

**FM Radio  
Station  
Operations  
Handbook**

# **FM Radio Station Operations Handbook**

**TAB BOOKS**  

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FM RADIO STATION  
OPERATIONS HANDBOOK

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## PREFACE

During the past 12 months, nearly 140 new FM radio broadcast stations went on the air in this country. Some 230 more are in various stages of construction as of this writing, and by the end of 1966, well over 1500 FM stations will be on the air.

Stereo broadcasting has become the "rule," rather than the exception. Higher radiated powers and dual antenna polarization have become prevalent and desirable. Most importantly, FM is no longer relegated to the "not-for-profit classical-music-only" category. It is no longer a crime for FM's to operate at a profit!

Yes, commercial FM broadcasting has finally proved itself, and in a few years it will be as popular--and as necessary--as AM radio is today. Yet, were it not for the pioneers, and for the operators who paved the way during the 50's and early 60's--who showed uncommon foresight and unswaying confidence--commercial FM might still be in the "rumble seat" and eventually "washed out" to make valuable spectrum space available for other important communications services.

But along with the rapid growth and success of FM, and the resultant new developments in FM transmission technology, comes the need for dissemination of knowledge. New operators, even though they may be experienced in AM or TV (which certainly helps), need to learn the unique techniques of FM broadcasting. This book--the first "anthology" on the subject--is based on the experiences of experts in modern FM

broadcasting. Subjects bridge the gamut from engineering and management to programming and sales. Based on articles which appeared in BM/E Magazine, it is the first, and the only, practical guidebook on FM broadcasting practices published to date. We hope it serves you well, and invite your comments and criticisms.

Verne M. Ray

May, 1966

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# Can Independent FM Make It?

By Len Buckwalter

**FM** JUST CELEBRATED its 25th birthday, but it's an anniversary marked with mixed emotion. Many FM broadcasters still "cry the blues," but FCC financial reports indicate that an increasing number are switching from red ink to black. And that Harvard study, which predicted FM receiver sales eventually outpacing AM, is proving a bit conservative. (More FM receivers were sold last year than predicted by the university researchers.) But spiraling set sales alone offer little comfort to the broadcaster who has lived with FM's lean years. What's the magic formula for success?

To find out, we went to one of the nation's most prosperous and fastest-growing independent FM stations—WTFM, which serves the New York metropolitan area. Although it operates in a vast market centered in an area of over 20 million people, there's a debit side, too; the region also contains some 45 active broadcast frequencies plus 7 major TV outlets. It's a perilous market which can offer the best—but also demands the best. WTFM's economic



One of two control rooms. Wall-mounted speakers permit monitoring of left-right stereo channels. White gloves are no joke, must be worn by everyone who handles records, which are played no more than 10 times.



## WTFM Personnel

40 people—count 'em—are on the payroll!

- 10—on-the-air personalities, including Peabody Award winning Program Director, Don Russell, who does special shows.
- 7—news reporters, including two who report from West Berlin and Paris.
- 2—General Manager and Chairman of the Board.
- 7—on sales force, including Sales Manager Fred Beck.
- 2—in engineering, Chief Warren Wilson and his assistant.
- 10—in secretarial, bookkeeping, traffic, public relations and advertising.
- 2—for building maintenance.

## Engineering & Facilities

On the surface it would appear that technical manpower is WTFM's weak point. Not so, however—part of the secret is that the transmitter is remotely controlled from WGLI Babylon, some 40 miles away. Thus, Chief Engineer Warren Wilson and his assistant are able to spend most of their time attending to audio signal quality and preventive maintenance.

Although no standby transmitter is used at present, the RCA Type BTF5D installed new when the station went on the air has given excellent service. New facilities are planned, however, and the present equipment will be used for standby operations.

And it occasionally out-rates 8 or 9 AM stations.

WTFM's Vice-President and General Manager, David H. Polinger,

whose knowledge of broadcasting is encyclopedic. He is presently on the Board of Directors of the National Association of FM Broadcasters. (Many readers may remember him as guest speaker at the 1963 NAB convention.) Polinger's experience slices across nearly every major segment of broadcasting: account executive at ABC; general manager of NTA that reaches out for some 60 miles. Spot Sales, one-time free-lance producer, and president of his own advertising agency. He speaks four languages, plays LaCrosse, sparkles when he talks of FM, and has yet to reach his 40th birthday. We asked him, "What is responsible for WTFM's success?"

