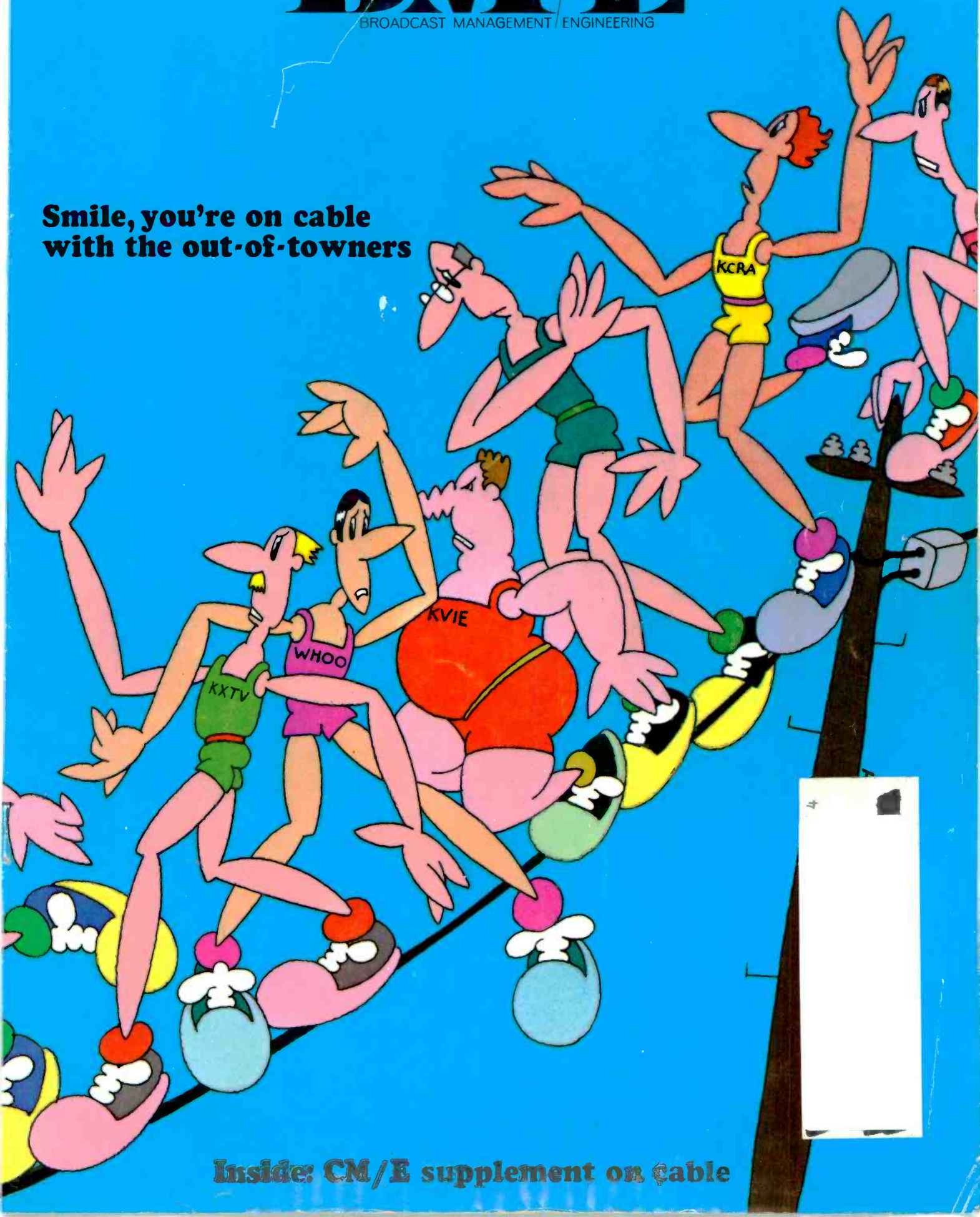
JULY 1971

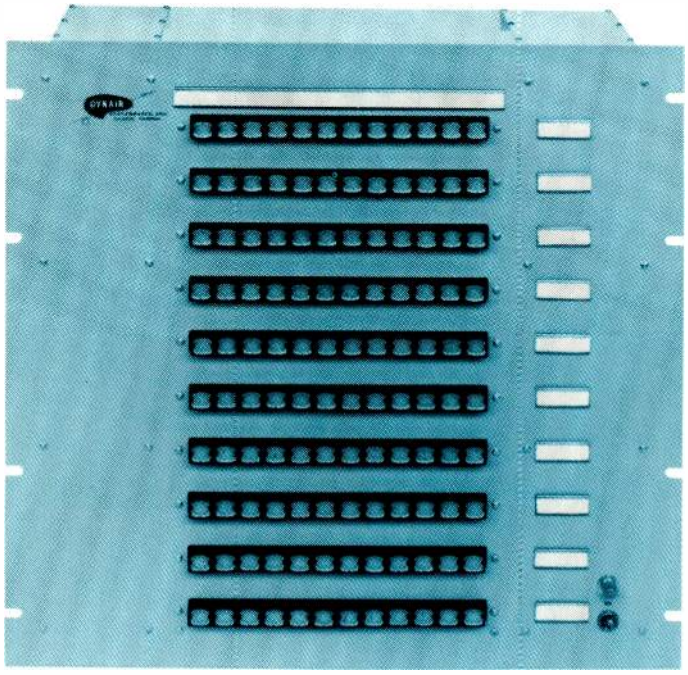
BM/E

BROADCAST MANAGEMENT/ENGINEERING

Smile, you're on cable with the out-of-towners



Inside: CM/E supplement on cable



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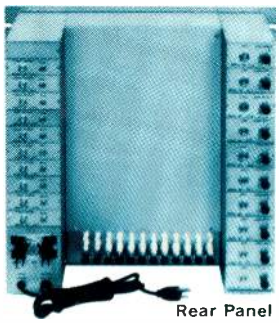

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Capacity	Video Only (Base Price)	Video and Audio	Panel Height
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6 in, 6 out	1,455.00	2,625.00	12.25
12 in, 6 out	1,645.00	2,815.00	12.25
6 in, 9 out	2,070.00	3,675.00	15.75
12 in, 9 out	2,335.00	3,940.00	15.75
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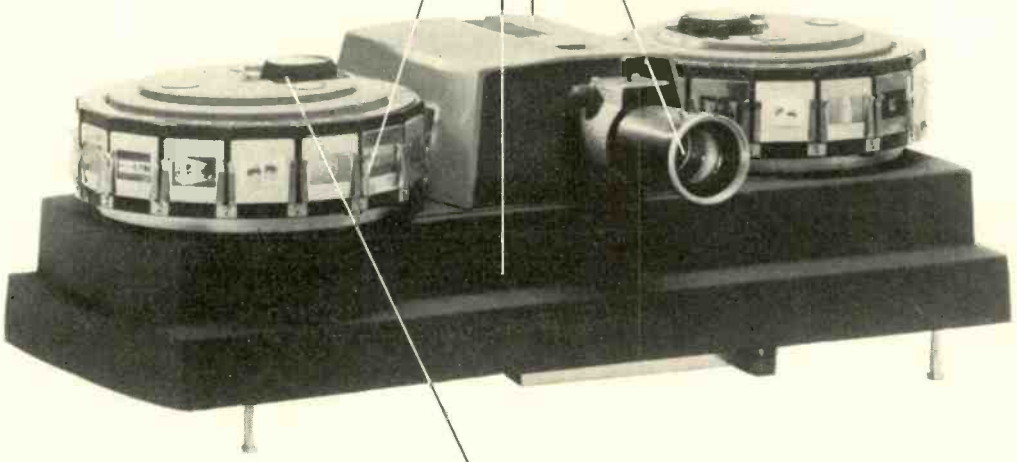

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SPECTRUM 32 PROJECTOR **Spindler & Sauppe**

Circle 101 on Reader Service Card

JULY 1971/VOLUME 7/NUMBER 7

BM/E

BROADCAST MANAGEMENT/ENGINEERING

Smile, you're on cable—along with the out-of-towners. As this issue goes to press, it appears inevitable that the FCC will permit some distant signals to be carried on CATV systems in every market. This means, like it or not, you'll be on cable, along with a dial full of rivals.

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52 **From The Editor**

MANAGEMENT:

Have to hire a consulting engineering firm to get you out of a jam with the FCC? Most consultants are called in because of inattention to operating details says John Battison in his article, Care and Treatment of Directional Antennas. Article is written for engineers, but there are two clear messages for management: Don't tolerate sloppy log keeping and, as a cost-effective idea, make DA-NDA switching push-button controlled. **Page 14.** For a push-button controlled vhf transmitter-antenna set-up, scan the article on **page 20.** If you're in FM and you see a title like Quadrasonic Broadcasting Is Here, you need no further words. Turn to **page 24.** For a discussion of what's likely to happen re AM and FM operator requirements, see **page 30.** The editorial this month says one way out of the bind is to cooperate with rival broadcasters —**page 52.**

ENGINEERING:

For some feedback on appropriate signal levels in your audio chain discussed in April, start with the Audio File report, **page 11.** Don't be surprised to find your directional antenna pattern way off when you run a reproof. How to keep the situation in hand is the subject of a timely, practical article by John Battison on **page 14.** How to set up a plan for remote switching of RF power (VHF or UHF) is covered thoroughly in in an article by S. M. King, **page 20.** Thinking of four-channel FM? Equipment for quadrasonic broadcasting is covered on **page 24.** And for a rundown of the pro and con arguments on third-phone operators doing first-phone duties, don't miss **page 30.** (There's more on the subject in Crosstalk, **page 39,** and the editorial, **page 52.**)

Broadband Information Services, Inc.
200 Madison Ave., New York, N.Y. 10016
212-685-5320

BPA

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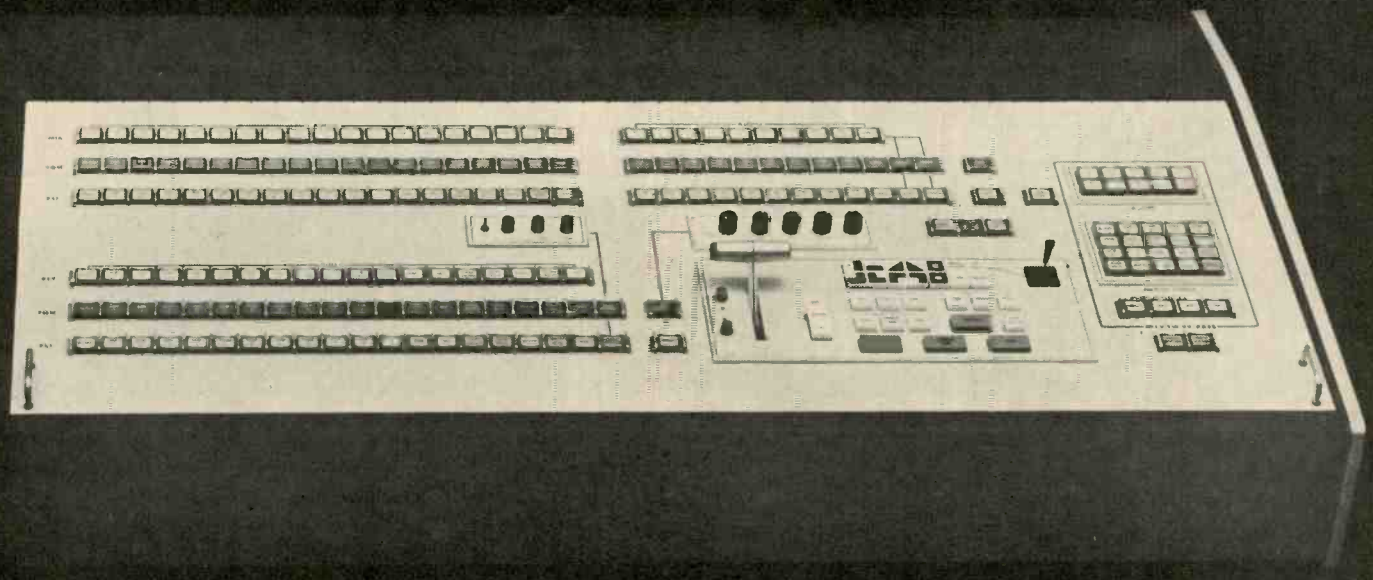
PREVIEW/BYPASS BUS PERMITS SELECTION OF ANY INPUT TO ON AIR OUTPUT ALLOWING THE MIX AND EFFECTS BUSSES AND EQUIPMENT TO BE USED FOR STUDIO PRODUCTION OR REHEARSAL.

COMPLETE DESCRIPTIONS AND SPECIFICATIONS OF THE 1400-24 AND THE COMPLETE GVG LINE OF PRODUCTION, MC, AND ROUTING SWITCHERS AVAILABLE ON REQUEST.



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BROADCAST INDUSTRY NEWS

Two-Way Cable Aids Bedridden Students

By the time you read this, it's expected that a disabled child will be "attending" school—even responding to the teacher—via a two-way cable system in Overland Park (Kansas City), Kansas. The experiment is being conducted by Tele-Cable Corp., a CATV operator in that city.

The initial experiment involves five students at their homes, and a teacher in the classroom. Each student will be able to see and hear the teacher, who will similarly be able to see and hear her bedridden pupils.

Each disabled child will be able to "raise her hand" in the classroom by punching a button on a home terminal. The teacher then answers by punching a similar button on a classroom terminal. At each terminal, there's a TV camera and receiver.

The experiment was made possible by the development of a terminal unit made by Vicom Manufacturing of Dexter, Mich. Since a single teacher can handle many children by remote control, the system in effect creates an electronic classroom of disabled and bedridden children. It makes for greater efficiency, as one teacher can work simultaneously with many home-confined children.

On the same day (June 23) that the child gets her two-way TV lesson, an Overland Park housewife will demonstrate shopping from her home through two-way CATV, with the cooperation of a Sears Roebuck store in Overland Park. Sears will put on live presentations, and the housewife will be able to make choices on the spot, by punching her terminal. A high-speed printer at Sears will give instantaneous printout of the housewife's name, address, and her order, through prearranged codes.

Other experiments will include a fire and burglar alarm network and an opinion survey.

Roadside Radio?

Since most automobiles are equipped with AM receivers, the Los Angeles Department of Airports wants to use a low-power transmitter to advise motorists of parking space, aircraft arrivals, and similar information at the L.A. International Airport. The FCC has granted permission for a 30-day test involving a 10-watt AM transmitter operating on 550 kHz along a section of the Century Blvd. approach to the airport.

(Continued on page 8)

Rich Brady of WTLC(FM) Indianapolis interviews driver Dan Gurney at Indy 500 time trials. Possibly first black radio personality to cover Speedway action, Brady made half-hourly reports during May, increasing interest in 500-mile classic by black community. Tangible result: complete sponsorship of coverage by a malt liquor firm.

Jim Anderson, DJ at KVCV(AM) Redding, Calif. thanks listeners for help in buying artificial kidney machines for patients who can't afford $4000 cost. Since April 1970 over one million Betty Crocker coupons have flooded KVCV, enabling purchase of six machines. Anderson headed drive, was aided by many local organizations.

BUILD YOUR SIGNAL ON A SOLID FOUNDATION

140-Series Generators give you the solid foundation needed to originate sync and subcarrier and to test all, or parts of the total TV system with highest-quality test signals.

First, the 140, or the 144, or the 146 Generator produces EIA sync with exceptional time stability because the sync circuitry is largely digital. A proportional control oven, which contains both the quartz crystal and the entire oscillator circuit, insures error-free operation of the color standard.

Second, the 147 Generator provides *all* the recognized in-service and full field test signals, except color bars which are produced by the 140 (or 144 or 146). Function generators and digital timing circuits substantially eliminate aberrations, instability and the front panel readjustments so often associated with products of this type. Yet, the 147 has the flexibility to be reprogrammed easily to meet special test signal needs.

Third, in-service testing with 147 Generator VITS is safe. Program material is handled *very* carefully. We realize it earns the revenue and protect it as follows:

- VITS insertion cannot occur in the absence of gen-lock.
- VITS are previewed before insertion.
- VITS insertion control can be remoted.
- Only preselect VITS will be inserted and incoming VITS will be deleted before that insertion occurs.
- Fail-safe operation is assured by relay loop-through control.

For many applications just one generator is required. See the chart for a summary of performance. Other TV Products are available from Tektronix, Inc. Ask your Field Engineer about the 140 Series and Picture and Waveform Monitors, Vectorscopes, TV Oscilloscopes and TV Accessories.

Features	140	144	146	147
EIA Sync	●	●	●	
Gen-Lock			●	●
Color Bars	●	●	●	
Linearity	●	●	●	●
Multiburst				●
Pulse & Bar				●
Window				●
Field Squarewave				●
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Flat Field				●
VITS Origin	●	●	●	●
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CATV Rule Goes to S.C.

A federal court has said the FCC local-origination rule exceeds its authority *(BM/E*, June, 1971). The Commission has temporarily suspended the rule.

The FCC now plans to ask for Supreme Court review of the decision. Pending such action, Sec. 74.11 has been suspended, and CATV local origination is voluntary, not mandatory. In the wake of the announcement, Cox Cable Systems has sharply curtailed its cablecasting. Cypress Communications and TelePrompTer report they will continue as before.

Forfeitures

WGET(AM) Gettysburg, Pa. has been notified of apparent liability for $1000 forfeiture for entries made in the operating log by a person not having knowledge of the facts required, and for failure to make daily antenna base current readings . . . KTXS-TV Sweetwater, Tex. has been denied reconsideration of hearing order, and fined $5000 for violation of studio location rules. It was found that KTXS-TV had moved its main studio to Abilene, Tex. without FCC approval . . . WTIK(AM) Durham, N.C. has been ordered to forfeit $2000 for operating with daytime power after local sunset . . . WAEL(AM) Mayaguez, P.R., has been fined $700 for failure to make and record field-intensity measurements at least once each seven days from Nov. 10 to Dec. 10, 1968, and for failure to make equipment performance measurements . . . WFMS(FM) Indianapolis, Ind., and WRDN(AM) Durand, Wisc. have each been ordered to forfeit $100 for failure to file renewal applications within the specified time.

Other Commission Actions

Armed Forces recruiting announcements do not entitle complainants to free time to respond under the Fairness Doctrine, says FCC. As it has done in several previous cases, the Commission ruled that recruiting announcements do not raise a controversial issue . . . Three Amarillo, Tex., TV stations have been notified by the FCC that they have engaged in "hypoing" by departing from normal promotional practices while audience surveys were being conducted in 1970. All three stations were requested by the Commission to submit statements indicating procedures which they will follow to assure compliance with Commission policies.

BM/E Sold to Employees

BM/E has been purchased from Mactier Publishing Corporation by a new company headed up by former employees, Charles C. Lenz, Jr., advertising director, and James A. Lippke, editor. Broadband Information Services Inc., the name of the new company, will be located at 200 Madison Avenue, New York 10016, (212) 685-5320.

