collar to be set in place.

1925' Tower Planned

An application for a tower to support an antenna 2000' above average terrain has been filed by the Black Hawk Broadcasting Co. for KWWL-TV, Waterloo, Iowa. The tower is to be built on a site twelve miles south of Independence and two miles east of Highway 150. Work has already started on remodeling and installation which will give KWWL-TV the first all-color television facility in Iowa. Equipment on order includes two color cameras for studio use, a video tape recorder, and color film camera.

The Black Hawk Broadcasting Company was founded in 1947 and presently operates radio stations KWWL in Waterloo; KLWW in Cedar Rapids; and KAUS in Austin, Minnesota; television stations KWWL-TV in Waterloo and KMMT in Austin; and the Coca Cola Bottling Company of Waterloo.

Long CATV Relay

The Federal Communications Commission has granted American Television Relay, Inc. of Phoenix, Arizona, construction permits to bring the four Los Angeles independent television stations to Teleprompter's Farmington and Silver City cable systems in New Mexico. The applications have been pending about one year. The present common-carrier microwave service from Los Angeles to Yuma, Arizona, will be extended into these new areas with the signal path to be split at Pinal Peak, near Globe-Miami, Arizona. The northern branch will go to Farmington, the southern branch to Silver City. The signals will travel distances of 700 and 400 miles, respectively. Service is expected to begin by January, 1966.

American Television Relay operates common-carrier microwave in Southern California and Arizona and has applications on file to operate in Texas.

NAB Fall Conference Series

Recruiting of radio personnel, a new radio license form, color television, and the impact of community antenna television are among items to come up for review at the eight 1965 Fall Conferences sponsored by the National Association of Broadcasters. Also on the agenda are reports on NAB operations by President Vincent T. Wasilewski and Board Chairman John F. Dille, Jr. A member of the Federal Communications Commission will participate in each of the conferences. Each Commissioner will speak informally and answer questions during the second morning session of the Conference.

New Gates "Top Level" positively prevents FM overmodulation

Strong statement? Read what one FM broadcaster has to say: "We can run our total modulation up to 98% and hold it without overmodulating, balance change or distortion." And another: "Truly it gives a new sound . . . crystal-clear beauty . . . rich and vibrant program definition, and it makes the station sound louder and fuller."

The Top Level is for use between your limiting amplifier and FM transmitter — designed for stereo or monaural use. It is fully transistorized. Gives instantaneous action. Extremely low distortion.

Write for brochure 168 and NAB engineering paper.
The day-and-a-half conferences, arranged by NAB for member radio and television executives, will be held in eight different cities across the nation from October 14 through November 23. Joint sessions for radio and TV delegates will be held each morning at each conference, with separate radio and TV meetings scheduled for the first afternoon. Each conference also will feature an opening-day luncheon, with a list of prominent speakers to be announced later. Each conference will open with Mr. Wasilewski's report to the membership at the first joint session.

Two presentations also are scheduled at the opening session: "The 1966 Elections—Action Now." and "CATV—Your Association's Position."

Mr. Dille will present his report at the second joint session on the second day. Informal remarks by an FCC Commissioner, followed by a question-and-answer session, will be featured during the second-day joint meeting. Also on the second-day agenda: "The People vs. Dr. Buzzard or The Road to the Code." A roundtable discussion between delegates and NAB staff members will conclude each conference.

The separate radio session on opening day will include: "People, Programs and Payment" (on the recruiting, use, and reimbursement of radio-station personnel); "Candor and the Radio Code," "Logging for Renewal—Adjusting to the New Radio Form," and "Radio Bull Session." (an opportunity for comments, questions, and answers about modern radio.)

The first-day TV session program: "Transition to Color—Challenges for Every Department," "TIO Presentation" (new ideas from the Television Information Office); "The Economics of Community "—Including the Latest on Equipment Leasing," "The Waking Giant — The TV Broadcaster as an Advocate," and "TV Bull Session."