Before Polinger spelled out his particular brand of broadcasting, he verbally sketched in two humorous caricatures of "traditional" FM stations in New York—combined! Moreover, it is the only FM station in the area to have appeared on Hooper ratings continuously for nearly two years.



WTFM's mobile unit, equipped to broadcast or record in stereo, uses Gates yard, Ampex recorder, and two EMT turntables.

FM broadcasters. One is the engineer, typified by individuals who thrill at superb sound, expansive frequency response, and equipment of sky-high fi. Success is measured by a given number of cycles per second. Then there is the operator who sees FM solely as the music lover's medium. He believes success is inevitable if he bestows culture—usually a heavy diet of Mozart and Beethoven. (Even these music masters are played sparingly on WTFM since they have become "popular.") Polinger recognizes the great value of engineering and esthetic talent at an FM station. Yet, he questions whether either talent *alone* will make an FM operation profitable.

Success can't be achieved through any single technique. WTFM's success, Polinger explained, is fashioned from a web of factors operating in unison. They comprise no push-button formula, and won't apply directly to all stations. Yet, they offer a model example of the kind of

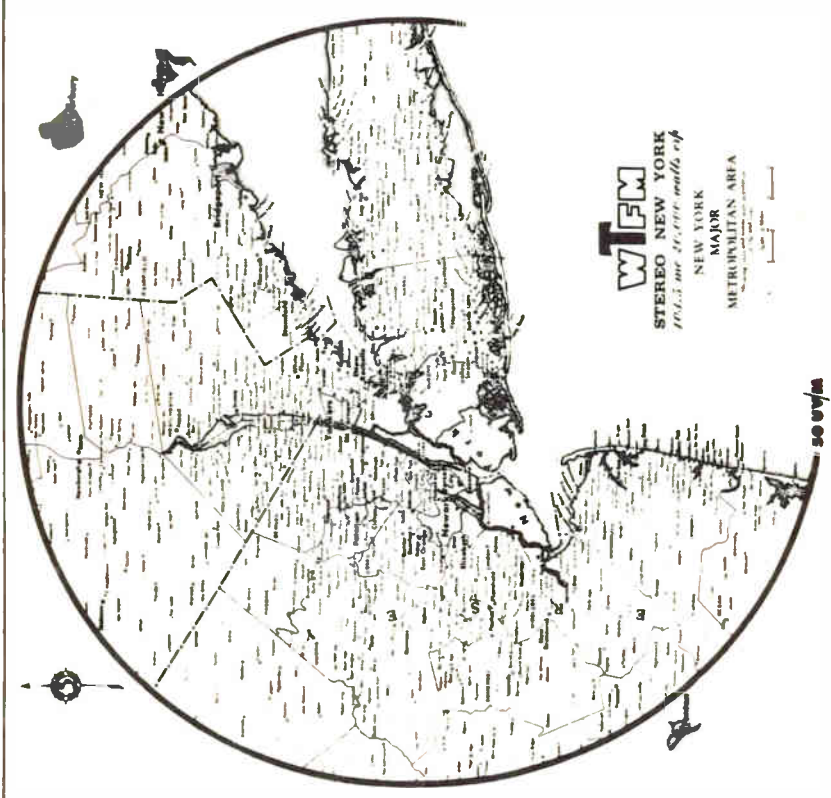
professionalism Polinger believes must prevail in broadcasting.

WTFM's on-the-air image is significantly molded by personality and atmosphere. Such professionalism is the work of veteran broadcasters like Program Director Don Russell, who has an impressive list of credits, and host Tom Mercein, a well known and authoritative radio voice. The music itself is not notably different from that of many other FM stations: light-music programming during the day leaning toward the classical format in the evening, including jazz and folk-music shows.