The immediate thrust of the new company will be in helping the broadcast equipment industry recover from a rather weak preceding 18 months. Special editorial calling attention to cost-effective purchases that will save operating dollars is planned for fall issues. The August issue will concentrate on remote control (unmanned) of television transmitters. September will explore automation in the broadcast industry. The expansion of CM/E, supplement for cable system operators, is also planned.

IN BRIEF . . .

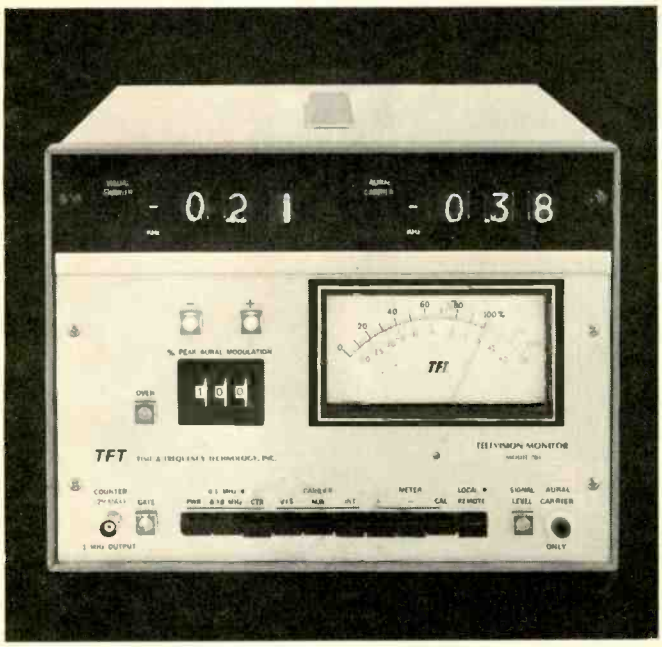
UPI/IGM joint project automates UPI Audio news network. IGM hardware will soon be used by subscribers to network, alerting them to news feeds when UPI transmits audio tones on line. Signals include join, cutaway, pre-emption, clock correction.

FM/AM auto radios owned by 25% of Chicago market population, according to survey by WFMF(FM), that city. Station placed newspaper ads asking responses to questionnaire. Survey also indicates that 95.5% own FM radios of any kind, while 61.5% own stereo FM receivers.

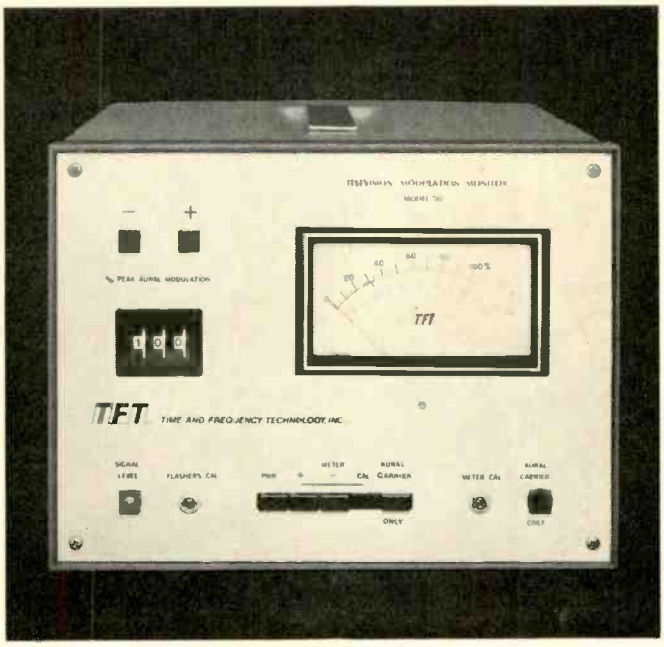
New TvB report lists dollar investments in television by local retailers. Report supplements annual reports on network and spot television. Top five local categories, with annual spending: leisure time stores, services ($90 M); business, financial services ($63 M); department, discount, variety stores ($63 M); drug, food stores ($36 M); auto, truck dealers ($31 M). Top category for spot TV was food and food products, while top network category was toiletries and toilet goods.

Ampex has received $1.2 M order to supply and install complete equipment at new KMVE(TV), Sacramento, debuting spring '72.

TFT's 3rd generation UHF and VHF TV monitors, optimized for remote operations



TFT 701: Frequency and aural modulation



TFT 702: Aural modulation only

No matter which instrument you choose, you get superior off-the-air monitoring without adding an RF amplifier. This substantially reduces interference problems caused by the intermodulation products of undesirable signals.

But, that's just one of several good reasons for specifying TFT instruments.

The 701, for example, uses frequency synthesis in its design. This means that you calibrate the internal frequency standard less often: only every 6 months for UHF and only every 18 months for VHF. Or you can use an external rubidium standard.

In addition, both the 701 and the 702 have two digitally-settable peak flashers which measure and display plus and minus peaks simultaneously, and a built-in aural modulation calibrator. They also provide outputs for a remote meter and peak flasher panel. (TFT Model 704)

What's more, you can choose from a complete range of accessories, for even more versatility and convenience. For example, the 701 can be furnished with an Automatic Logging Adapter and Digital Clock (Model 705), and a WWVB receiver (Model 710).

Other options and accessories include Off-frequency and Over-modulation Alarms, an SCA Demodulator and a Tracking Audio Oscillator/Distortion Analyzer (Model 712). The 712 can be used either with the monitor or as an independent instrument.

Both the 701 and the 702 are FCC Type-Approved (Nos. 3–187 and 3–189 respectively). Although this Type Approval applies only to instruments directly connected to a transmitter, it's the only approval you need to use the TFT monitors in remote control operations. There are no further modifications required.

For complete specifications about TFT's 3rd generation TV monitors, and/or a demonstration, call or write:

TFT ***TIME AND FREQUENCY TECHNOLOGY, INC.***
2950 SCOTT BLVD., SANTA CLARA, CA 95050 (408) 246-6365

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AUDIO FILE:

FOR BETTER IDEAS
FROM AUDIO ENGINEERS

Console-to-transmitter comments

In the first Audio File (April, 1971) we ran the observations of Eric Small, then Chief Engineer at WNCN(FM) New York City* concerning the best way of getting your audio from the console to the transmitter. At least one reader has taken exception to Small's advice. Oliver Berliner, president of SounDesign Engineers, Beverly Hills, Calif., has been well-known for some years in the audio fraternity.

His first comment is that the 3-dB pad placed in the output of a broadcast audio console is not for isolation but to maintain a more constant source impedance when feeding a telco line. After the pad, the level should be +8 VU because of the losses normally encountered in a long line.

He also says that virtually no recording studio type consoles are used by radio stations, as such consoles are too sophisticated and elaborate for broadcasters' needs. He says that most stations use regular broadcast consoles.

Berliner continues, claiming that Small failed to qualify his remarks relative to the necessity of having all portions of the studio's program lines at the +8 VU level. Says Berliner: This applies only in cases where the transmitter is remote from the studio. Furthermore, even in such instances there is little need for maintaining more than +4 VU at all points in the studio, since patching out a piece of equipment that raises the level from +4 to +8 VU seldom happens. Even when it does, the maintenance man knows that he's doing it, and what the results will be.

Finally, says Berliner, running program levels at +4 VU, even throughout very elaborate installations, is more than adequate. It means we can demand less gain from our equipment, and consequently get less noise pickup from the sensitive low-level stages. What do you think?

*Now Chief Engineer, WOR-FM, New York City.

Consumer or professional?

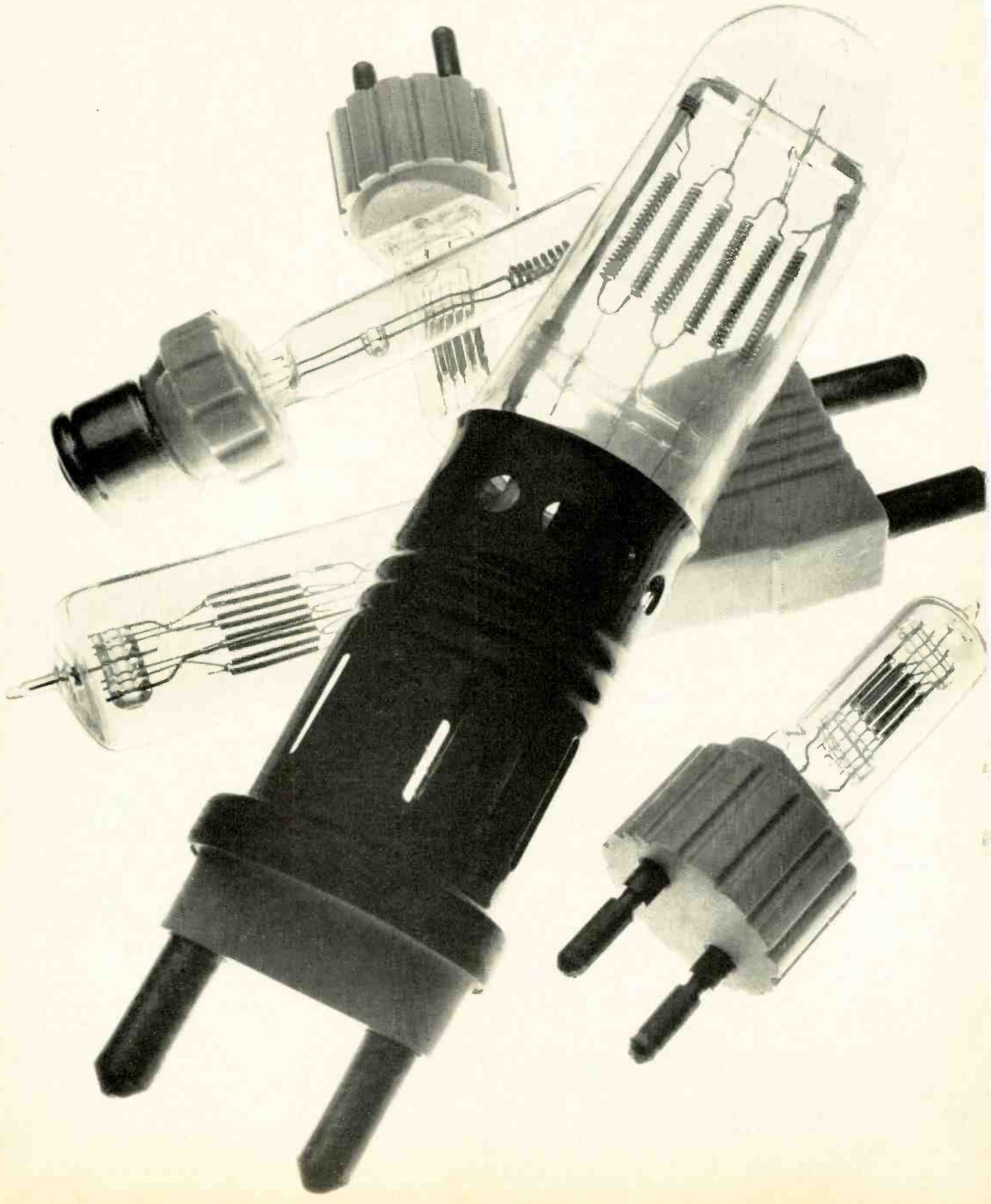
Every year the distinction between hi-fi and professional audio gear becomes more blurred. Zenith recently introduced what is called a Circle of Sound™ speaker in an effort to provide omnidirectional sound coverage. The woofer faces down, radiating from an opening several inches above the floor. The tweeter faces upward, radiating into a cone dispersal unit that spreads the directional high frequencies around 360°.

The point is that some of your listeners are using hi-fi equipment of this caliber. The quality of what they hear approaches the level of what you're putting out at the studio. If you program for these listeners, and give them a clean signal, you certainly aren't going to offend the portable transistor-radio crowd or the auto FM listener.

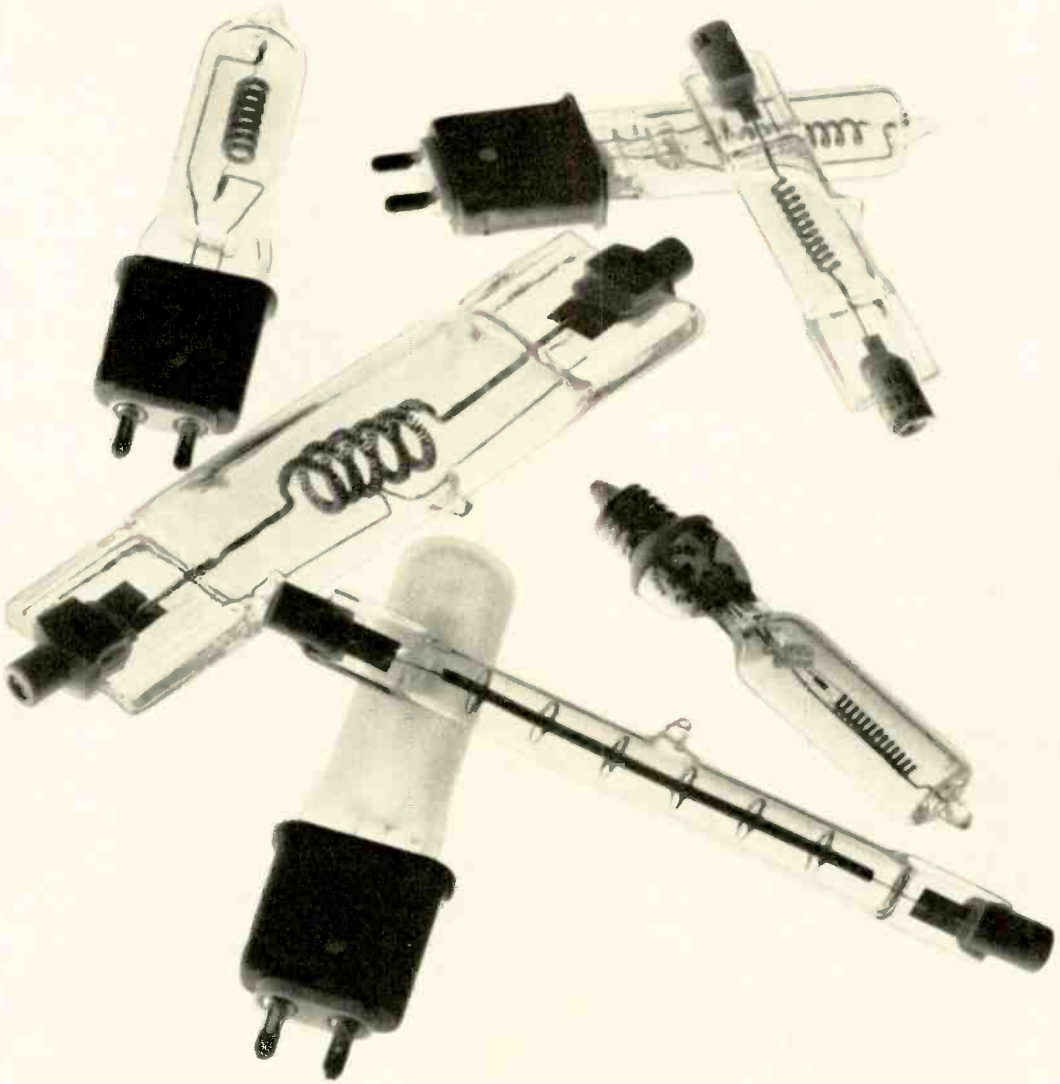
In fact, home hi-fi gear like the Zenith speaker often serves nicely for studio, lounge or house monitoring at the station. The decor can even add a nice touch to a lounge or lobby.

For Sylvania ad, circle 107 on Reader Service Card →

Some of our substitutes for those big, fat incandescents.



Some of our substitutes for our substitutes.



Those big, fat incandescents blessed the world with a lot of big, fat fixtures and sockets.

So after we came up with our skinny, little tungsten-halogen lamps, the first thing we had to do was set them up on big, fat bases so that they'd fit the old sockets.

Which meant developing a complete line of Substitution Lamps. (You see some of them at the left.)

But soon new fixtures arrived on the scene. These took full advantage of the inherent small size of Sylvania tungsten-halogen lamps.

(Which, by the way, outlast the fat incandescents about 3-to-1, don't blacken and lose brightness with age, and don't fall off in color temperature.)

For the new fixtures, we developed a complete new Standard Line of tungsten-halogen lamps, like the ones on the right.

Whenever studios replace their old fixtures with new ones, they can substitute our new lamps for our Substitutes.

Which is OK with us.

Because both of these lines are so much better than the old lamps, that no matter which our customers use, we feel we've done them a world of good.

And there's just no substitute for that.

We have a brochure on each line. For your copies, write to: Sylvania Lighting Center, Danvers, Massachusetts 01923.

GTE SYLVANIA

Care and Treatment of Ailing Directional Antenna Systems

By John H. Battison

Careless log keeping, "lost" monitoring points, cold weather and weeds, can get you an FCC citation for improper D.A. operation. How to avoid these pitfalls and some concrete suggestions on getting a wandering system into licensed parameters are covered.

WITHIN RECENT YEARS the FCC has shown an ever-growing amount of interest in directional antenna operations. New stations going on the air are finding an increased emphasis on the part of the Commission in obtaining concrete proof of absolute adherence to the theoretical directional antenna patterns. Existing stations, when their licenses come up for renewal, are quite frequently in for a shock. Examination by the Commission's renewal branch engineers often discloses that the operating logs for the composite week indicate that the directional antenna system has been operating outside its licensed parameters!

Some of the older established stations are being required to update directional antenna proofs which may have been made twenty years ago or more. Many of these have not been re-proofed since the original license was issued. In some cases, the Commission's requirements are satisfied by an explanation of the discrepancies on the operating logs. In others, a skeleton or partial proof is the only thing that will satisfy the Commission's engineers.

Re-proofing directional arrays that were installed twenty years ago or more turns up problems. Many of the original measuring points along the radials have been built over, or are rendered useless by the proximity of buildings or overhead lines. Many times, too, monitoring points that have become old and trusted friends over the years, are found to be at the very least misleading —if not downright untruthful. You will find monitoring points that are still within the license limits even though the surrounding area has changed. Yet when the radial is run and analyzed, the inverse fields are higher than the MEOV!

In a situation like this, the only solution is to select new monitor points. If this is done, it will probably also entail making a series of new nondirectional measurements, utilizing the new measuring points along the radials, plus, of course, running a skeleton proof.

One can encounter some rather unusual problems when making a partial proof or re-proof of an older station. The number of towers used in one of the patterns may have changed since the original proof. A case like this may call for two different sets of radials—one for each pattern.

As a case in point, one of our client stations, which originally had a five tower in-line array for a DA-2 configuration, added a sixth tower to be used in the daytime pattern only. The reworked configuration used tower No. 6 and tower Nos. 1 and 2 of the original array which then formed the daytime antenna system.

The original proof-of-performance radials were drawn from the center, No. 3 tower, and were thus good for day and night measurement purposes. When the daytime array was modified, new radials were required from the center of the daytime array.