Locations and dates for each of the eight Fall Conferences, and the FCC Commissioner appearing at each are:


Oct. 18-19 Atlanta, Marriott, Robert T. Barkley

Oct. 21-22 Baltimore, Md., Lord Baltimore, Robert E. Lee

Oct. 25-26 Boston, Statler Hilton, Kenneth A. Cox

Nov. 11-12 Chicago, Sheraton Chicago, Mr. E. Lee

Nov. 15-16 Denver, Brown Palace, Lee Loewinger

Nov. 18-19 Spokane, Davenport, Mr. Cox

Nov. 22-23 Phoenix, Westward Ho, Chairman E. William Henley (Commissioner Rosel Hyde will be out of the country during the six-week period when the Conferences are held.)

UHF Under Construction

The transmitter for WPFL-TV, one of the three new UHF television stations

October, 1965

NOW! GIVE YOUR FM STATION
100% MODULATION CAPABILITY

WITH THE FAIRCHILD CONAX!

- Now! The FAIRCHILD CONAX enables FM radio stations to increase their signal strength and apparent loudness potential by the effective control of high frequencies which cause trouble when pre-emphasized. High frequencies add sparkle and "bite" to program material and pre-emphasis improves signal-to-noise ratios. When the two are combined, however, it often becomes necessary to decrease the station's power to eliminate over-modulation possibilities.

- How can high frequencies, which normally contain less energy than mid or low frequencies, cause trouble when pre-emphasis is applied? Simple! High frequency information, such as the jingling of keys, the sharp "s," the muted trumpet, cymbals, or other high frequency sounds, often become high frequency "spikes" when pre-emphasized thereby exceeding the FCC 10% modulation limitation. By making high frequency information "spike-free" (through the use of inaudible Super Fast attack and release times) the FAIRCHILD CONAX now allows the use of the full high frequency pre-emphasis curve.

HERE'S A STEP-BY-STEP GRAPHIC ANALYSIS OF THE FAIRCHILD CONAX IN ACTION...

FIG A — Normal program material with program information distributed in mid-range—500 to 5000 cycles.

FIG B — Same program material pre-emphasized. Still trouble-free.

FIG C — Program material with a high percentage of high frequency material in its content—such as found on today's records.

FIG D — Same high frequency program material (hot) after pre-emphasis. Note high frequency "spikes" now exceed 100% of modulation.

FIG E — Same program material now controlled by the FAIRCHILD CONAX action.

Note even with pre-emphasis the lack of trouble from high frequency "spikes" that normally would cause over-modulation.

- The FAIRCHILD CONAX has an exclusive patented preview circuit which applies a standard pre-emphasis curve to any entering signal. The patented FAIRCHILD CONAX frequency dividing and controlling network allows accurate and inaudible control of the troublesome high frequency "spikes." This means you can transmit a signal with high average modulation level up to 3 db higher, utilizing the full apparent loudness possibilities of your rated power. In FM stereo and SCA transmission, the FAIRCHILD CONAX prevents splatter between the SCA channel and the stereo channel, allowing you to use both of these dollars producing signals to their fullest. Now full modulation capabilities can be realized without the danger of FCC citation or any change in the transmitted sound of your signal. Now FAIRCHILD CONAX gives your station that brighter and louder sound... the sound that sells. AVAILABLE IN MONO OR STEREO COMPACT SIZE!

Write to FAIRCHILD the pacemaker in professional audio products — for complete details.
in the Greater Philadelphia area, has been delivered at the station's studio at 1230 East Mermaid Lane, Wyndmoor.

The station has scheduled equipment tests to begin September 1 and program tests to start September 17.

Mr. Franklin R. Valentine, Jr., has been appointed executive vice-president and director of Unicorn, Inc. Prior to joining the firm, Mr. Valentine was associated with Charles A. Sammons and National Trans-Video of Dallas, Texas, for a period of 12 years. An attorney by profession, he will act as General Counsel for the Corporation.

Robert E. Lauterbach has been appointed manager-broadcast sales for General Electric Visual Communications Products. Mr. Lauterbach succeeds John Wall, who recently was appointed to the new position of manager-industry relations for G-E Visual Communications Products. He will make his headquarters at Electronics Park. Mr. Lauterbach is a native of Denver, Colorado, a graduate of California Institute of Technology in electronics, and holds a master's degree in business administration from the University of Denver. Formerly general manager of cable operations, John P. Campbell has been named vice-president of Cox Cablevision Corp., a wholly owned subsidiary of Cox Broadcasting Corp. Mr. Campbell has been active in CATV since 1954, having established the Dubuque, Iowa, cable system for Jerroid Electronics Corp., at that time. He was later eastern regional manager for H & B American for five years and has been with Cox Cablevision since July of 1963.