But listen, for example, to the daily segment from 10 in the morning to 2 in the afternoon. There's no mistaking WTFM among the welter of stations on the band. The reason, in this case, is Charles Duval, the announcer—or "host"—for the show. Duval has a french accent—not the mild Charles Boyer variety, but one you'd expect to hear, say, on the Riviera. It's no secret that male reaction to Duval's voice hovers



David H. Polinger, WTFM V-P & Gen. Mgr., has what it takes to make FM station operation profitable.



**WTFM**  
 STEREO NEW YORK  
*104.3 mc stereo with 4/4*  
 NEW YORK  
 MAJOR  
 METROPOLITAN AREA  
STEREO IMAGE MADE BY  
 W. H. W. & SONS, INC.  
 NEW YORK, N. Y.

**WTFM** 103.5 mc  
*general rates*

ANNOUNCEMENTS

**(aa)**

PROGRAMS	30	15	10	5	10	15	30
1000	1100	1100	1100	1100	1100	1100	1100
1100	1100	1100	1100	1100	1100	1100	1100
1200	1200	1200	1200	1200	1200	1200	1200
1300	1300	1300	1300	1300	1300	1300	1300
1400	1400	1400	1400	1400	1400	1400	1400
1500	1500	1500	1500	1500	1500	1500	1500
1600	1600	1600	1600	1600	1600	1600	1600
1700	1700	1700	1700	1700	1700	1700	1700
1800	1800	1800	1800	1800	1800	1800	1800
1900	1900	1900	1900	1900	1900	1900	1900
2000	2000	2000	2000	2000	2000	2000	2000
2100	2100	2100	2100	2100	2100	2100	2100
2200	2200	2200	2200	2200	2200	2200	2200
2300	2300	2300	2300	2300	2300	2300	2300
2400	2400	2400	2400	2400	2400	2400	2400
2500	2500	2500	2500	2500	2500	2500	2500

ANNOUNCEMENTS

**(a)**

**60 SECOND**

**FIVE MINUTE NEWSCASTS**  
Every Hour on the Hour

10 per sec	15 per sec	30 per sec	60 per sec
\$15.00	\$22.50	\$45.00	\$90.00
\$20.00	\$30.00	\$60.00	\$120.00
\$25.00	\$37.50	\$75.00	\$150.00
\$30.00	\$45.00	\$90.00	\$180.00
\$35.00	\$52.50	\$105.00	\$210.00
\$40.00	\$60.00	\$120.00	\$240.00
\$45.00	\$67.50	\$135.00	\$270.00
\$50.00	\$75.00	\$150.00	\$300.00
\$55.00	\$82.50	\$165.00	\$330.00
\$60.00	\$90.00	\$180.00	\$360.00

WTFM's 50 uv/m contour has a radius of 60 miles, reaches over 3 million FM homes in the Metropolitan New York area.

between mild uneasiness to militant rejection. But Duval's potent air personality wows the housewives, who, of course, comprise the listening audience during these midday hours. In fact, the station even stimulates "controversy" over the issue. One promotional piece frankly asks: "Why do so many men hate Charles Duval?" Listed are questions which cleverly suggest the answers, e.g., "Is it because women love the sound of his voice—his continental charm?"

As Polinger explains it, listening to WTFM helps the drudgery-ridden housewife "fantasy away her day." This continental, exotic atmosphere is infused throughout the station's programming and announcing. It identifies WTFM with a distinct, unmistakable image, an image similarly sustained for impact on the client. For example, during my conversation with Polinger his phone rang. Minutes later he told me it was an advertiser who remarked how pleased he was that even the station's telephone operator fitted the cosmopolitan WTFM image. The point, of course, is that WTFM works at preserving its individuality.

But the station's face to the world is just one technique. Another key factor is an unceasing campaign to educate the prospective client to WTFM's value as a selling medium. Advertising agencies have tended to regard FM as a "new thing," its pulling power still open to question, its audience numerically uncertain. Polinger calculates that he spends about as much time with a client as with the client's agency.