The nighttime pattern was still referenced to the No. 3 tower, and because of the spacing between this tower and the new No. 6, it was necessary to maintain two separate sets of radials, one each for the day-night patterns as shown in Fig 1.

The array was adjusted so that all the nighttime monitor points were within the license specifications, and the radials were run. Practically all of the points on the original radial were found to be useless because of the intrusion of overhead lines, and new construction, which in some cases completely obliterated the old points.

It was necessary to pick new regular and al-

Mr. Battison is a consulting engineer with the firm Carl E. Smith, Consulting Radio Engineers, Cleveland, Ohio. He authored the *BM/E* series: *Design & Operation of D. A. Systems,* which appeared in 1966.

ternate monitor points, and also to select new points along the radials to complete the proof-of-performance. Even though not required to do so by the FCC, the licensee could probably have saved money by having the chief engineer make a skeleton proof from time to time. Deteriorating radial conditions would have been detected and alternate monitoring points selected.

Log keeping—keep alert

Some of the problems experienced by the broadcasters in connection with his antenna system are simply the results of inadequate and careless log keeping on the part of his operators. The Commission will usually accept phase monitor readings within 4° and plus or minus 5 percent of the current ratios as specified in the license except, of course, for those unfortunate licensees who have tolerances of plus or minus 1° and plus or minus 1 percent.

Careless logging, which represents phase angles to be consistently outside the 4° tolerance, and/or base current ratios that are consistently outside the tolerances allowed by the license, and for which no corrective action appears to have been taken (according to the log or the maintenance entries) almost always result in a requirement for a skeleton proof-of-performance. A number of these cases have come to our attention recently in which DA adjustment and/or partial proofs were required. In some cases it was quite apparent that had proper attention been paid to log keeping during the preceding years, a costly (and license-renewal delaying) proof-of-performance would not have been required.

In fact, much of the consulting engineer's work is frequently due to carelessness, and inattention to detail on the part of log keepers, and the people whose job it is to insure that proper log entries are made. On the other hand, such items as widely varying phase and current ratios on a particular tower are usually indicative of changes in either the power supplied to the tower, or the phase monitor system.

If variations are indicated for a specific tower and the parameters for the other towers in the array are normal, an immediate inspection should be made of all the elements in the transmission line system. Starting at the phasor, all connections should be checked for tightness and, if practical, the line condition should be checked for intermittent shorts, or open circuits due to faulty soldered connections, etc. In such case the varying base current was traced to worn out and dirty contacts in the pattern-changing relay at the tower base. When the relay was replaced, the base current returned to normal.

Shortly after, the same tower began to exhibit random variations on the phase monitor. This particular trouble was eventually traced to an intermittent connection in the sampling loop on the tower. From ground level observation the loop had appeared sound, and it was not until a close-up physical check was made that its condition was discovered.

It is quite possible that a careless, inattentive, and disinterested operator would have been content to go along repeatedly entering normally expected phase monitor readings. Unless the erratic phase monitor readings occurred precisely during the time that parameters were being recorded or logged, these variations could have gone unnoticed.

Monitor points, new and old

When a construction permit for a directional array is issued, certain monitor points are specified. These values show the maximum radiation that is permitted at these points. Normally, a licensee is required to measure and record these

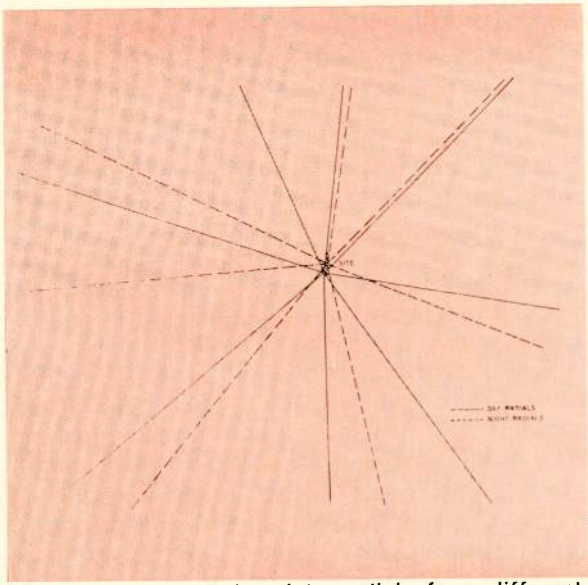


Fig. 1. Example of day-night radials from different towers. In this case, day radials (solid) originated in center of towers number 1, 2, and 6 and night radials from tower number 3.

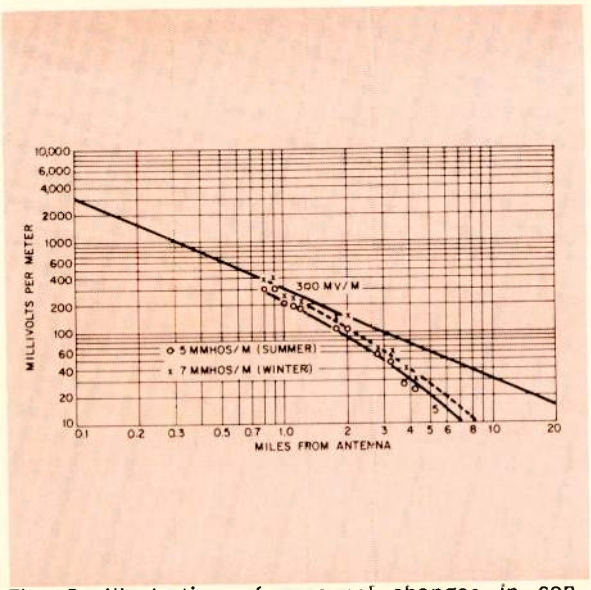


Fig. 2. Illustration of seasonal changes in conductivity. Note the inverse field remains the same, but the conductivity has increased from 5 mmhos/m to 7 mmhos/m.

values once every seven days. A monitor point that is consistently high (in the absence of unusual circumstances such as extreme cold conditions which are acknowledged to increase conductivity) can usually be taken as an indication of misadjustment in the directional antenna system. This assumes, of course, that nothing has occurred in the vicinity of the monitor point to account for the consistently high readings. Great changes have taken place in local construction and power line installations in most areas in recent years. It is, therefore, a very wise precaution to select alternate monitoring points and obtain the Commission's approval to log and use these in addition to the regular points to demonstrate that the array is properly adjusted.

The use of alternate monitor points also serves a double purpose. Local conditions can cause a change in a regular monitoring point reading that might indicate excessive radiation. But if the alternate monitoring point does not also indicate excessive radiation, the increase may be due to a purely local condition. Knowledge of this fact may prevent an inexperienced operator from attempting to readjust an array that is already operating properly!

Any discussion of monitoring points brings up a topic which has become of increasing concern to engineers who are required to maintain directional antenna systems—cold weather. It has finally been accepted in engineering circles that cold weather produces an increase in ground conductivity in many parts of the country. Thus, a monitor point which has been running happily within 1 mv/m of its limit throughout the spring, summer and early fall, may begin to run perhaps 1 to 10 mv over its limit with the onset of winter conditions, when the ground freezes.

Inspection of the station's operating logs may lead to a citation, and perhaps a monetary forfeiture, if monitor points consistently run above their limits and no efforts have been made to account for this phenomenon.

One precaution which can be taken to prevent problems of this nature requires the making of a series of measurements along the radial, or radials, involved—if possible, at the same points at which the original proof-of-performance measurements were made.

The new figures should be plotted on log-log paper and reanalyzed. Frequently, it will be found that a new, higher, conductivity curve will fit these new figures, and that the inverse field measured at one mile remains within the MEOV. This is an indication that the radiated power is within the licensed parameters, and that the increase at the monitoring point is due to an increase in conductivity. See Fig. 2.

If the foregoing is the case, the correct step is to record all the information and file an application requesting a modification of license to specify a higher monitor point value during winter months. If interference considerations permit, a relaxation of the MEOV and a permanent increase in monitor point limits may also be requested.

Try phasor rocking—with caution

A technique that is employed to return a wandering directional antenna system to its licensed parameters is "phasor rocking." This is not a project to be undertaken lightly, and without making the proper preparations. It must also be done carefully if it is to be useful—this means it is time consuming. Carried to its ultimate conclusion, it involves the stationing of personnel equipped with field measuring sets and mobile radio equipment at each of the points to be monitored. After each change is made in a phasor setting, the fields measured at the monitor points are reported by radio to the engineer performing the adjustment. These values are then recorded in the appropriate columns against the specific adjustment. Fig. 3 shows a typical format for a phasor rocking operation. The top line should contain the licensed parameters for all the towers and the phenomena being measured.

The next line should contain the actual currently employed phasor and common point settings. This is very necessary, so that in the event that the array becomes unstable or goes out of control, it will be possible to return to the original operating conditions.

It is, of course, necessary to request an authorization from the Commission to operate with parameters at variance from the licensed values for a period of time to cover the proposed tests. Until the Commission has authorized this operation, it is essential that no departures from the licensed parameters are made!

If an operating bridge is available, it should be connected at the common point to ensure that abnormal departures from the licensed common point impedance, and hence current, do not occur. Normally, small variations in the common point impedance will be noted, and can be recorded as the phasor controls are rocked. But unless any very wide variations are noticed, which would indicate a very bad misadjustment of the phasor, these readings are not too important at this time. Of course, if a new set of phasor control settings is obtained, it will be necessary to measure and correct the common point impedance as required.

A good way to proceed with the phasor control rocking is to vary the controls systematically in turn, commencing with the magnitude control for tower 1 and advancing it about three-quarters of a turn clockwise. All phase monitor readings are then recorded with the reported reports of monitor point readings. The actual change in phasor settings will depend on individual preference and condition. The No. 1 tower magnitude control is then retarded one-and-one-half turns counterclockwise from its last setting, so that it is actually three-quarters of a turn counterclockwise from the original setting. Again, all phase monitor point readings are recorded. This magnitude control is now returned to its original setting and all readings should be the same as

		Phasor						Phasor Monitor			Monitor Points mv/m			
I_{cp}	Z_{cp}	#1 M	∠	#2 M	∠	#3 M	∠	#1 M	∠	#2 M	∠	#3 M	∠	1	2	3	4
10X	50+j0	9.5	3.6	8.5	4.0	7.0	6.3	0.6	156°	1	0°	0.35	185	21	15	36	49
		+.5											–	21	16	33	48
		-.5												19	15	37	50
				+.5										16	13	36	47
				-.5									–	20	13	30	48
						+.5								16	14	37	49
						-.5							–	13	11	29	40
			+.5											21	14	34	40
			-.5										–	22	13	34	38
							+.5						–	12	13	30	36
							-.5							23	16	29	36
10X		10.0		8.0		6.0	6.8	0.69	158°	1	0°	0.41	184	10.5	13	25	36
		+.5											–	10.5	13	21	34
		-.5												9	12.5	22	34.5
				+.8										7.5	11	21.5	34
				-.5									–	8.5	11	18	34
						+.5								8	10.5	18.5	34
						-.5							–	6.5	9	17	33
			+.5											6.5	8.5	16	29
			-.5											6.5	8.5	18	28
							+.5						–	5	7.5	17	27.5
							-.5							9	10	19	28
		10.5		7.5		6.5	7.3	0.74	160°	1	0°	0.5	185°	5	8	15	22

Fig. 3. Tabulation of readings after a D-A is brought back into spec by phasor rocking. See text for details.

they were prior to the first movement of this control.

Next, the phase control of No. 1 tower is moved in a similar manner, as are all the other controls in turn. When the exercise has been completed, the tabulation will look like Fig. 3.

Analysis of these results should show that specific adjustments to certain towers will cause changes in the desired direction in monitor point readings and phase monitor readings. It is usually possible to determine from this tabulation which way the phasor controls should be moved to obtain the desired results. I must emphasize, however, that it is absolutely essential to record the phasor settings before any knob is turned, and to keep an accurate and concise record of every adjustment made. If you don't do this, you are liable to end up with an array that is completely out of adjustment!

DA-NDA switching made easy

Many of the directional stations that have been constructed in recent years embody control circuitry that make it possible, in the case of a DA-N station, to switch from nondirectional to directional operation and vice versa by pushing a button. In the case of DA-2 stations, although more complicated, it is frequently possible to switch from each pattern to a nondirectional and back again by means of push buttons. If any of you are contemplating the construction of a new antenna system, or an updating or modification of an existing one, I would strongly recommend that you include this facility. It doesn't cost a great deal of money and the convenience that it provides is priceless. As a matter of fact, there have been strong suggestions that the Commission will, before too long, require that this facility be embodied in all directional antenna systems. I firmly believe, not only from an engineer's viewpoint, but also from the point of view of management (whose interest lies in preserving continuity of signal pattern during DA measurements), that it is a very worthwile addition to any antenna system.

The DA-NDA system that I have described above speeds up every kind of measurement operation. It is possible to go to any measuring point once only, and to read any antenna pattern value at that point in the course of two or three minutes. These readings are made under identical weather and field strength meter orientation and adjustment conditions.

I might add, in connection with NDA readings, that when questionable readings are noted at a monitor point, or when trouble in a DA operation is suspected, nondirectional readings taken at the monitor point and ratioed to the directional readings give a very good indication of an antenna's performance and condition.

An item that is frequently overlooked, because its operation is normally trouble-free and consistent, is the phase monitor system. We are not going to talk about the instrument itself, but we will talk about the connections between the instrument and the antenna system. If you have inherited a directional antenna system whose installation details are not very familiar to you, you would be well advised to become familiar with every detail of the installation, not forgetting where the excess sampling lines are stored.

As we are all aware, it is necessary that all sampling lines have the same electrical length. This means that the line length is controlled by

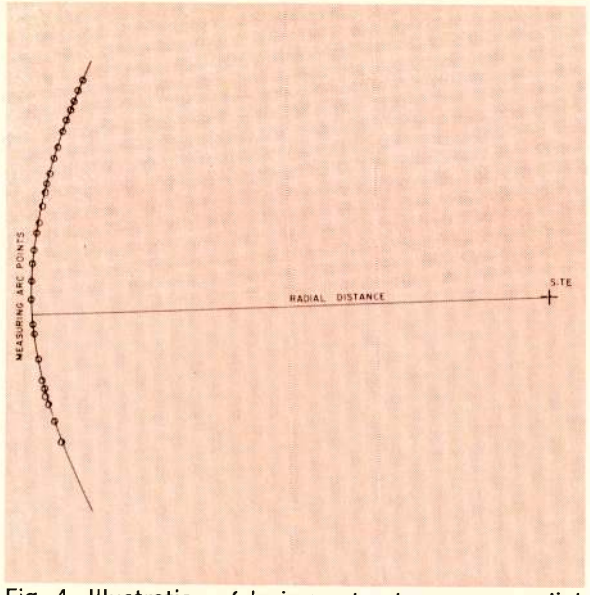


Fig. 4. Illustration of laying out a transverse radial when trying to locate null and lobe positions.

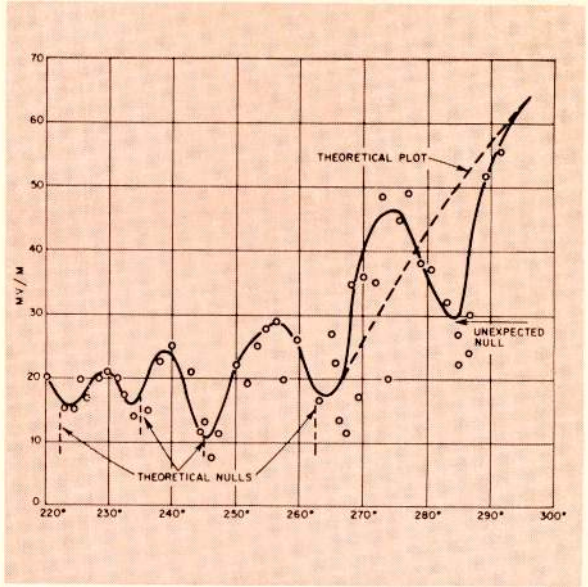


Fig. 5. Plot of transverse radial measurements showing azimuth versus field strength.

the distance to the furthest tower. The towers that are closer to the location of the phase monitor will have lines of the same length, but the excess line will have to be stored somewhere. It is an axiom of the FCC, and good engineering practice, that all excess line lengths be stored in such a way that equal lengths of all of the lines are subjected to the same climatic and temperature conditions. If this is not the case, the expansion or contraction of unequal lengths of line will cause a plus or minus change in the phases indicated on the phase monitor. If you experience changes of this type under extremes of weather condition, be prepared to check the location of the excess phase monitor sampling line.

Run transverse radials to spot nulls or lobes

Sometimes in the adjustment of a directional antenna, an unwanted null or an unwanted lobe may appear. It frequently happens when the monitor points have failed to show that the antenna is not correctly adjusted, i.e., the monitor points are within the FCC limits. But when a skeleton proof or radials are run, it is sometimes found that the inverse fields along these radials are higher than one would expect from the monitor point values. Or, of course, the points could be a great deal lower than the licensed monitor point values, and this again would be a cause for suspicion.

If an unwanted lobe or null is suspected, running a transverse, or cross radial, will frequently show up the unwanted effect. The technique of making a transverse radial is a little different from running a regular radial.

In the case of a transverse radial, it is a good idea to select an arc, or radius of a suitable value, perhaps two miles, and draw this arc with a radius covering the whole of the area under suspicion, Fig. 4. Good measuring points were picked at intervals of about 1/10th of a mile, or less, along this arc and a series of measurements made

When these measurements were plotted on linear paper with the azimuth plotted in degrees along the abcissa, and the field strength in millivolts along the ordinate, the pattern shown in Fig. 5 was produced. The licensed pattern called for a null at 277°. To our surprise, we found the null to be at 287°!

The transverse radial could, of course, be run as a straight line in any desired direction. Then the distance from the antenna would vary for each point, and a third variable would be introduced into the problems. Use of a transverse radial is not very common in normal directional antenna work, nor is it required or even desired by the FCC. However, it is a tool that can be very useful at times.

In concluding these notes on directional antenna problems, I might re-emphasize that many of the problems that station engineers encounter can be prevented by proper maintenance. It seems to be an obvious thing, but you would be surprised at the number of times we encounter DA problems which are directly traceable to what I like to call "agricultural laziness!"

The antenna field should be kept clear of all brush type vegetation, and grass and weeds should be kept cut to a low level. Within the area around the tower base screens, the crushed rock—and only crushed rock should be used there—must be kept clear of weeds and vegetation. Weed killer applied here at regular intervals is very useful. One of the surest ways of encouraging varying DA meter readings is to allow high brush growth in this area.

One station that we inspected had a wild grape vine securely wrapped around the RF lead from the tuning house to the antenna base. Luckily we found it before the "Grapes of Wrath" of the FCC descended on the station. **BM/E**

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Remote Control of TV Broadcast Transmitters—Including RF Switching

by S. M. King

Now that the FCC has ruled that VHF stations can employ remote control, broadcasters all over the country are studying how they can benefit. Author King says all operations should be controllable remotely to gain the maximum advantage from the ruling. This means remote switching of RF power.