Charles L. Townsend has been promoted from director of product development to vice-president in charge of engineering operations at TelePro Industries, Inc., a subsidiary of Defiance Industries, Inc.

Mr. Townsend has 27 years of executive engineering background with the National Broadcasting Company. An early television pioneer, he was design-

Norman Knight, president of Knight Management Corp., Boston, has appointed Walter Welch general manager of CATV operations. Mr. Welch will develop various CATV properties including Virgin Isles TV, Inc., St. Thomas, Virgin Islands, U.S.A., and other Caribbean interest for the Knight enterprises.

After 15 years of broadcast engineering, Mr. Welch entered the CATV field in 1958 and has served as chief engineer of two CATV companies and vice-president and general manager another.

**PROPERTY TRANSACTIONS**

**New Acquisition**

Acquisition of the assets and business of Dage-Bell Corporation by Raytheon Company has been announced. Dage-Bell manufactures closed-circuit and broadcast television equipment, language laboratories, and learning-center systems. Under the terms of the agreement, Raytheon assumes all of Dage-Bell's liabilities, and 161,534 shares of Raytheon common stock are to be distributed to Dage-Bell stockholders as part of the liquidation of Dage-Bell.

Dage-Bell is the sixth acquisition by Raytheon in the past 12 months. Earlier acquisitions were Amana Refrigeration, Inc., the computer division of Packard-Bell Electronics Corporation, the computer-memory business of Philco's Aerotron Division, Micro State Electronics Corp., and Penta Laboratories, Inc. Raytheon will operate the business as a subsidiary within its Equipment Division.

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**Broadcast Engineering**

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NEW PRODUCTS

Automatic Logger
Log 96 is designed to meet FCC requirements for automatic program logging. It records 96 hours of program material on 1200' of standard 1/4" recording tape; time reference is accomplished by a 1000-cps tone burst automatically impressed on the tape every five minutes. Electronics are fully transistorized, and a solid-state 28-volt power supply is included. The drive motor is of the synchronous, hysteresis type. The basic model of this Autotronics of Oklahoma product is priced at $595. A choice of blue wrinkle or blue enameled panels is available.

Circle Item 120 on Tech Data Card

Solid-State Video Amplifier
The Model IT-284A video amplifier provides a 50% increase in output voltage over the original ITI design, the Model IT-284. The response of the Model IT-284A is down a maximum of 3 db at 14 mc; thus it provides 1100-line resolution capability. A peak-to-peak input of .25 volt provides a 75-volt output. The predecessor unit will continue to be available for those applications where its 1600-line capability is required. Both devices are all solid state. Single-unit price of the Model IT-284A is $400. The companion power supply, Model IT-285A, is optional at $200.

Circle Item 122 on Tech Data Card

Vidicon Viewfinder Camera
The VC-6 vidicon viewfinder camera has been developed by Maryland Telecommunications for broadcast or closed-circuit applications. The camera is designed to accept, from an external source, timing pulses conforming to EIA Specification RS170, paragraph 5.3. The unit consists of fully transistorized separate camera-viewfinder and control units which utilize broadcast-type 1K con-

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Circle Item 56 on Tech Data Card

nectors and Belden 8280 or 8284 cable. The VC-6 is equipped with a four-lens turret and tally lights. Lens selection and focus control are located on the right side of the camera. Specified resolution is in excess of 800 horizontal TV lines at .3 foot candle of target illumination, and over 500 horizontal TV lines at .04 foot candle. Other features are a cascaded input Nuvistorized video preamplifier, nonmicrophonic video amplifier with 10-megahertz bandwidth, sweep protection, linearity of both horizontal and vertical axes within 2%, an automatically regulated electrical focus and target adjustment for light-level changes (4000 to 1), and a fully regulated power supply (±1%). The camera-viewfinder weighs less than 35 pounds, and the control unit weighs less than 8 pounds. The price is $3995 less.