Consider a campaign devised for Zenith. The client wished to achieve three specific objectives:

excite immediate interest, develop strong remembrance of the slogan "Zenith Quality," and motivate listener response. The station decided to run a contest in which the listener was to make up as many words as possible using the letters in "Zenith Quality." Prizes included Zenith FM receivers and a color TV. Nothing startling, until the results and their implications are examined. The responses numbered some 4,000. With this figure as a base, it was calculated that contestants spent a total of more than 81,000 hours at the word-game—and, of course, in gazing at the words "Zenith Quality." The successful campaign didn't stop there. Using the data, WTFM printed a promotional brochure of convincing impact—another selling tool to fill the void, to impress the prospective advertiser that FM is a medium of proven effectiveness. WTFM continuously explores new ways to promote its name and reputation, from use of hi-fi show booths to broadcasting live from the New York World's Fair. It has even applied for the chance to originate the first FM stereo broadcast around the world via Telstar.

Another stratagem employed by the station is a single-channel receiver, fixed-tuned to WTFM. Again, it is an approach designed to generate convincing evidence for the prospective FM advertiser. The special receiver, called the WTFM Auditoron, is sold over the air at \$19.95. (Audiron franchises one FM station in each market. Polinger reports that approximately 5,000 units have been sold.) More important is the resulting sales piece which leads off with "A Gift to our Advertisers—the WTFM Bonus Audience." After explaining the Auditoron, it

## Sales & Promotion

A good part of WTFM's success can be attributed to the strong emphasis on sales and promotion. Fred Beck, a thoroughly experienced sales manager, oversees a full-time staff of six crack salesmen; in addition, the station is represented nationally by Jack Masla & Co. Armed to the teeth with hard-hitting, fact-filled promotional material, these men keep the commercial spots well filled. (Based on FCC definition, commercial time ranges from about 60% during the day to some 65% in the evening.) Fully 90% of billing is for national advertising, a point many AM's would like to boast about.

WTFM makes extensive use of NAFMB material to sell clients on the general FM audience. Also, no effort is spared in developing exclusive data about WTFM. Some of this includes:

- ... a **World's Fair manual**, citing WTFM's exclusive studio and exhibit (the only radio station to broadcast from the Fair on a regular 7-days-a-week schedule).
- ... a **Bonus Audience manual** with complete facts and figures on the extra and exclusive audience provided by Auditron sales.
- ... a **10-page report** on the "Zenith Quality" contest, with breakdowns of participants by sex, location, profession and education.
- ... a **12-page report** on a Martini & Rossi Mono-Stereo contest, containing reproduction of listener responses and tabulating the returns by geographic location. (They came in from 4 states.)

The ultimate in WTFM promo pieces, just off the press, is a beautiful  $8\frac{1}{2} \times 11$ " manual of 34 sheets printed on only one side of expensive stock. It gives a complete profile of the station, including its 97% adult listening audience. It defines the programming used to appeal to the better educated, higher income adult listeners, and describes the backgrounds of key program personalities. It provides a complete rundown of day to day programming. And at the back is a foldout map showing the 50 uv/m contour, with the latest rate card neatly tucked into a bound-in pocket.

Thus, the sales crew has plenty of ammunition—but more than this, they are the kind of professionals who know how to get results for their clients—results that keep sponsors sold and add to an impressive file of facts and figures for use in bigger and better promotions. Nothing contributes more to success than success itself.

goes on to describe a special feature—namely that more than 1,000 such units have been purchased by doctors and dentists for their waiting rooms. Since an average of 30 people spend time in a doctor's waiting room each day, there is a captive audience estimated at 180,000 people. A final twist is the last page of the brochure; it lists, by name, the doctors who have purchased Auditrans.

It would be naive to assume that any FMer following the same route can achieve equal success. The central idea, however, is that WTFM's performance jostles the misconception that an FM station can provide good music and high-quality sound, then wait for success to materialize. In Polinger's words, "It takes guts and foot-

work." He believes this is especially true for the FM outlet in sparser population areas, outside the top 50 markets. Where it is impossible to cultivate a select audience, as in larger cities, competition is with local AM stations.

And here is where the most penetrating conclusion may be drawn about WTFM and David Polinger. In speaking to him, one gets the unmistakable impression that he is not a representative of the FM industry in any "traditional" role. He considers himself a professional broadcaster above all else. He seeks not an elite, narrow listenership, but the wider audience which is now rapidly developing. Polinger has proved that an FM outlet can be "run like a radio station."