MOST MODERN TRANSMITTERS ARE DESIGNED to permit remote control and monitoring. However, such is not the case with presently used transmission line systems which conduct the RF power from the outputs of the transmitter amplifiers to the antenna. In these systems, switching to bypass the diplexer, to connect a transmitter to a dummy load, or to put a standby transmitter "on-line" is done manually at the patch panels. This manual tearing down of one RF path and building up of another has typically meant leaving the air for anywhere from ten minutes to two hours, and is in no way remotely controllable.

Remote switching of high RF power can be reliably accomplished by means of motorized coaxial transfer and SPDT switches and switching control panels. Such switches are commercially available today in all currently used coaxial line sizes, although some configurations are more adaptable to transmission line layouts commonly found in broadcast stations than others. Any coax switch to be considered for use in broadcast stations must have manual override, electrical interlocks, and certainly should have positive mechanical locking into the operating positions. It should also cycle fast enough to keep off-air time to no more than one second. Fig. 1 shows a motorized coaxial transfer switch specifically designed for remote operation of broadcast transmitter systems.

Switching control panels should contain all necessary actuating switches and status lights. Such panels generally display a schematic of the switching system. By means of back lighting, the RF transmission paths in use are indicated to the operator. Control switches are located at the position in the schematic occupied by the coaxial switch being controlled to avoid human error. A typical panel is shown in Fig. 2.

Between the RF switches and the switching control panel, there is a certain amount of logic circuitry. This circuitry can allow certain preselected operating modes to be set up by activating a single command switch, rather than operating each switch individually. It can also make it impossible to set up "prohibited" configurations.

Mr. King is marketing manager of Micro Communications Inc., Manchester, New Hampshire.

Computer control is possible

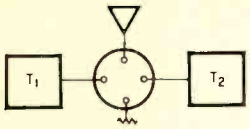
The RF switching systems as described in this article are amenable to computer control as well as operator control. Relatively simple programs can be written so that a computer can sense abnormal operation at many points in the transmitter system, diagnose the probable cause, decide on the proper alternate operating mode, issue appropriate commands to the switching system, and verify operation of the new mode. The advantages of computer control are quick-reaction time and predictable decisions—and the additional cost is modest.

Most VHF TV broadcast stations have two transmitters. In some cases one transmitter is simply a backup of the other one. In other cases both transmitters are used simultaneously with their outputs combined and than fed to a single antenna. A remotely controlled switching system can be designed for virtually any station configuration utilizing motorized coaxial transfer and SPDT switches and controls.

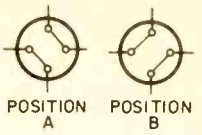
The simplest case is one in which either one of two transmitters is connected to the diplexer and the other, which can be on hot standby, is connected to a dummy load (Case A), chart. By using one transfer switch, as shown, either transmitter can be switched to the diplexer and the other to the dummy load.

The condition in which the outputs of two transmitters are normally combined (Case B) is somewhat more complex. The power combiner makes use of a 90°, or quadrature hybrid. This is a 4-port device which has the property that, when a signal is applied to any port, it is divided equally between the two opposite ports, but 90° out of phase, while the adjacent port is isolated. Now when two equal signals with a phase offset of 90° are applied to two adjacent ports, they appear at

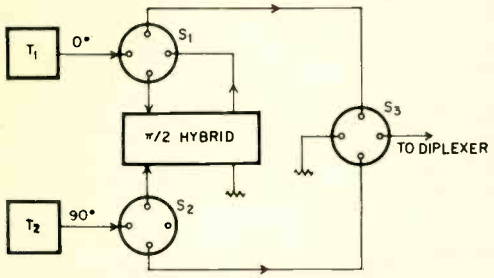
Case A: Switching alternate transmitters on line



Operating Mode	Switch Position
T_1 to Load; T_2 to Antenna	A
T_2 to Load; T_1 to Antenna	B

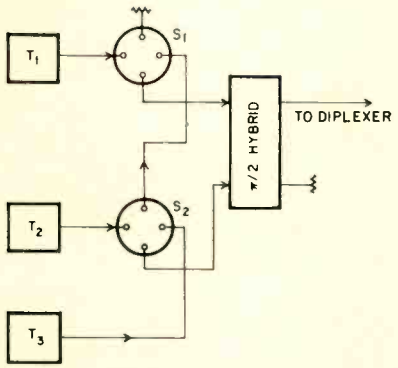


Case B: Transmitter outputs combined or used singly



Operating Mode	Switch Position S_1	S_2	S_3
T_1 and T_2 into Combiner; combined output to Diplexer	A	B	A
T_1 and T_2 into Combiner; combined output to Load	A	B	B
Bypass Combiner; T_1 to Diplexer; T_2 to Load	B	A	A
Bypass Combiner; T_1 to Load; T_2 to Diplexer	B	A	B

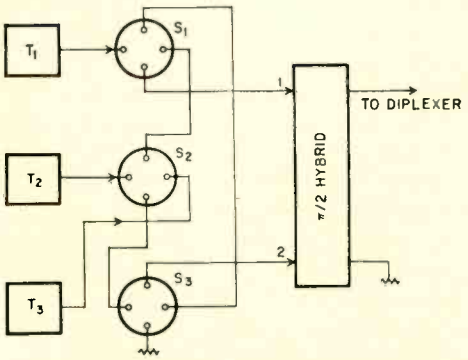
Case C: Combining outputs of any two or three transmitters



Operating Mode	Switch Position S_1	S_2
T_1 and T_2 combined; T_3 to Load	A	A
T_2 and T_3 combined; T_1 to Load	B	A
T_1 and T_3 combined; T_2 to Load	A	B

Note: The phase quadrature relationship between inputs to the hybrid combiner must (and can) be preserved.

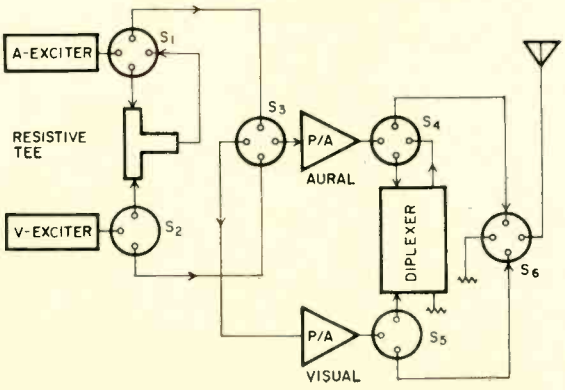
Case D: Combining outputs of any two of three transmitters with combined output fed to diplexer or to load



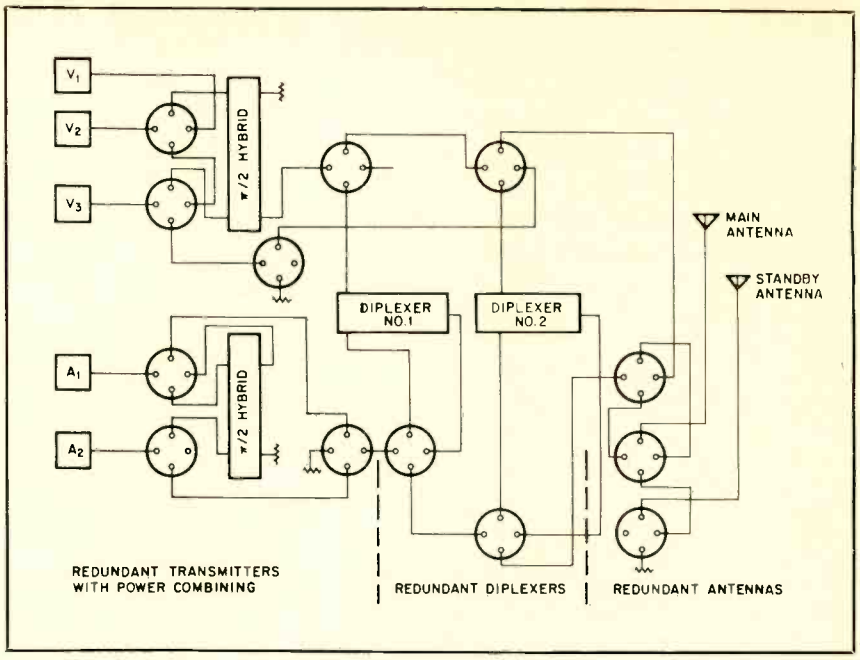
Operating Mode	Switch Position S_1	S_2	S_3
T_3 to port 2; T_2 to port 1; T_1 to Load	A	A	B
T_3 to port 1; T_2 to port 2; T_1 to Load	B	A	B
T_1 to port 1; T_3 to port 2; T_2 to Load (Above same as Fig. 5—Case C)	A	B	B
T_1 to port 2; T_2 to port 1; T_3 to Load	B	B	A
T_1 to port 1; T_2 to port 2; T_3 to Load	B	B	B
T_1 to port 2; T_3 to port 1; T_2 to Load	B	A	A

Note: The phase quadrature relationship between inputs to the hybrid combiner must (and can) be preserved.

Case E: Multiplexed visual and aural signals bypass diplexer



Operating Mode	Switch Position S_1	S_2	S_3	S_4	S_5	S_6
1. Each exciter to its own P/A; P/A outputs diplexed to antenna	B	A	A	A	B	A
2. Exciter outputs multiplexed in tee; multiplexed signal to aural P/A, to antenna; visual P/A to load	A	B	A	B	A	A
3. Exciter outputs multiplexed in tee; multiplexed signal to visual P/A, to antenna; aural P/A to load	A	B	B	B	A	B



Hypothetical TV broadcast station with remotely controlled rf switching. Depicts redundant transmitters, diplexers and antennas.

one opposite port 180° out of phase (no signal) and in phase at the other (full signal). It can be seen then, that as long as both transmitters are operating, the sum of their power is available to the antenna. However, if one transmitter fails, the power of the remaining transmitter is split in two and only one-quarter of the original power goes to the antenna. Therefore, a switching system for two combined transmitters must make provision to by-pass the combiner and connect either transmitter to the diplexer, as well as connect either transmitter or the combiner output to a dummy load.

There are cases where a station has three transmitters (Case C). The outputs of any two are combined and then fed to the diplexer, while the third is maintained on standby to be switched into the system should either of the active transmitters fail.

In this last case, it is often considered unnecessary to bypass the combiner, since the probability of two transmitters failing simultaneously is small. However, if one desires to bypass the combiner, the switching system would be a combination of Case C and Case B.

There is an interesting variation of Case C described above (Case D) which allows one load to be used both as a dumping load and the transmitter test load. By the addition of a third transfer switch, not only can any two transmitters be connected to the combiner in proper phase relationship so that the sum of their outputs appears at the output port, while the third transmitter is connected to a dummy load just as in Case C, but also, any two transmitters can be connected to the combiner in reverse order so that the sum of their outputs appears at the load port of the combiner with all signals cancelling at the output port. Although the combiner load must now have sufficient capacity to absorb the full power of two transmitters, rather than one-half the power of one transmitter, one load is eliminated from the system. And the additional switch would be required, in any event, to switch the combiner output between the diplexer and a load.

A common method of maintaining signals on the air, used by UHF stations equipped with single visual and aural transmitters in the event one should fail, is to multiplex the exciter signals and utilize the remaining transmitter amplifier. When this is done, the diplexer must be bypassed and the signal fed directly to the antenna. (Case E.) At the same time, the dead transmitter must be connected to the dummy load so that repairs can be made and the transmitter fully tested prior to returning to the air. A typical diplexer bypassing scheme is shown.

The situations described in the preceding paragraphs are simply typical examples to indicate the flexibility of operation which can be achieved through the use of remotely controlled switching systems. For simplicity, we have ignored the fact that there are both visual and aural channels in television broadcast transmitters. In general, the visual and the aural channels will require separate and equivalent switching systems up to the point of diplexing. Practically any operating mode can be established by means of an appropriate switching system. Other typical switching functions include:

- Switching between main and emergency antennas.
- Switching between parallel transmission lines.
- Switching between redundant diplexers.
- Switching any transmitter off line into dummy load.
- Bypassing diplexer with multiplexed signal fed directly to antenna.
- Switching transmitter outputs from diplexer inputs to separate antenna inputs.

These, and many other operating modes, can be selected separately or in combination, depend-

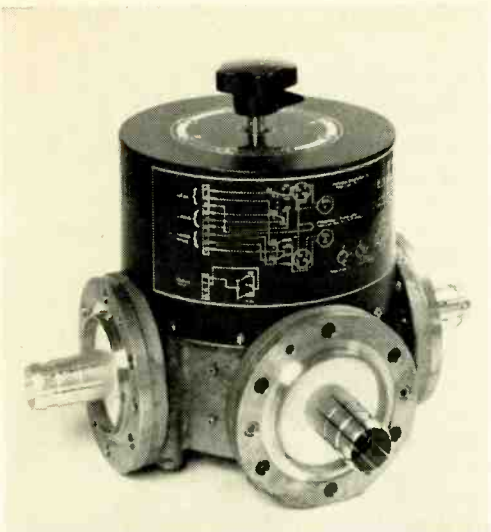


Fig. 1. Motorized coaxial transfer switch 3⅛ in. in diameter manufactured by Micro Communications Inc. Switching time is less than ½ second.

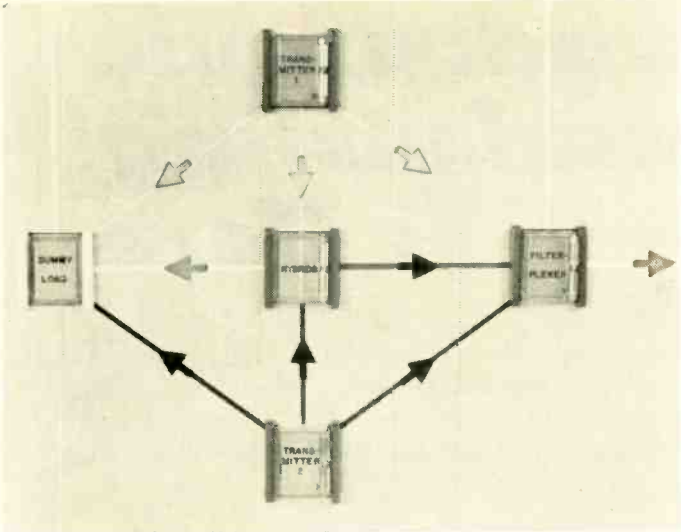


Fig. 2. Switching control panel with back-lighted schematic associated with switching system for two transmitters with combined or independent outputs.

ing on the switching logic designed into the system. The elements of the switching systems to which we have been referring, high power coaxial switches, logic circuitry, and switching controls, permit considerable flexibility in the system design.

Fig. 8 is the schematic of a hypothetical station with redundant transmitters, redundant diplexers and redundant antennas. The coaxial transfer and SPDT switches make it possible for an operator at a remote switching control panel to choose many alternative modes of operation. Parts or all of this schematic can be used as a guide when planning a switching system for any particular station.

RF switching systems are custom designed, using standard, commercially-available components with system complexity dictated by the individual station's requirements and available funding. Also, an initial switching system can be developed with the capability of future growth without obsolescence. Further, systems involving both remotely-controlled motorized switches to rapidly handle unexpected situations, and patch panels to establish routine configurations on a scheduled basis, are feasible.

When planning or evaluating a proposed remotely-controlled RF switching system, there are a number of questions which should be answered to ensure a satisfactory level of performance and reliability. The following are the main questions to be borne in mind:

- Are the switches rapid-acting so that a transmitter can be blanked, the switching operation completed, and the signal returned to the air in no more than *one second*?
- Do the switches have a manual override feature?
- Are the switches equipped with the appropriate "micro-switches" to accomodate the switching logic circuitry? (These switches are necessary for position indication, blanking, interlocking, etc.)
- Are switch operating positions positively determined by locking pins?
- Does the switching logic circuitry permit change to alternate operating modes automatically by a single push-button command? (At least some mode switching should be done automatically to minimize down-time under emergency conditions.)
- Can the switching system be computer controlled?
- Can other modes be set up by operating each switch individually in sequence?
- Will the logic circuitry refuse to accept "forbidden" combinations?
- Does the switch control panel display the entire RF circuitry in schematic form, and does it indicate the signal flow path?
- Is the position of each switch displayed?
- Is each switch control located at its respective switch location in the schematic?
- Are switches protected from inadvertent operation?
- Are single-command mode switches clearly labelled with the operating mode they establish?
- Are operating modes indicated at the mode selection switches, as well as on the circuit schematic?
- Is switch position maintained if all power is temporarily lost?
- If future growth is planned, does the switching system have sufficient capacity to accomodate this expansion?
- Are the phase relationships preserved for combiner operation?

These guidelines to the efficient design of RF switching systems and selection of equipment for television broadcast service are a distillation of many years of experience in planning switching systems for vhf and uhf broadcasters. **BM/E**

Quadrasonic Broadcasting Is Here

It's hard to keep score but probably as many as 30 stations have done, or are doing, some broadcasting of four-channel stereo. The Electro-Voice 4-from-2 system is in the lead but purists denounce it.

FOUR CHANNEL STEREO "is where it's at," Richard Kaye, WCRB, Boston, told the 1971 NAFMB annual convention, and then quipped, "It's being pushed by manufacturers of VU meters." There is no doubt about it, four-channel stereo, real or pseudo, is here. But it's being pushed by innovative broadcasters and not meter manufacturers.

Jon Kelly, Electro-Voice Inc., reported at the NAFMB convention last March that 24 stations had done some kind of four-channel broadcasting. We suspect the number is over 30 by now. Most stations that are doing regular quadrasonic broadcasts are using the E-V encoder to convert four channels of information into two. Listeners with a $60 decoder from E-V (and two more amplifiers and speakers) can hear full quadrasonic programming.

The E-V approach is in the forefront now because the system is simple, inexpensive, within FCC regulations and, most importantly, is available. The experiences of WRNL, Richmond, Va., and WDHA, Dover, N.J., both using E-V equipment, will be discussed later.

But for every shrill decibel of enthusiasm being evoked now for quadrasonic broadcasting as it is being practiced today, there is an equal magnitude of base grumbling coming from other quarters—dedicated devotees of four-channel broadcasting, but *true* four-channel, not *pseudo* four channel as the E-V, Dynaco, Scheiber and Sansui systems are described by the purists.

There are basically two approaches to quadrasonic broadcasting:

1. a carrier-multiplexing approach,
2. a matrixing approach.

The purists belong to the first group. They have a vocal "unofficial" leader in the person of Jim Gabbert, KIOI, San Francisco, an early pioneer in experimental (after hours) true four-channel broadcasting using the Quadracast Inc. method invented by Lou Dorren. (Gabbert also did some of the first four-channel broadcasting by simulcasting with another station.) This "faction" has the sympathetic ear of Harold Kassens of the FCC, who dubs the 4-from-2 approach "pseudo" four channel. The trouble is, though, that the carrier-multiplexing approach will require an FCC rule

Sansui 4-Channel/2-Channel Encoder/Decoder System

THE SANSUI QS SYSTEM enables encoding of four information channels into two, then decoding or recovering the four original channels. Some background material is helpful to understand its operation.