Circle Item 123 on Tech Data Card

VIDICON PROTECTION

Cam-Trol, a device that automatically protects the vidicon against burnout and damage due to flashing or reflecting bright light, is produced for use in closed-circuit television applications by Centurion Products. The unit, designated Model CT4, consists of a protective shield connected to a power-pack control. The shield automatically covers the camera lens when light exceeds a predetermined level. When the light returns to a safe level, the shield automatically returns to an open position, exposing the lens again. The standard Cam-Trol includes an opaque shield which cuts off picture transmission when it is activated by bright light. A filter shield is also available which cuts down on light intensity while allowing continuous transmission of the picture.

The product is designed to be effective both indoors and outdoors, and can be set for activation at various light levels. The device automatically caps the camera lens when the camera power is turned off. This is important, since bright light can destroy the photosensitive phosphors on the face of the vidicon even when the camera is not operating.

Circle Item 124 on Tech Data Card

Cinema's new compact rotary slide-wire attenuator is now available for your mixing console or ganged units. A must where smooth control is desired, other standard types are also available for applications demanding precision noiseless attenuation, reliability and long term stability.

GRAPHIC EQUALIZER

The Cinema Graphic Equalizer offers a compact system of extreme flexibility. Each of the six controls permits the operator to equalize or attenuate that portion of the spectrum 6 db. This is an active unit having zero insertion loss and up to 35 db additional gain.

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Circle Item 57 on Tech Data Card

BROADCAST ENGINEERING
16-mm TV Projector

This multispeed 16-mm motion picture projector, Model 224-A-TV, features flickerless operation at all speeds—1, 2, 3, 5, 6, 10, and 30 frames per second. L-W Photo, Inc. designed the machine for video-tube projection. A continuous- hold control permits stop-motion projection onto a television camera pickup tube without loss of light intensity or color value. The projector incorporates a television-type shutter, a synchronous motor, and a timing-belt drive. A hand-held remote control unit is included with the portable, 30-lb projector. It operates the projector at all speeds, plus reverse and stop-motion, and at single-frame. Other features include an automatically- maintained film loop, digital frame counter, and a cooling and heat-filtering system to prevent film damage. The projector utilizes a 750-watt lamp and operates with standard 115-VAC power. A daylight projection viewer is built into the case for desk-top viewing.

Circle Item 125 on Tech Data Card

Solid-State Audio Amplifiers

Known as Model A-24 Preamplifier/Program Amplifier and Model A-40 Program/Program Amplifier, the units pictured here are designed to meet the requirements of broadcasting and recording. The Model P-2 Regulated Supply provides power for combinations of the two amplifiers. The Model A-24 has a maximum gain of 50 db and maximum output of +24 db. For applications requiring a higher line level along with a higher-loss line pad or output splitting network, the Model A-40 Program/Program Amplifier provides extra ceiling reserve capability. The units are products of Melcor Electronics Corp.

Circle Item 126 on Tech Data Card

AM Modulation Monitor

The latest addition to the Visual Electronics line of auxiliary transmitter equipment is a new AM modulation monitor type MM-1A. The monitor is for use by AM broadcasting stations and reads both positive and negative modulation as well as carrier shift. The modulation meter is calibrated to read positive peaks to 133% and negative peaks to 100%.

An audio output is provided to feed the station's off-the-air monitor amplifier; a second audio output is provided to feed a noise and distortion meter. A peak indicating flasher unit is incorporated, which may be set to indicate modulation percentage from 50% to 120%. In addition, a relay is employed to operate a remote indicator or flasher.

 Provision is made for use with remote meters; connectors and controls are built into the monitor to adjust the loop resistance of the external meters.

Circle Item 127 on Tech Data Card

In a tube-type cable system of any size at all . . . one man and one truck must devote full time to replacing defective and expensive tubes. Vacuum tubes spell "trouble." They burn out in a hurry . . . and this kind of trouble will cost you much more than the price of the tubes and the labor of a technician. This kind of trouble will cost you subscribers and a bad name in the community.