The sound image between the L (left) and R (right) speaker in conventional two-channel stereo transmission is established by differences or similarities in phase and magnitude level of the signals in the two channels. The signal components involved may be classified as being 1) in-phase components, 2) independently-phased components and 3) multiple, random-phased components:

In-phase components will generally occur when the originating instrument or other sound source is midway between locations L and R, Fig. 1A.

Independently-phased components generally occur when the location of the source is entirely on the left (or right) only, Fig. 1B.

Multiple random-phased components tend to be produced by echoes—bounced, indirect sounds that interact with each other in myriad, complex patterns that cannot be easily simplified, Fig. 1C. Note that these signals do not provide useful information on sound location or position. They do contain information useful for expansion of the sound field and are important elements in the QS 4-to-2/2-to-4-channel conversion system.

The Sansui QS decoding matrix functions as follows:

$$F_L = L + kR$$
$$F_R = R + kL$$
$$R_L = L - kR$$
$$R_R = R - kL$$

where k is a constant (blend factor) < 1. It must be predetermined and adjusted to the same value for encoding and decoding.

The block diagram of the QS decoding matrix appears in Fig. 2. Fig. 3 gives the correlation between the signals in the matrix system and their location and distribution in the listening area. Fig. 4 is the schematic of the matrix circuit. The cases in which the two channels are **in phase, 180° out of phase,** or in which the signal occurs **independently in one channel** but not the other all relate to recognizable points of location. In addition, **randomly phased** components carry information concerning indirect sound or echo. If channel gain control is included in the decoding device, it is possible to control the distribution of the "environmental" sound included in the two channels to the degree desired. This may be done to the degree that the introduction of an entirely artificial delay or echo becomes unnecessary.

The encoding matrix, not surprisingly, is essentially a reversal of the decoder already shown. Encoded L and R channels consist of the following components:

$$L = F_L + kF_R - R_L - kR_R$$
$$R + F_R + kF_L + R_R + kR_L$$

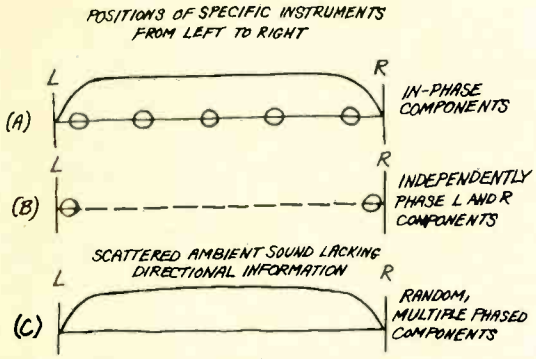


Fig. 1. Three different sound components and their distribution.

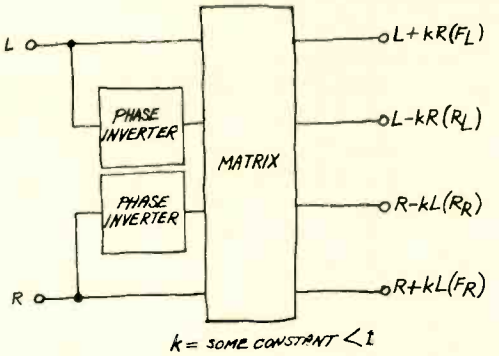


Fig. 2. Block diagrams of the QS decoding matrix.

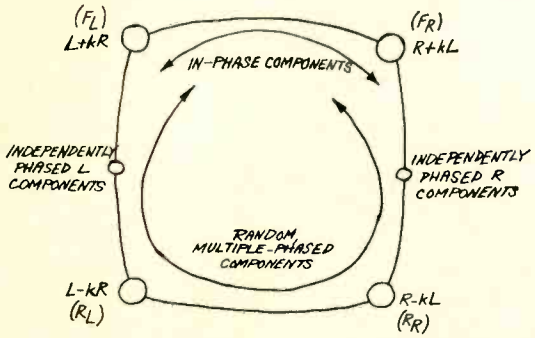


Fig. 3. Correlation of signals in the matrix with speaker.

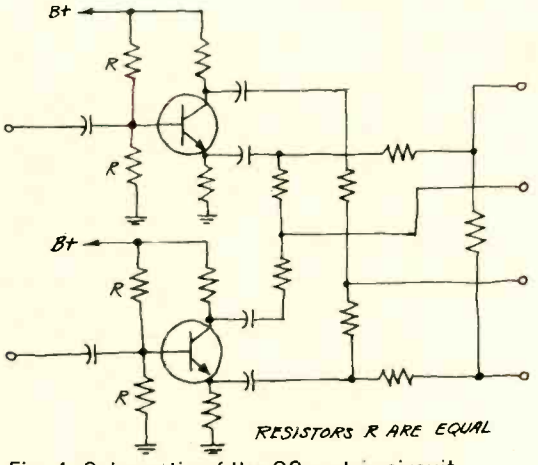


Fig. 4. Schematic of the QS matrix circuit.

Again, k is a constant representing the blend ratio, which must be set to the same value as in the decoding matrix. A detailed analysis would show that, after decoding, R_L and R_R signals are 180° out of phase. Rather than to reverse real-speaker polarity, a 90° phase-shift network has been introduced into each of the rear channels. The R_L channel has been delayed 90° while the R_R channel has been advanced 90°, achieving a total change of 180° as between the two rear channels.

Role of a phase modulator

If one disregards phase-interference patterns that exist in the presence of live sound and tries to reproduce the sound through two speakers, as in conventional two-channel stereo, the effect falls short of convincingly simulating the original situation. This is true for more than one reason, but the limitation of dynamic range, as an example, is one important one.

Apparent dynamic range, particularly with respect to short-duration sounds, is greatly dependent on reinforcement by indirect sound components. (This may be observed by noting the difference in apparent loudness when the hands are clapped in an open field or anechoic chamber as compared to the apparent loudness when the hands are clapped with the same force in a reverberant location.) Despite a high peak amplitude, a transient will not seem loud. If it can be followed by echoes that are only briefly delayed, the impression on the human ear is that of pulse-stretching—the apparent duration of the sound has been increased and it sounds notably louder.

Increasing from two channels to four, while improving the sound distribution somewhat, still does not reasonably approximate the sound-interference fringe. To achieve this strictly by increasing the number of channels, one would have to add a substantially greater number of channels than would be practical.

To achieve the large number of phase-differentiated signals that simultaneously occur in the live sound field, Sansui continuously phase modulates the rear-channel signals relative to the front information. Indiscriminate use of such phase modulation could easily obscure the sound image and directional information encoded in the rear-channel signals. The modulation must therefore be applied in a controlled fashion. The actual phase-modulator configuration in the QS system consists of the phase-shifter network, a frequency modulator and three audio oscillators. Action of the phase modulator is tailored to take into account the frequency characteristic of the phase shifter. A "random" control signal governs the action of the phase modulator portion, this "random" signal itself being made up of the output of a subsonic oscillator in combination with sampled program material. Phase modulator action is thus determined, to a great extent, by signal content.

change—at least as it is being done by Quadracast, since bandwidth requirements exceed 75kHz plus a 25kHz guardband for a total of 200kHz. But the Quadracast approach doesn't sacrifice any of the high quality of the best of two-channel stereo.

Separation between left and right speakers remains 40 to 42 dB over a 50-1500 Hz range with signal-to-noise ratios of 60 to 62dB per channel. The mono and two-channel stereo listeners get a mixed-down added signal of all four channels. Four-channel listeners having Quadracast decoders can get four discrete channels of information. The 4-from-2 systems cannot achieve this separation (which is more on the order of 4 to 11 dB). Incidentally, it is the use of the phrase "four independent channels of sound" in the E-V literature that incenses Gabbert.

The Dorren Quadracast approach uses a 76 kHz subcarrier to furnish decoding information. This produces, with sidebands, a total bandwidth of 92kHz deviation rather than 75kHz. Although this is within the guardband protection for FM, the FCC is concerned that the station in the next frequency will be hurt. Gabbert thinks not and will submit data to the FCC shortly to show that broadcasters using subcarriers now use up as much bandwidth. Furthermore, Quadracast reports that the phase shift systems used by the 4-from-2 advocates create problems for automobile reception as field tests show. Lou Dorren agrees that matrixing schemes can produce pleasing and enhancing effects but says true discrete four channel does that plus much more. He points out recordings are being made on 8 and 16 tracks and, if you mix down to four rather than two, you can get genuine rather than synthetic effects.

As Kassens looks at the situation, the FCC can only regulate system design between the mike and the transmitter. If matrixing encoders are added before the input jacks, the signal could be altered in phase (or even distorted) and it would be outside of the FCC's jurisdiction, providing the outcome does not interfere with normal mono or two-channel stereo reception. That is, the FCC wants to make sure that the mono and stereo listener gets every bit of information contained in the original program. It would not like to see the quality standards set for two-channel stereo compromised. At the NAFMB convention, Kassens said he was concerned that it is being implied that the E-V system, or others like it, have FCC approval. The FCC has approved no system, he points out.

Matrixing enhances: no real compromise

The proponents of the various matrixing approaches say there is no real point in waiting for the ultimate in perfection since the key issue is compatibility. As Morley Kahn of Dynaco, Inc. points out, the Crossley stereo system was considered superior to what was adopted by the FCC, but it lacked compatibility and therefore lost out. All of the matrixing systems proposed so far are compatible with existing service. Kahn raises several questions, the answers to which support the matrixing approach. "Do you want to emulate the concert hall or do you want the band right there in your living room?" If it's concert hall ambience that you want, you don't need four discrete tracks. (And if you place musicians in the four corners of your living room, you can't *also* have ambience, says Kahn.) Kahn also asks, "In whose interest should we be concerned, the hardware manufacturer or the listener?" His reply is that the matrixing approach is simpler at half the cost.

WRNL plays quadrasonic music from 4-channel tapes, such as Project 3 releases, on Sony 4-track tape deck or from RCA 8-track cartridges on Toyo cartridge player. E-V encoder is on bottom of stack. Rerecorded encoded two-channel tape is handled on automation equipment.

Of course, the matrixing schemes on the scene so far are not alike and, although there may not be a compatibility problem in terms of mono or two-channel stereo listeners being short-changed, encoding-decoding systems all use slightly different parameters and this means there is a standardization problem.

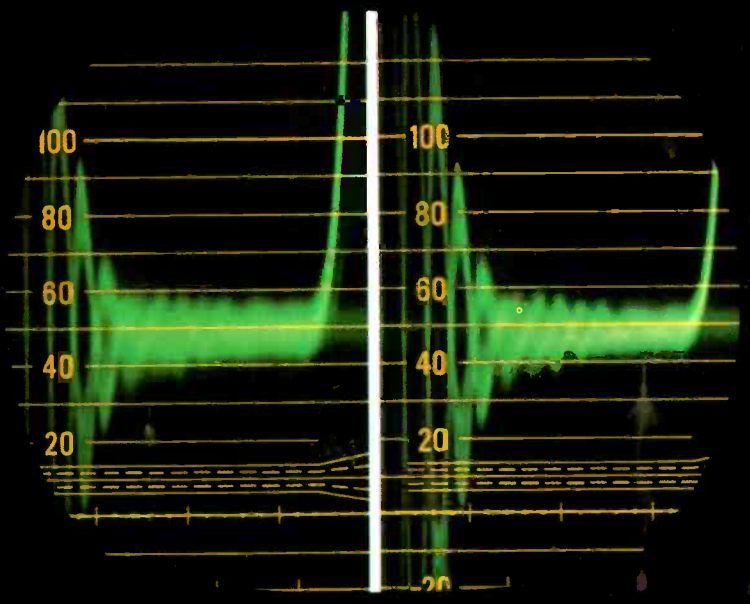
For example, the Scheiber scheme of matrixing provides one-to-one directionality; i.e. if the programming is delivering one signal to a specific speaker, the listener can hear this individual signal move from one speaker to another as the original was recorded. Scheiber says his system, therefore, provides balanced programming material and that all signals are heard with their original intensity. Other systems divide the signal up and often rear channels are way down or lost.

But detractors of the Scheiber system say it requires use of comparative amplifiers which are gain sensing. This is an expensive approach and if the programming material was not designed for four speakers (i.e., having strong original direction), the artist's position will float from speaker to speaker. This apparently comes from gains being expanded and compressed in each pair of diagonal speakers in proportion to the relative levels decoded for the two speakers.

The Electro-Voice system is based on Len Feldman's approach (*BM/E*, May, 1970). The decoding takes into consideration the trade-offs that are possible. Rather than try to get an equal

(Continued on page 28)

New Memorex Chroma 90 has the highest signal-to-noise ratio of any conventional video tape.



Chroma 90 averages 2 db less noise than any competitive broadcast tape. Look at it on a waveform monitor. Chroma 90 (right) shows a 20% lower noise level than the leading broadcast tape. You get cleaner masters, sharper dubs.

balance from each speaker, as does Scheiber, a technique of reducing the separation of the front speakers to get more localization of the artist is used. Also greater back-to-front isolation at the expense of rear separation was chosen. According to E-V, the listener can balance for his particular listening position wherever he is in the room or be able to walk around the room and hear the signals as he might expect from the four recording points. The coefficients were chosen to trade off apparent isolation with price.

Enhanced Listening Play List

Much regular two channel stereo comes across greatly and naturally enhanced—sometimes almost as well as true four-channel with most matrixing schemes. The reason is that some two-channel stereo has a singer or musical instrument centered equally on both channels. This information then goes to the front speakers via the decoder. Any information (like echo or natural ambience) that is partially out of phase goes to the rear speakers via the decoder. The degree of enhancement varies greatly since these recordings were not designed with four-channel sound in mind. WDHA-FM has put together a partial list of some current recordings which are enhanced quite well with the decoder.

CLASSICAL AND PP CLASSICAL:
Ravel's Tzigane-Moscow Symph. Orch.
(Angel SR40077)
Debussy-Nocturnes/Ravel-Daphnis & Chloe
(DGG-2530038)
The Carmen Ballet-Arthur Fiedler/Boston Pops
(RCA-LSC3129)
Fiedler's Friends/Boston Pops
(RCA-LSC-3199)
Fabulous Broadway-Arthur Fiedler/Boston Pops
(Polydor)
Mantovani in Concert (London PS578)
Mantovani Memories (London)
Piano Rags by Scott Joplin-Joshua Rifkin
(Nonesuch H71248)

LIGHT POP:
An Astromusical Odyssey-Spunds Galactic
(London Phase 4)
Spaced Out-Enoch Light (Project 3)
Tap Root Manuscript-Neil Diamond (UNI)
El Condor Pasa-James Last (Polydor 24-4509)
Elton John (UNI73090)
Bridge Over Troubled Waters-Paul Desmond (A&M)
Oktoberfest/Strictly Oompah-Will Glah's Orch.
(London Phase 4-SP441-22/44145)
Whales and Nightingales-Judy Collins
Magical Connection-Gabor Szabo (Blue Thumb)
Panorama-Wes Montgomery (Riverside-RS3046)
All Simon & Garfunkel albums—especially
"Bridge Over Troubled Waters"

HEAVIER POP:
New Ways But Love Stays-Supremes (Motown MS720)
All Things Must Pass-George Harrison (Apple)
Jesus Christ Superstar (Decca)
Sidewalks Talking-Hollins & Star (Ovation)
Emerson, Lake and Palmer (Cotillion SD9040)
John Barleycorn Must Die-Traffic (VA55504)
Rotary Connection (Cadet LPS312)
All Beatles albums—especially "Sgt. Pepper"
(Apple & Capitol)
All Moody Blues Albums (London & Threshold & Deram)
Many selections on all Chicago albums (Columbia)
All Crosby, Stills, Nash & Young albums—especially
"DeJaVu" (Cotillion)

The coefficients of the decoding also permit regular two-channel stereo to be processed with interesting results. Again, these coefficients localize the center stage artist to the front of the room and, indeed, if the front speaker channels are turned down, he will not be heard in the back speakers. The far outside information of the original two-channel recording will be heard predominantly in the back speakers. One can have the illusion of sitting in the audience and hearing ambience or applause on all sides, as if he were in the audience. If one prefers to sit on the performing group, he can balance his rear speaker levels so the performance information appears to come from the front, and all other information from the room. Sansui reports it has sold a number of Quadphonic Synthesizers, QS-1, for the purpose of achieving surround sound for any stereo broadcast. The Sansui is not exactly a simple device—it has a seven-position effects switch and sells for over $200—but quite dramatically it transforms two-channel stereo into a "live sound field." Some listeners report the effect is more pleasing than that achieved by four-channel equipment.

The Sansui synthesizer uses a matrixing circuit which analyzes and then synthesizes separate direct and indirect sound components to produce four channels from two.

Direct sound waves are defined as those having identical amplitude and phase. They are extracted from the two sum signals that would come from two microphones placed in front of a musical instrument. They emerge from the front speakers. Remaining indirect sound wave components, those possessing different amplitude, phase, and frequency characteristics, are released from rear speakers.

The sound field created when the indirect sound waves from the rear meet the direct signals from the front is judged very satisfactory. In fact, there are no holes or disorientation signals present, which sometimes happen in discrete four-channel reproduction.

Sansui has also developed a separate encoding matrix system to develop 4-from-2. This system was imported into the U.S. and is being evaluated now at WFMT, Chicago. *BM/E* has learned that this system is now in production after making some changes in the matrixing parameters which were recommended by the station. Thus, Sansui equipment may soon be a real alternative to E-V. WFMT's evaluation is considered significant since this station has a high reputation for quality (*BM/E*, December, 1970).

Sansui has not been secretive about circuit details as have others which are presumably worried about patent protection. The accompanying box, Sansui Encoder/Decoder System, reveals some details.

WDHA's experience

WHDA, Dover, N.J., made its first four-channel broadcast on February 5th. On March 8th the

(Continued on page 46)

New Memorex Chroma 90 gives the best color performance of any conventional video tape.

See how Chroma 90 virtually eliminates chroma noise during programming. Here it's playing back 100% color bars. Try that with anybody else's tape and see what happens.

Who's In Charge Here? The Third-Phone Flap

THE LICENSED OPERATOR in charge of a broadcast transmitter has been the subject of much controversy throughout broadcasting's 50 years. The latest series of arguments has been raging for over a year, and an FCC decision in the matter is near. Stated simply, the question is: Should third-phone operators be permitted to run a radio station—regardless of power, directional antenna, etc?

Background

Originally a first-phone operator had to be on duty at all broadcast stations. In 1953, the FCC authorized RP's (Restricted Radiotelephone Permits) for routine operation of non-directional AM stations of 10 kW or less, and of the same time, the Commission permitted remote control of these stations. The rules then provided that at least one first-phone man be in full-time employ at such a station.

By 1963, it was common knowledge that holders of RP's, who are not required to pass any exam, weren't doing too well as transmitter operators. The FCC amended the rules, banning the RP for broadcasting, and substituting the familiar third phone with broadcast endorsement as a requisite for routine operation at the types of stations mentioned earlier. In lieu of having a first-phone man in permanent employ, a station could hire a part-time or contract chief, the Commission ruled. At that time, the FM power ceiling was increased from 10 kW to 25 kW for third-phone operation.

During the 1960's many stations (chiefly in small markets) complained of the difficulty their employees had in getting even the endorsed third phone. In 1968, the FCC introduced the Provisional Radio Certificate, which is issued before examination and carries the authority of an endorsed third phone. It is good for only one year and may not be renewed. The idea is to permit a person to operate until he can take the regular exam and qualify for an endorsed third phone.

NAB petition

In March 1970, the NAB filed a petition with the FCC, asking for a rule change to permit routine operation by endorsed third-phone operators at substantially all radio stations. A similar petition was filed in May 1970 by the Oregon Association of Broadcasters, and other similar requests have been made by individual broadcasters.

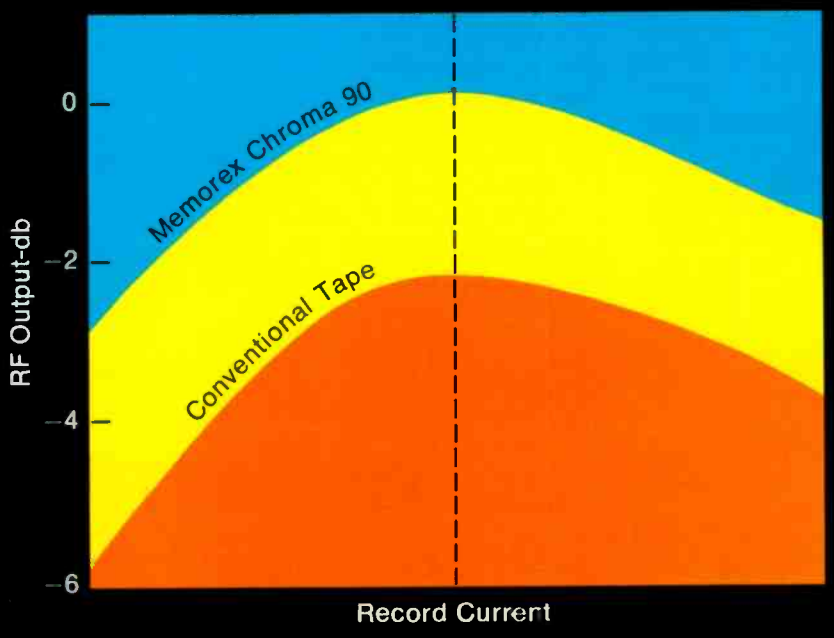
The gist of the argument by NAB et al is to permit all AM stations, both directional and non-directional, and FM stations with powers of 50 kW or less, to use endorsed third-phone operators. Directional AM's would be required to have one first-phone man employed fulltime; other stations could have contract chiefs. The rule change is urged for several reasons:

- First-phone men are hard to find, because defense and space electronics pay more.
- Modern sophisticated transmitters are so stable they don't require first-phone nursemaids; meter reading can be done by third-phone operators.
- Most first-phone men do little more than meter reading anyway, and the first-phone exam doesn't cover directional operation at any length.
- Most stations usually rely on an experienced, qualified chief engineer for anything other than routine operation.
- High-power FM, and high-power non-directional AM stations are no more complex than their low-power counterparts.
- The FCC already requires a showing that a directional array is stable before granting remote-control permission, and some 420 stations have demonstrated this stability. This, along with the increased accuracy and efficiency of phase monitoring, should remove the need for constant attention by a first-phone operator.
- Relaxed operator rules will benefit minority-group members by opening new jobs for them. It is stated that the first-phone exam is very difficult, but that most persons can pass the third-phone exam easily. It is claimed that the first-phone exam requires either months of home study, study at an accredited radio school at considerable cost in time and money, or taking a "quickie" course costing $500-$1000. The proposed rules, says NAB, would open up numerous opportunities to minority group members not having the time, money, or innate technical aptitude to become first-phone operators.

The Association on Broadcasting Standards Inc. supported the NAB petition, and stated that proper operation of a directional AM can be secured with one first-phone man in full-time employ, who has the duty of examining and countersigning the operating log each day. Some 20 AM and FM stations supported the proposal, as did the Alabama and Georgia Associations of Broadcasters, and various U.S. senators and congressmen. Their reasons were similar to the above, with the addition of the argument that many first-phone men are 90-day wonders from "quickie" schools who have very limited technical expertise, and who are hardly more qualified than endorsed third-phone men. Other arguments: Under present rules, stations must hire the licensee, instead of the (experienced) man. It

(Continued on page 32)

New Memorex Chroma 90 has the highest RF output of any conventional video tape.



For a given amount of head current, see how much more energy you get from Chroma 90 than from other tapes. Yet it's perfectly compatible with systems set up for conventional tapes.

would be better to pay less to (third-phone) operators, and more to a really qualified (first-phone) chief.

Opposition to NAB

In May 1970 Elkins Institute of Dallas, a long-established radio school, filed with the FCC a statement opposing the NAB petition. The National Association of Broadcast Employees and Technicians (NABET) also filed a statement opposing the NAB request.

Elkins' principal argument is that NAB is more concerned with the economic prosperity welfare of stations than with maintaining a public trust. The chief points:

- Lesser-grade (third phone) license holders are doing a poor job of operating stations. According to FCC Annual Reports, the discrepancies per inspection of AM and FM stations rose from 35% in 1953 to 100% in 1968, a situation described as "technical erosion."
- There is no shortage of first-phone license holders; more than 96,000 were licensed as of 1969. Radio stations have trouble attracting first-phone men because salaries are too low.
- It is true that some first-phone men are not fully qualified, a situation found in any line of business. Qualification is obtained through formal training (at an established school) plus intensive experience and in-house training, whose importance NAB has recognized in its broadcast manuals. At any rate, a first-phone man is still more qualified than an endorsed third-phone holder. Even meter reading requires both accurate reading and evaluation by a person sufficiently qualified to use the information and detect trouble before it occurs.
- The NAB is inconsistent in arguing that the first-phone exam is very difficult, but, on the other hand, doesn't guarantee competency. A similar inconsistency: The third-phone test guarantees familiarity with broadcast equipment and procedures, and at the same time it's easy for anyone to pass.
- It may be theoretically true that modern broadcast equipment is very stable and doesn't require constant attention. However many radio stations use old, outmoded equipment which doesn't perform properly.
- The NAB has taken the wrong approach to the minority employment problem. Rather than downgrade a job so more persons can hold it, the skills of the potential employees would be up-graded so they can be eligible for jobs. The NAB would render a disservice by lowering standards so a barely-qualified minority-group member can get a job in which there is no possibility of advancement.

The Elkins' petition was accompanied by a number of supporting letters, including one from Bernard Wise, president of CCA Electronics, who urged the importance of having a number of people at a station who can communicate with the transmitter supplier in the event of trouble. The importance of being able to detect subtle deviations in performance, so as to anticipate trouble, was emphasized. Another supporting letter was from B. Whitfield Griffith, Jr., an authority on high-power broadcast systems. He felt that endorsed third-phone operators could not be relied on to competently operate the many complex directional arrays now in operation.

NABET, as well as various individual first-phone holders, advanced many of the Elkins' arguments. In particular, NABET asked how minority-group members will be persuaded to qualify for broadcast employment if they know they will be entering essentially a declining market, which the industry hopes ultimately to phase out of existence.

FCC reaction

In July 1970, the FCC responded to the above actions by adopting a Notice of Inquiry and Proposed Rule Making (Docket 18930). Considerable discussion of the arguments ensued:

- The FCC noted the economic plight of many small-market directional stations, which accounts for the relatively low operator salaries at such facilities.
- It was felt that the number of rule violations was more likely due to lack of technical supervision, rather than being necessarily a function of the grade of routine operator employed.
- The present operator at a station using modern equipment is more of a monitor than a repairman; operators seldom do more than notify the chief or consultant when repairs or adjustments must be made at a directional station.
- Directions vary, from simple two-tower versions to complex multi-tower arrays; so does stability. Thus no blanket statement can cover all directions. It is noted that a directional must be maintained within specified limits or it will cause interference to other stations.
- The Commission has therefore always considered it unfeasible to permit lesser-grade operators to operate directionals. However, it may be possible that certain directional stations, upon showing of stability and reliability of the transmitting equipment, could be routinely operated by endorsed third-phone operators, if they were precluded from making any adjustment which might adversely affect array operation.
- The FCC agrees with the NAB proposal which would require a first-phone operator in fulltime employment (rather than on contract) if endorsed third-phone men are to be used for routine operation. Moreover, the FCC would add a requirement for a backup first-phone man, to be on call for periods when the fulltime first-phone man is absent or unavailable.
- The Commission would also add a requirement that a first-phone man be on duty every day the station is in operation, and at the beginning of operation in each directional mode. He would also have to read and countersign the previous day's operating log if a first-phone man wasn't on duty at day's end.
- The chief or supervising engineer at a directional station should be qualified in DA operation, which is difficult to insure under the present licensing procedure. It is suggested that a DA endorsement be added to the rules, with a supplementary exam required for the first-phone operator who is to be chief or supervising engineer.
- Instruction of lesser-grade operators by the supervising first-phone man should be increased.
- Critical arrays and arrays of

(Continued on page 42)

Here's your chance to call our bluff.

Memorex Corporation, Video Products
Memorex Park, Santa Clara, CA 95050

I'd like a free 15-minute reel of Chroma 90.

Name _____ Title _____

Address _____

City _____ State _____ Zip _____

Firm _____ Phone _____

(Limited time offer. Only one free reel per firm.)

Everybody says they have the best tape on the market. So we don't blame you if you're skeptical about our claims.

That's why we're willing to let our tape speak for itself. Send for a free reel of Chroma 90. Use it on your own equipment.

We don't expect our talk to convince you. But our tape will.

MEMOREX

Circle 112 on Reader Service Card.

Now showing...the New Reliables

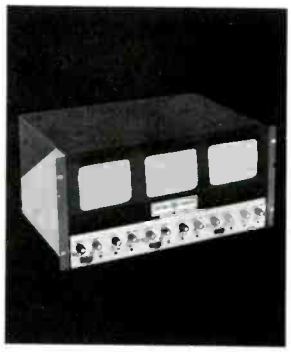
Five inch monochrome assembly features three 5" units in rackmount configuration. Small size requires less rack space than similar units and permits monitoring of 3 separate video signals. High quality, all-purpose monitors with Setchell Carlson UNIT-IZED® plug-in circuit modules.

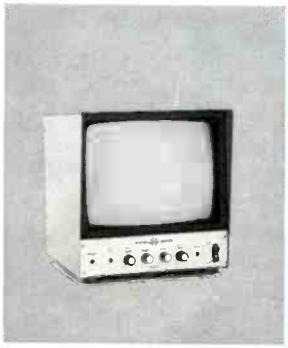
New 10" monochrome video monitors offer horizontal resolution of 640 lines or better plus 100% solid-state circuitry for long-life reliability. Unit is available in rackmount or in attractive metal cabinet. A 12" model is also available.

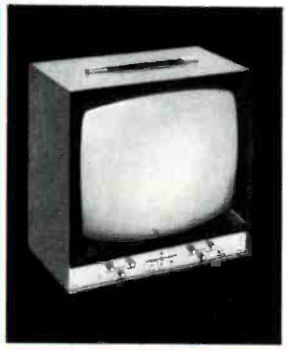
In addition to 640-line resolution, the 16" monochrome monitors have all major operating controls located on the front panel for ease of operation. Front-panel screwdriver adjustments for vertical linearity, vertical height, and focus provide protection against accidental misadjustment.

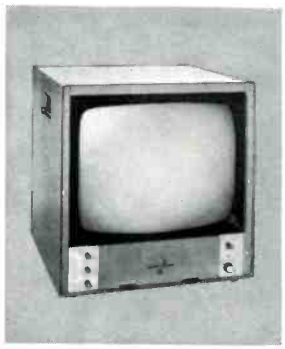
Nineteen inch monochrome video monitors offer traditional Setchell Carlson quality, including exclusive UNIT-IZED® plug-in circuit modules for easy maintenance. Horizontal resolution is 640 lines or better. Available in rackmount or attractive cabinet models.

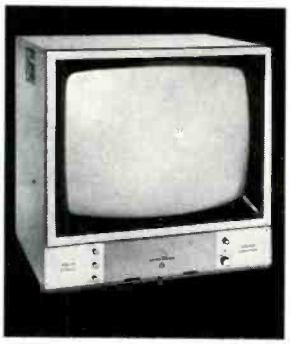
Professional quality 19" color video monitors offer broadcast quality at a modest price. Horizontal resolution is 300 lines (color) and all set-up controls are located behind a hinged front panel to prevent accidental misadjustment. Also available in 25" model.

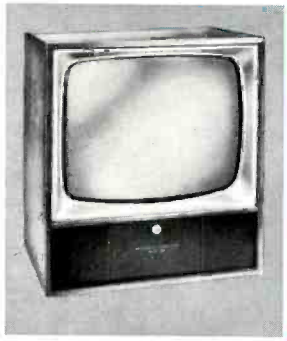












The 23" monochrome video monitor offers excellent picture quality and attractive styling at a modest cost. Circuitry is 100% solid-state and the horizontal resolution is rated at 640 lines or better. Monitor has a variety of applications due to multitude of professional-quality features.

Regulated circuitry in the 25" color monitor provides extremely stable operation and prevents raster size or brightness deviations due to line voltage fluctuations. Horizontal resolution is 300 lines (color). Set-up and operating controls are front-mounted for ease of operation.

"Educator" Monitor/Receiver, 23" monochrome model, is designed specifically for educational and training applications. Controls are front-located. Tamper-proof control compartment door with lock is optional. Horizontal resolution is 600 lines or better with video signal input. Also available in 25" color model.

The Color "Educator" is a 25" model offering big-screen, sparkling color — 300-line (color) resolution — plus big-room audio. Designed specifically for educational and training applications, the "Educator" series Monitor/Receivers offer the utmost in reliability, flexibility, and ease of operation.

Setchell Carlson's solid-state UHF/VHF television receiver and RF demodulator provides a high-quality composite video signal and separate audio signal, assuring excellent monochrome and color picture quality. It is ideal for video recording and as a signal source for video monitors.

The quality and reliability of Setchell Carlson products is legendary. SC Electronics pioneered the concept of modular circuit construction. Every Setchell Carlson product features this concept in our UNIT-IZED® plug-in circuit modules, assuring operating dependability and maximum ease of maintenance. One hundred percent solid-state circuitry means maximum stability, long-life, low power drain, and a minimum of heat. Every feature in a Setchell Carlson product is meticulously designed to give you outstanding performance at a modest cost.

For many years, people involved in many different facets of broadcasting, closed circuit television, medical training, industrial TV applications, custom remote installations, and in the field of education have been able to depend on Setchell Carlson quality and reliability. It has become a tradition. We know that whatever your application, you will find a product to fit your need in the Setchell Carlson line.

Let your SC Electronics dealer give you a showing of . . . The new Reliables. Or, write to us for more information. Remember SETCHELL CARLSON, where quality is a tradition.

SC ELECTRONICS, INC.
A SUBSIDIARY OF AUDIOTRONICS CORPORATION
530 5th AVE. N.W. ST. PAUL, MINNESOTA 55112

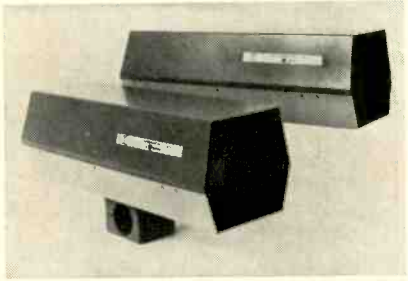
Circle 113 on Reader Service Card

BROADCAST EQUIPMENT

New and significant

For more information, circle boldfaced numbers on Reader Service Card.

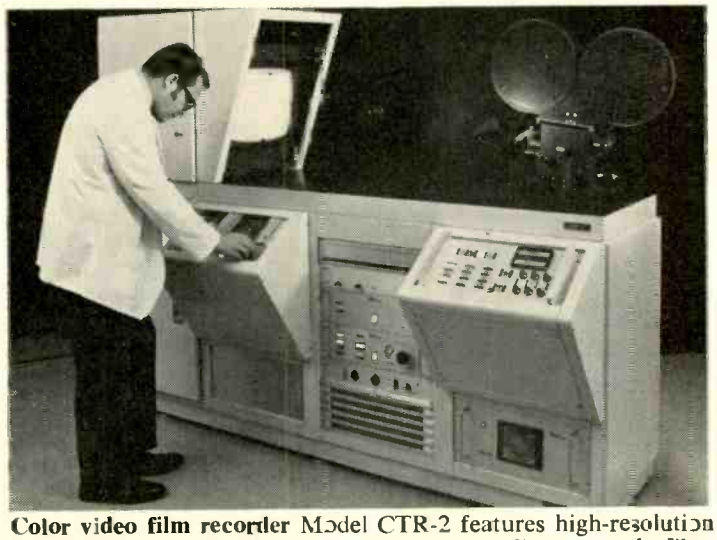
Color TV optical links provide short-haul transmission requiring no FCC license. MAQ Series uses LED operating in infrared range as transmitter. Power output is 0.5 mW transmitted in 0.5° beamwidth to photo detector diode in receiver. Maximum video S/N exceeds 59 dB



at 350 ft. Maximum differential phase is ±0.7° and differential gain is 0.3 dB at 50% APL. MAQ-100 indoor model, $2500; MAQ-101 outdoor model, $2800. MICROWAVE ASSOCIATES. **277**

Vhf color TV transmitter line features i.f. modulation, four-second start-up. B7103 series includes basic 1-kW transmitter, with power amplifiers providing output powers of 1, 5, 10 kW in both low and high bands, 15 kW in high band only. Compact transmitters are solid-state (except power amplifiers), meet FCC requirements. Stability of picture and sound carriers is ±500 Hz per month. MARCONI. **275**

Color film processor handles 16 or 8 mm film, conducts standard ME-4 process at 20 ft/min. Unit warms up in 10 min, can force two stops without slowing down, has 2000-ft magazine and feed elevator. $6980. JAMIESON **284**



Color video film recorder Model CTR-2 features high-resolution tri-color kinescope, H and V aperture equalizers, comb filter decoder for chrominance/luminance separation, vectorscope, photometer, 10-step gray-scale generator. Camera is 35-mm with *f*/1.3 lens, driven by closed-loop phase-locked system using air bursts for film advance. Suitable for both negative and reversal color film; scan reversal available. $75,000. TELEDYNE CAMERA. **290**