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October, 1965
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Circle Item 60 on Tech Data Card

Television Relay Equipment
All solid-state television relay equipment, the MA-2 system includes the MA-8508 receiver and MA-8507 transmitter. Microwave Associates STL and mobile equipment is housed in rugged, cast aluminum cases for rack mounting in STL service or hand-carry in field use.

Both units are available in 1-, 3-, or 7-channel models. Transmitter output is two watts for a 1- or 3-channel model, and one watt for the 7-channel model. Transmitter differential phase and gain null are adjustable for optimum color performance. The crystal-controlled receiver operates in the 1990- to 2110-mc broadcast band and with an optional low noise preamplifier has a noise figure of 6 db. Equipment meets all FCC requirements and applicable CCIR and Canadian standards for black and white or color television. Nominal power consumption using 110-volt AC or 28- or 12-volt DC is 60 watts: 35 for the transmitter, 25 for the receiver.

Circle Item 128 on Tech Data Card

Cartridge Head Assembly
A cartridge head assembly that is directly interchangeable on all ATC cartridge machines is being manufactured by Lang Electronics, Inc. Azimuth and height adjustments on the assembly are made with a standard Allen wrench. ▲

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STUDIO & CAMERA EQUIPMENT

91. CLEVELAND ELECTRONICS — Data concerns modifications using new yoke assembly to update 3" image-orthicon camera.

92. GENERAL ELECTRIC—Brochure GEA 7558 describes new PE-26 completely transistorized portable 3" IO camera system. "First With 4-V" (brochure GEA-6650) includes photos and user reactions to the first 27 G-E color film-camera installations. Brochure GEA-7558 lists specifications and tube complements for VHF transmitter cubicle combinations. Specifications for second generation UHF klystron transmitters are listed in brochure GEA-7555B.


94. TV ZOOMAR—Information on Angenieux lenses for IO's and vidiconos, and data on Evershed Mark II servo-controlled pan and tilt equipment.

TELEVISION EQUIPMENT

95. DENSON—Flyers and catalog describe new, used, and surplus electronic equipment.

96. VITAL—Data sheets give specifications of Model VI-500 stabilizing amplifier, Model VI-10A video distribution amplifier, and Model VI-20 pulse distribution amplifier.

97. WARD—Specification sheets describe new solid-state color phase equalizer and low-pass filter.

TEST EQUIPMENT & INSTRUMENTS

98. BLONDER-TONGUE — Catalog features new "Lab-Line" series solid-state UHF/VHF test equipment accessories.

99. HICKOX—Brochures on industrial tube testers including new Model 580, Model 539C, and Model 752A instruments.

100. I.E.H.—Flyer lists full line of harnesses and adopters for color tubes.

101. SECO—Folder illustrates 20 test instruments including color-bar generator.

102. TELEMET — Sheet supplies specifications for transistorized TELECHROME Model 3518-A1 color-bar generator.

TRANSMITTER & ANTENNA DEVICES

103. AIR SPACE DEVICES — Brochure describes "Saf-T-Climb" device used to ensure safety during tower erection or maintenance.

104. BAUKER—Preliminary specifications are available for Model 605 7500/5000-watt FM transmitter.

105. DYNAIR—Flyers give particulars on RX-4A solid-state professional TV tuner. Illustrated bulletin introduces Series 6000 solid-state modular balanced-line transmission equipment and cites advantages of balanced-line video transmission.

106. GATES—Sixteen-page "FM Station Planner" makes equipment recommendations for class A, B, and C stations. Literature describes new FM-3G 3000-watt FM transmitter.

107. MOSELEY ASSOCIATES — Four-page leaflet gives details and specifications for Type II and Type III STL radio remote-control systems.

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The classified columns are not open to the advertising of any broadcast equipment or supplies directly produced by manufacturers unless the equipment is used and not the manufacturer's. Display advertising must be purchased in such cases.

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1-64 tf

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4-64 tf

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

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AMPEX HEAD ASSEMBLY RECONDITIONING SERVICE for all Ampex professional model recorders. This professional service features precision reworking of all heads for maximum head life. Your assembly is thoroughly cleaned and polished 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. "Loamer" assemblies available if necessary. LIPP'S, INC., 1630 Euclid St., Santa Monica, California 90404. (213) EX 3-0449.  

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5-65 tf

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10-65 tf
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