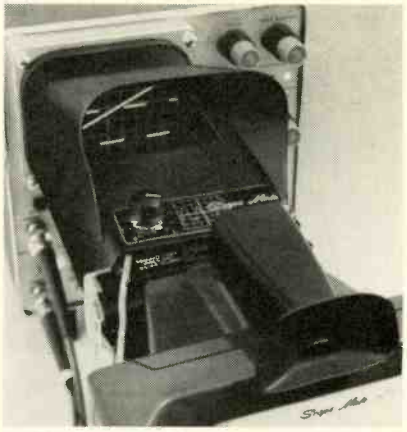
CCTV console, camera are designed for compact portability, remote use. Originator II console is desk-top portable including EIA RS-170 sync generator, six-input switcher-fader with preview bus, vertical interval switching, audio mixer, video monitors. TVC-625 vidicon camera has 850-line resolution, 60-gauss field, FET hybrid cascade input amplifier, 40 dB S/N. JERROLD **278**

Dual-trace oscilloscope has 25-MHz bandwidth, 10-mV sensitivity, delayed sweep. Telequipment D67 has sweep rates from 2 s/m to 0.2 μs/cm (40 ns with X5 magnifier), 3% accuracy, 14-ns risetime, triggering at TV line and field rates. $975. TEKTRONIX. **281**

Arc lamp power supply provides regulated constant current with low lamp current ripple for xenon, krypton, and similar high-power arc lamps. Standard features of EMX Series include less than 10 ms response time, remote programming, and high peak power capability. ELECTRONIC MEASUREMENTS. **279**

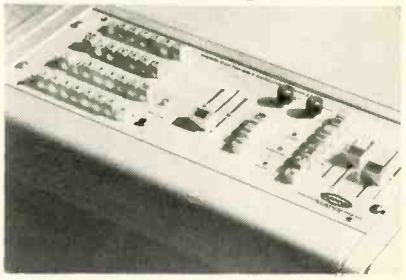
(Continued on page 36)

Oscilloscope camera set fits inside or outside 3-, 4-, 5-in. round or rectangular CRT's. Model SC02 Scope-Mate™ uses low-distortion auxiliary lens system and standard Polaroid Colorpack II or III, pro-



viding object-to-image ratio of 1:0.85. Electronic shutter control has speeds from infinity to 1/100 second. $139.50 including Colorpack II camera. INTEGRATED CONTROLS. **282**

Video switcher is designed for CATV, ETV, ITV use, complies with EIA RS-170. Cletron Model 610 has vertical interval switching, special-effects generator, monochrome processing amplifier. Has 10



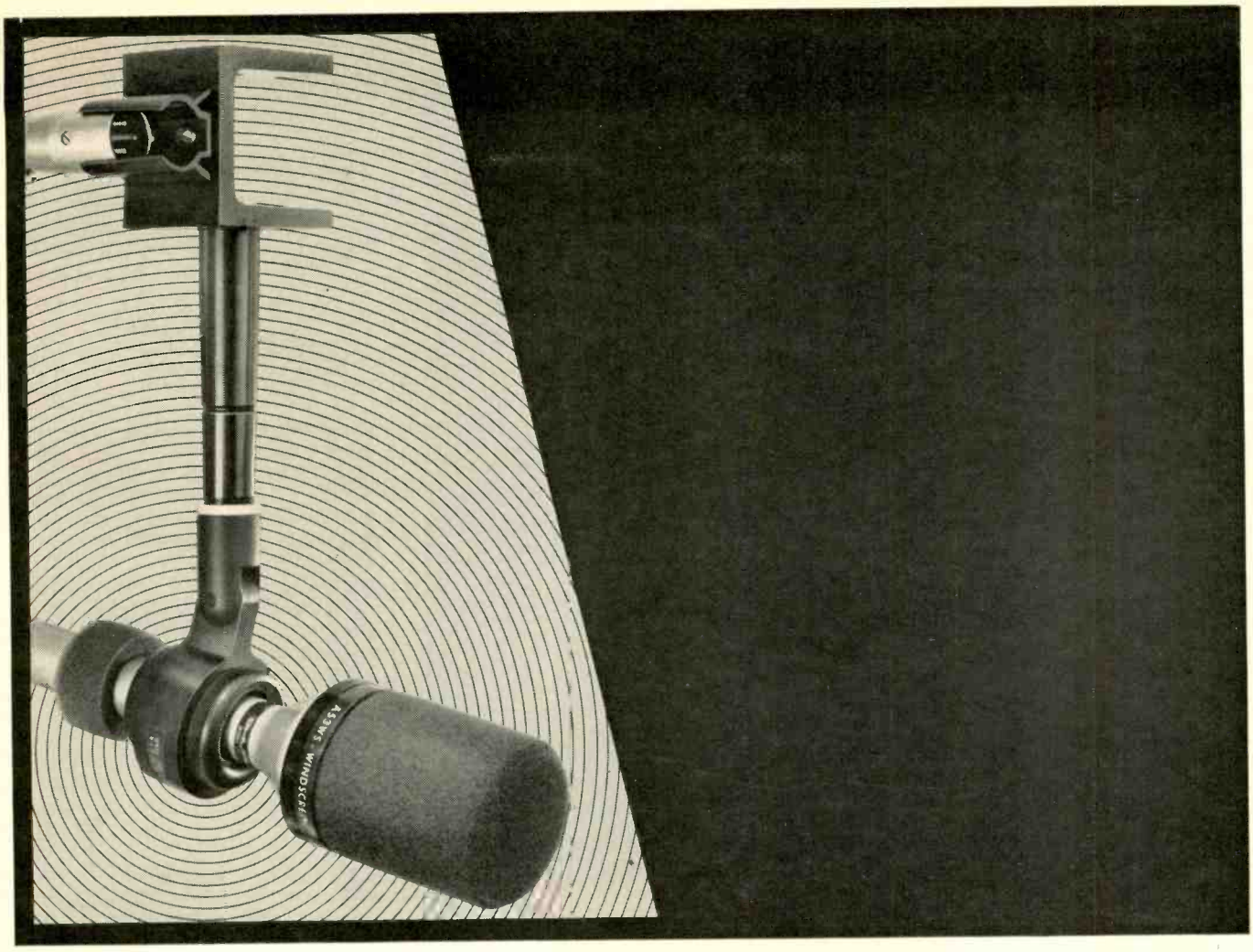
video inputs: seven monochrome comp or non-comp; three color or monochrome composite. Two modes of video matting and keying, front panel selectable automatic sync insertion. CLEVELAND ELECTRONICS. **283**

Sync generator has available line/field rates of 525/60, 625/50, 873/60, 945/60, 1023/60, 1029/60, 1203/60. 525 rate conforms to EIA RS-170, higher rates to RS-343. Dage Model 718/719 sync generator has dual isolated outputs for comp sync, comp blank, V and H. Solid-state, size 1¾ × 7¼ × 9¾ in. VISUAL EDUCOM **285**

Turntable preamps are available in stereo or mono, provide O dBm into 600 ohms, with headroom to +15. The 6400 Series has three selectable curves: RIAA/NAB; +5 dB at 15 kHz; −5 dB at 15 kHz. GRAY **286**

Vidicon camera pan head has auto pan or manual, with automatic run

(Continued on page 38)



Boom Boon.

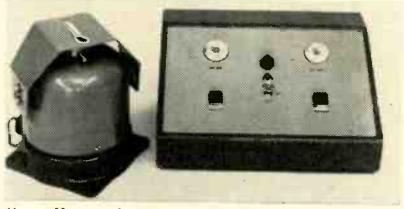
We've taken our most versatile, best-performing unidirectional studio microphone, the *Shure SM53,* and made it even more versatile by developing a complete boom accessory system that equips the SM53 for every conceivable boom and "fish-pole" application! Shure design engineers started with a major breakthrough in design: a small, lightweight, extremely effective isolation mount. They developed a super-flexible isolation cable, a pair of highly-efficient front-and-rear windscreens, and a 20″ boom extension pipe. Finally, they developed a complete boom assembly that combines unusually small size with superb control and noise isolation. Result: an accessory lineup that makes every Shure SM53 studio microphone a complete microphone system! Write:

Shure Brothers Inc.,
222 Hartrey Ave., Evanston, Ill. 60204.

SHURE

Circle 115 on Reader Service Card

and dewell control. Model 370 pan head is used with Model 250/2C program timer which allows setting



"run" and "dwell" times for auto panning. Pan head capacity, 22 lb, with panning from 4° to 345°. Pan head, $275; program times, $410. POWER-OPTICS. **280**

Reverberation device has selectable short, medium, long delay times. Model 659A Compact Reverbertron has switch selection of local or remote operation providing three types of control: dry, premix 1, premix 2. Frequency response is ±1 dB from 20 Hz to 20 kHz on dry channel, with 50 Hz to 6 kHz on reverb channel, adjustable ±15 dB. Lock mechanism included for portability. FAIRCHILD SOUND EQUIPMENT. **287**

Base insulators for guyed towers are available in strengths from 0.5-10 million lb and breakdown voltages from 50-500 kV. Most sizes available in 60 days. CONTINENTAL ELECTRONICS. **288**

AM modulation monitor is solid-state, plug-in, with critical circuits on glass epoxy circuit boards. TBM-8500 monitor is FCC type-approved, has front panel selection of direct-reading S/N. Carrier-failure alarm circuit makes relay contacts accessible on back panel. TBM-8500 monitor, $850. RM-85T/R remote metering kit, $105. MCMARTIN. **289**

Twin microphone mount permits two or three microphones to be installed on a single microphone stand. The new accessory separates the mikes by eight inches horizontally to assure optimum separation for phasing and stereo purposes. Model TM-1 is designed for use with stands equipped with a 5/8-inch 27 male thread. Finish is satin chrome. ATLAS SOUND. **291**

In-studio and on-location omni-directional microphone, D-160E, features a removable, wire mesh windscreen which locks securely to the mike body. Without the screen, response is absolutely linear; with the windscreen, there is a presence rise of 4-5 dB between 3000-12,000 Hz. Unit has an output level of −55 **Dynamic cardioid microphone,** U-2, dB. $60.00 AKG. **292**

part of the MD 421 family, contains no bass equalizer so that all shaping can be done at the console. Each mike comes with individually-measured response curve. Finish is flat black, non-reflective. $114. SENNHEISER. **293**

CROSS-TALK

Dear BM/E:

Mr. R. H. Coddington should be commended for his article "Meeting The Engineer Shortage" in the March issue of *BM/E*.

His facts are accurate, his solutions are good and his thorough knowledge of the industry obvious. It is long overdue that the FCC catch up with the technical advances that are available to broadcasters.

Present operator requirements in broadcasting are antiquated. It's time broadcasters were allowed to utilize the automatic logging of its transmitter operations and leave the first class operators free to do more constructive work for the station.

Bill Ward, VP/GM,
KBBQ (AM)
Burbank, California

Dear BM/E:

I fail to see how Mr. Coddington's solution of automated supervision is going to help the small-market directional AM station. At numerous small-market directionals the shift engineer is a combo man, who already holds a first phone. Now, if the manager replaces this supervision with an automated system (which will be expensive), will he fire this man and hire a third class op. Hardly, as this combo man was hired in the first place for his skills in news, on the board, or as a sportscaster or salesman. In these cases, the fact that the man had a first phone may have been secondary to his other skills. So where is the cost savings? At this station I do not see where there would be any savings by going to the third and automated supervision, with our present staff. Don't think I am going to bat for the 90-day wonder or the paper engineer, as I am opposed to the present quickie schools which turn out a DJ with a blue diploma, who knows absolutely nothing about engineering.

I foresee another problem if the third-class proposal goes thru. In a few years, as the number of first phones drop, how will owners and general managers entice third phones to go to the extra work of studying and preparing for a first phone and the chief's job, for little or no more pay. Currently, when a chief is needed, an existing first phone can be talked into taking the job. Or does Mr. Coddington believe that a chief's pay will go up with the advent of the automated supervisory equipment? That is not likely in the small-market station.

Fred Clinger
Chief Engineer, WBCO
Bucyrus, Ohio

Circle 120 on Reader Service Card →

A VHF transmitter site is a nice place to visit, but you don't have to live there.

RCA has developed the most advanced VHF color television transmitter on the market. So you don't have to live with it, if you don't want to.

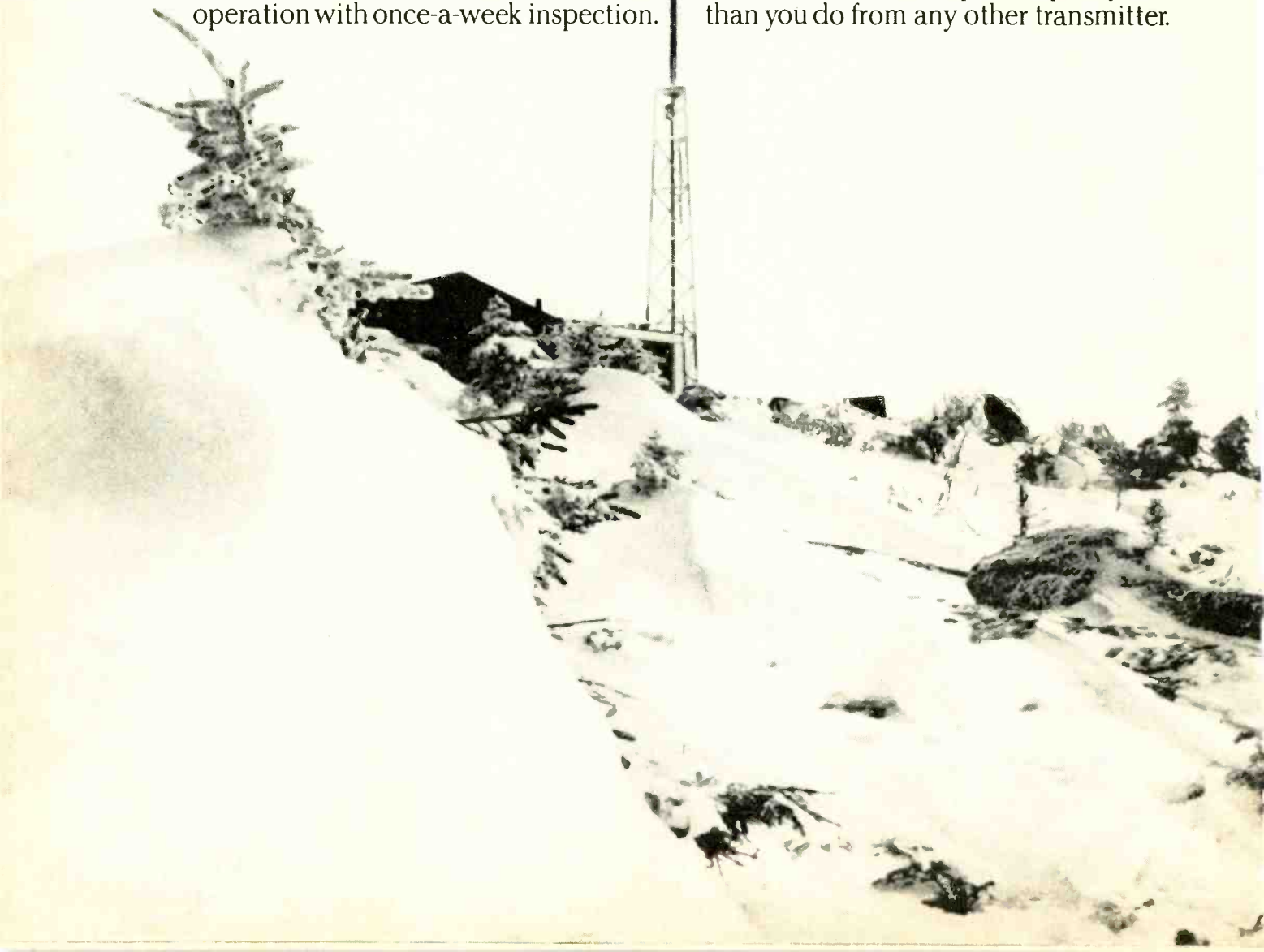
The 50 kW TT-50FH. It's designed for unattended operation, with provisions for automatic logging and remote control. When you're ready, so are we.

In fact, the TT-50FH is the only high band VHF transmitter specifically designed as a twin system, which fulfills the FCC's requirements for remote operation with once-a-week inspection.

It's actually two complete 25 kW transmitters with true parallel design and instantaneous automatic exciter switchover.

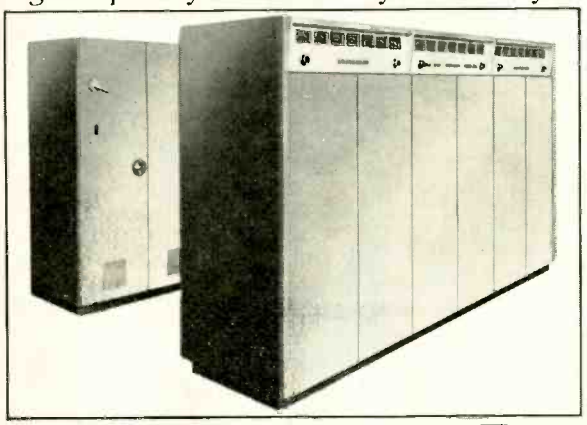
Barring failure of primary power, it's virtually impossible to lose your signal. Which just happens to be the best in the business.

For one thing, the TT-50FH gives you solid state diode modulation at carrier frequency and our sideband shaping takes place at the output, so you get greater assurance of spectral purity than you do from any other transmitter.



The TT-50FH has only two tuned visual amplifier stages, so it's easy to maintain, too. The fewer stages you have, the fewer adjustments you have to make, and there's less chance for trouble.

With the TT-50FH, you make an adjustment, and it lasts. We'll guarantee signal quality and stability for 30 days.



The design is reliability itself. The circuits are solid state design up to the IPA. There are only three tubes in each transmitter. Only two tube types. And the control logic is solid state. That's more solid state than any other transmitter.

One more thing. To make things even easier for you, our optional Opto-Switcher puts everything that goes between the transmitter and antenna into one package, factory adjusted for maximum performance.

It all adds up to superior performance. The TT-50FH performance specs are 100 per cent better than any previous generation transmitter.

We've been the leader in TV transmitters since television began. Now we have something really new for you. The best signal. The most reliable design. The best performance. The ideal transmitter for remote control. The most advanced transmitter on the market.

The TT-50FH. By RCA.

RCA

Third Phone (Continued from page 32)

doubtful stability would not be permitted to use third-phone men.

- A modern, accurate, and possibly type-approved phase monitor would be required at stations using endorsed third-phone men, who would be required to notify a first-phone operator whenever specified permissable limits are exceeded.

The Commission also noted that third-phone operators are sometimes "moonlighters" and that they are probably expected to perform non-technical functions to a greater extent than first-phone men.

SBE's position

During the past six months or so, there has been a growing movement within the Society of Broadcast Engineers to ask the FCC to upgrade the first phone license. At the same time, the SBE has not opposed the NAB petition to ease operator requirements in radio. This is hardly surprising since at least one SBE official is on the NAB Engineering Advisory Committee which drafted the NAB petition.

At this point, draft petitions are being circulated among SBE members. The general ideas are to ask the FCC to:

- Reinstate the old requirement of two years' satisfactory service for renewal of license.
- Add new sections to the license exam, covering respectively AM directionals, FM, and TV.
- Require any of the above as endorsements on the first phone license, if the holder is chief operator of respectively, a directional AM, an FM, or a TV station.

Some SBE members are wage-earning technicians, others chief engineers or station executives. Yet there seems informal agreements on two points:

- The NAB will probably get its way.
- Upgrading the first-phone license through required service and specialized endorsements for chiefs should help insure that these personnel are better qualified.

Or, as one member put it: If we're going to have to get along with third-phone operators, the first-phone men had better be pretty good. **BM/E**

WCCO-TV used a color processor to win the battle for news ratings.

"With six stations fighting for the same audience, you learn to move pretty fast," says Sherman Headley who is General Manager of the Minneapolis-St. Paul television station.

"And when we got our own color processor in 1965, we really opened up. Now we process over 1,500,000 feet of color film a year—and that's almost exclusively for color news, sports, and public affairs.

"Our film units have contributed tremendously to the range of our news coverage. A happy result of this has been the number of awards we've received—just recently for our third documentary filmed entirely in Vietnam.

"But the best award is audience recognition. Our news programs have about 50% share of TV viewers, and that's the kind of recognition we're after.

"As you can see, we keep our machine pretty busy. But the ME-4 Process is so simple, especially in combination with Kodak's packaged chemicals, that all our cameramen know how to run the machine. So if you come across anyone who's not yet sold on the ME-4 Process, have him talk to us."

Need more information? There's someone else you can talk to: your nearest Kodak Representative. Call his number below and check out the benefits of Kodak ME-4 and mini ME-4 color processing. But you don't want to wait too long. A color processor may give you a big advantage, but it's not exactly a secret weapon.

EASTMAN KODAK COMPANY ATLANTA: Bob Baker 404/351-6510/CHICAGO: Dick Potter 312/654-0200/DALLAS: Frank Reinking 214/351-3221/HOLLYWOOD: John Waner 213/464-6131/NEW YORK: Bill Reddick 212/262-7100/SAN FRANCISCO: Joe Semmelmayer 415/776-6055

NEW LIT

For copies of these literature offering, circle numbers for appropriate items on Reader Service Card.

Drugs are described in 12-page brochure: The Far-Out Search—Some Facts About Commonly Abused Drugs. Booklet offered by publisher to companies seeking to increase public confidence in corporate good citizenship. Paul S. Amidon & Associates. **200**

Coax cable, rigid transmission line are listed, described in 8-page brochure. Includes performance curves, accessories, connectors. Phelps Dodge. **201**

Attenuators for audio, video covered in 24-page catalog from Tech Laboratories. Includes step type, balanced and unbalanced, T, H, L pads, pi networks, ladder circuits. **202**

In Support of Clean Water—**Disposing of Effluents from Film Processing:** 12-page pamphlet evaluates photographic chemicals used in film processing, suggests how to reduce water pollution. Eastman Kodak. **203**

Portable speech scrambler illustrated in two-page brochure from Lynch Communication Systems. Model E75 scrambler usable in radio and telephone communication, with preselected code cards for information security. **204**

Tape head replacement guide from Nortronics covers 2800 domestic and foreign tape recorders. Has cross-references to model and head part numbers for reel-to-reel and cart machines. **205**

CCTV studio system, Originate IV, is described in catalog sheet. System includes video production center, cameras VTR, monitor, audio gear, lighting. Ampex. **206**

Rear zoom, focus control attachments for CCTV cameras by Sony or Panasonic, described in brochure from D. E. Carlson. **207**

Brochure describes line of **CATV equipment** and accessories. Reviews principal features of each item, includes electrical characteristics tables. GTE Sylvania. **208**

Uhf parabolic antennas are described in bulletin from Andrew. 6-GHz dual polarized UHX Series antennas have front-to-back ratio of 75 dB at 180° ±80°. **209**

Low-cost **video equipment** for CATV, CCTV, ETV is covered in brochure from RCA. Includes live cameras, film chains, monitors, VTR, sync generator, DA's, switchers, lighting equipment. **210**

Phase-stable cable is subject of literature from Phelps Dodge. Note explains phase-temperature coefficient tests on five types of coax. Includes data tables. **211**

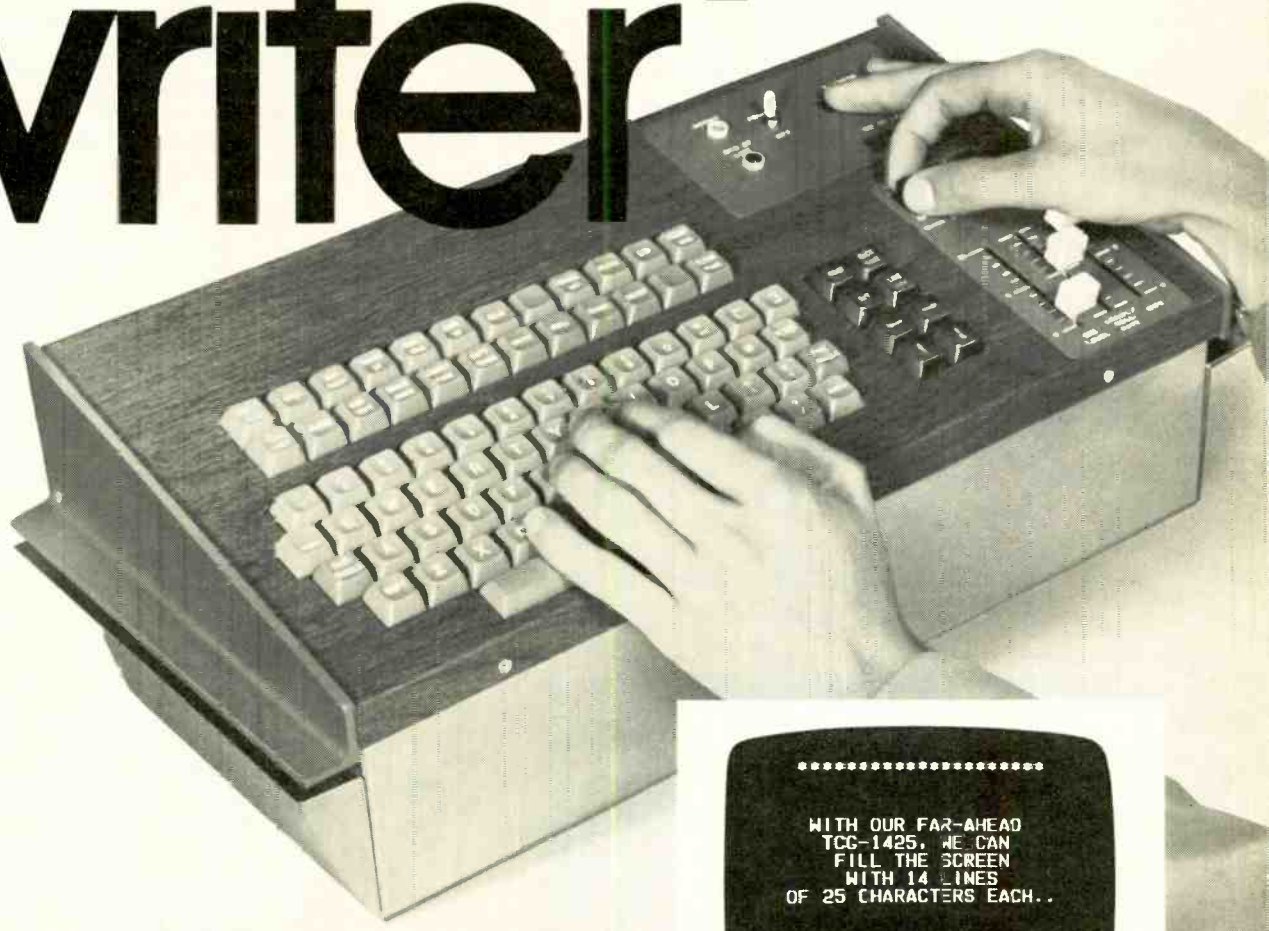
TV relay system for 10.55-13.2 GHz range covered in brochure. MA-12C system is low-cost, solid-state, one-way or bidirectional, color or B&W. Microwave Associates. **212**

Delay lines by Daven are shown and discussed in buyer's guide from Edison Electronics Div., McGraw-Edison. Includes technical discussion, glossary. **213**

Bulletin describes **frequency meter/synthesizer/signal generator** with frequency range of 10 kHz to more than 500 MHz, frequency accuracy better than 1 ppm, heterodyne detector sensitivity better than 5 mV. Lampkin. **214**

Circle 124 on Reader Service Card →

Easy writer



TeleMation's new TCG-1425 Character Generator

Our versatile TCG-1425 puts more edit-ability at your fingertips than any other character generator. Designed *specifically* for use in broadcast and teleproduction, it gives you a choice of two keyboard-selectable sources (output is automatically synchronous), as well as partial and full-page alphanumeric display, and the industry's two biggest handfuls of editing and control features.

The easy-to-use keyboard encourages you to become an overnight virtuoso. Display editing functions include copy up/copy down, hop left/hop right, snake up/snake down, automatic line and page centering, and open line/close line (for making corrections without resetting full lines). For control flexibility, the TCG-1425 gives you one-line horizontal crawl, line-by-line horizontal wipe, vertical wipe, vertical roll and flash. Edging, shadowing and matting are also available.

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station began broadcasting an hour (7-8 PM) of quadrasonic stereo each night. On April 4th this was increased by adding the two-hour weekly Boston Pops program on Sundays (3-5 PM).

The listener response has been fantastic according to Robert A. Linder, general manager. Over 2000 letters were received the first month. All local dealers sold out initial supplies of decoders.

WHDA decided, after a survey of the field, that the E-V encoding process would be practical and effective for present broadcasting. The mono listener notices no degradation of sound, the two-channel stereo listener loses no separation and hears a fuller more spacious sound, and the four-channel stereo listener will receive a very satisfying amount of separation left-front from right-front and rear-from-front.

Linder says it's only the left and right rear channels that are not very much different. But considering how easily the $60.00 decoder plugs into the tape-monitor jack of an FM stereo receiver, Linder says he is very satisfied.

Although the broadcast system is 4-from-2, the nightly program is sponsored by TEAC who is promoting the advantages of *discrete* separation which can be obtained with TEAC tape recorders!

WDHA uses primarily four-channel pre-recorded tapes for most of its program material and plays them into the E-V encoder. The station does have a Bob Crewe Generation encoded disc and Ovation Sampler encoded disc and was expecting some compatible encoded discs from Project 3, at the time of *BM/E's* contact. A list of music used by WDHA accompanies this article.

WDHA was one of the first stations to broadcast two-channel stereo which is why they rushed to be first with four-channel too. Judging from the response of very enthusiastic four-channel listeners and sponsors—high fidelity manufacturers and dealers—Linder firmly believes that four-channel is here to stay. And until a workable system for more perfect separation is developed (which may be years off), Linder feels the small investment for an E-V system and quadrasonic sound today more than worthwhile.

WRNL-FM, Richmond, Va., commenced its four-channel broadcasting in conjunction with the Richmond stereo music show which was held on March 19, 20 and 21 of this year. The station, which normally used Schafer automation did live broadcasting from the show on those dates.

It was the third station to go on the air with the E-V system, preceded by WJIB-FM, Boston, and WDHA. WRNL does claim a first in the country to use a Toyo four-channel quad cartridge machine with the new RCA Q-8 cartridges. The reproduction from these cartridges was amazingly good, according to Sam Straus, chief engineer.

The total equipment complement used by Straus includes the E-V encoder, the Toyo cartridge unit (using the RCA four-track cartridges), a Sony 366-4 four-track tape deck, four Shure M68 mixers, and a Collins twin-tape and stereo console 212S-1.

The response to the broadcast was overwhelming, WRNL reports and, within a few hours of commencing quadrasonic broadcasting, all decoders available in Richmond were sold out. (Approximately 15,000 people saw the live broadcast from the stereo show.)

WRNL-FM now broadcasts quadrasonic music two hours a day. It will increase this schedule as more music becomes available. It currently has 20 hours of suitable selections. It plays from this list, two hours each day.

So far, only records using the Electro-Voice Stereo-4 approach developed by Len Feldman (*BM/E*, Feb. 1971 and May 1970) are available (From Crewe, Ovation, Project III, Stereo Dimension and Alshire). This approach loses some stereo separation. Recently E-V announced and agreement in principle with Peter Scheiber (Audio Data Co.) to pool efforts in seeking encoding standards that would be acceptable to the industry. Scheiber's system uses comparative amplifiers to increase separation. A discrete 4-channel disc system is available from JVC (Nippon Victor) but this approach is not compatible with the four-from-two matrixing schemes. **BM/E**

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Next month: a beginning series on 4-channel stereo by Lawrence Gahagan, co-general manager, KPEN
Presstime: CBS Records and Sony have announced a matrixing scheme using helical modulation. Details next month.

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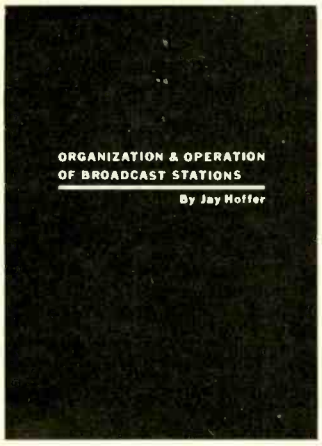

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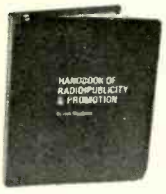

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FROM THE EDITOR

The Third Phone Flap

If the Commission finds time in the next few months to sort out replies to the proposed rule making concerning AM and FM operators, Docket 18930, it may come to a conclusion regarding certification requirements of operators. It's expected that, in the final outcome, third phone licensed operators will be permitted to handle more jobs.

Broadcast managers, by and large, favor relaxation of the rules to permit third phone operators to be in charge. Reasons are primarily economic. No broadcaster wants a resident doctor on staff if he can share a doctor on call with others.

Those in the industry whose jobs are at stake, and those who worry about performance standards, are reluctant to see any diminishment of requirements for qualified experts being on board at all times.

This editor, tongue-in-cheek, once proposed that there is no need for an on-staff chief engineer. (*Fire the Engineer, BM/E*, August 1970.) We suggested the FCC set high performance standards and stiff license penalties for violations in lieu of operation requirements. We foresaw this leading to an investment in high reliability equipment and service contracts with qualified engineers who would, through preventative maintenance (and penalties for failure), keep transmitters on the air.

Needless to say, we were inundated with protests from engineers who assured us, by citing personal experiences, that the airwaves would be empty a goodly part of the time if a trusty engineer isn't on the spot to get a broken-down rig on the air.

Within the industry, there are those who hold that being on air is something sacred and that any downtime is blasphemy against God and the engineering profession. Others are more concerned about the wrath of the FCC and the vindication of a sponsor whose commercial was not aired.

For the wealthier stations, the latter keeps everyone on his toes. For the small station with lots of available time, downtime is not disasterous—it's easy to schedule makegoods.

Thus, the situation is somewhat self-correcting. In rich markets, the pressure is there to stay on the air and managers can be trusted to staff up appropriately.

In the small markets, however, the lag in self-correction may get out of bounds from the point of view of the public interest. Therefore, limits on the boundaries should be set—e.g., no more than, say, four failures per quarter year or more than 30 minutes off-the-air, save for acts of God. If a station exceeds such limits, the sanctions can be high—such as loss of license. The FCC could grant the frequency to some other applicant who demonstrated a greater likelihood of staying on the air. A similar requirement could be imposed on cable operators.

There is no doubt it, there is a conflict. But it does seem a little absurd that part of this industry operates so close to the borderline that it can't afford competancy. We can envision an alternative. Why don't all broadcasters in a community cooperate by jointly sharing a common transmitter room and antenna farm. Such a cooperative venture could certainly employ and afford qualified help.

Old pros in this industry tell us it won't work. There is too much rivalry amongst local broadcasters. To this, our reply is you can't have it both ways. Cooperate and save costs or foot the bill yourself. Newspapers have learned how to share facilities. Why can't broadcasters?

James A. Lippke, Editor

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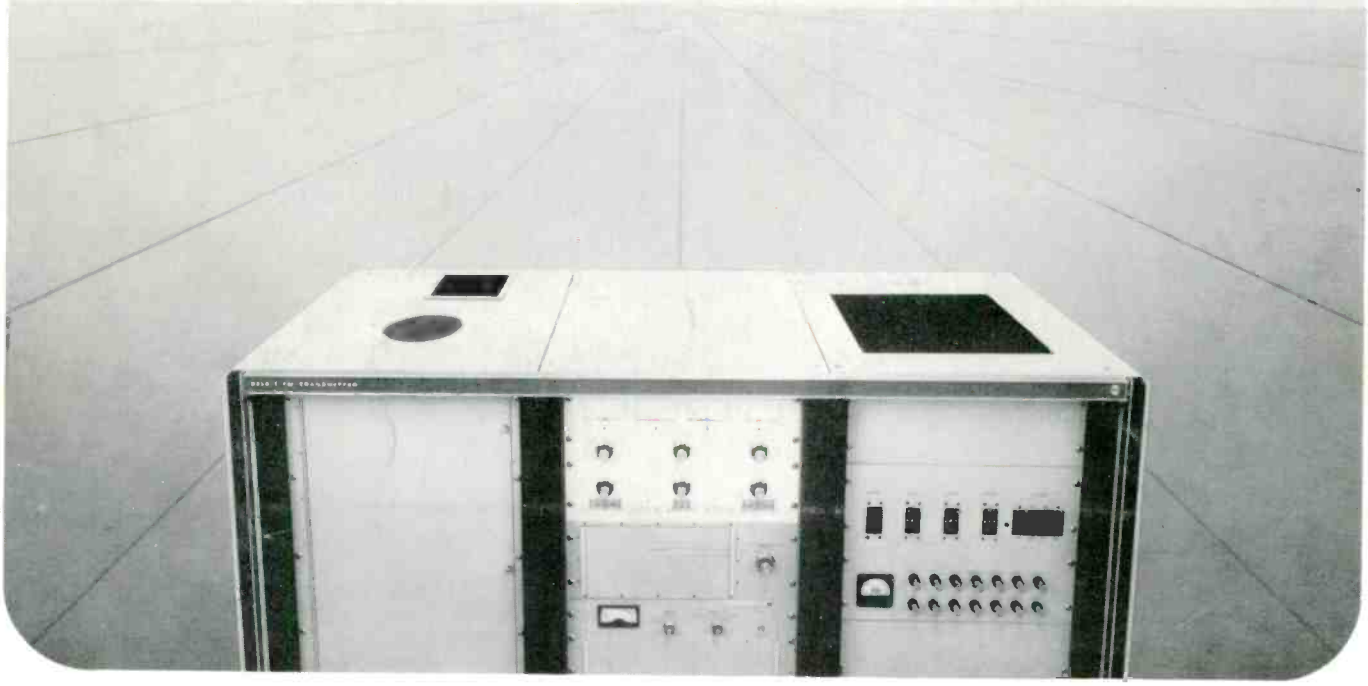

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