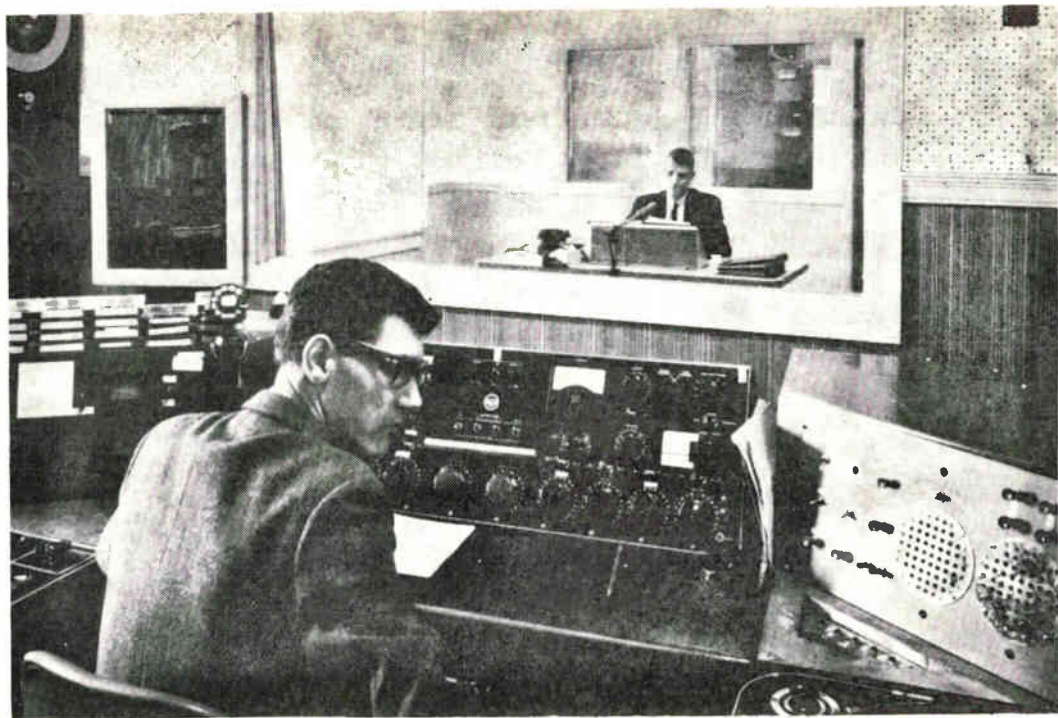
# **WJFM . . . Nation's Most Powerful FM Station!**

By Bruce M. Glycadgis

93.7 on the FM dial has become a household term to more than 150,000 families in Western Michigan. For 21 hours each day, WJFM radiates its powerful voice of  $\frac{1}{2}$  million watts (ERP) over some 30 counties and dozens of communities. WJFM began broadcasting with this tremendous power (the next highest FM station power is about 260 kw) on November 15, 1961, a significant date for FM

listeners in about a third of the state because it meant they could receive noise-free radio programs whether their receivers were small, large, cheap or expensive. It brought on a resurgence in the purchase of FM receivers within the area, especially in localities which had never before received FM. November 15, however, represented not the beginning, but, rather, the climax of a continuing

Main control room with Dave Hunter, night-time emcee at controls, and Dan Smith, day emcee.



effort to provide FM to the vast listening public of Western Michigan.

### The Beginnings of WJFM

The birth of WJFM goes back to 1946, the year Fetzer Broadcasting obtained its first construction permit for the facility. This CP was for the unheard-of (in

plant. (Over 150 kilowatts, 21 hours a day, are needed to provide the 50-kw transmitter output used today.)

In 1950, Fetzer constructed WKZO-TV, and it was determined that the TV tower would also be suitable for an FM antenna transmitting at reduced power. Thus, on June 25, 1951, WJFM took to the



Dan Smith, popular WJFM emcee, at the stereo control center.

those days) power of 500,000 watts. The company was confronted with many complications: Equipment capable of producing 500,000 watts was not readily obtainable; also, there was the problem of a suitable antenna site with adequate ac power available for such a powerful transmitting

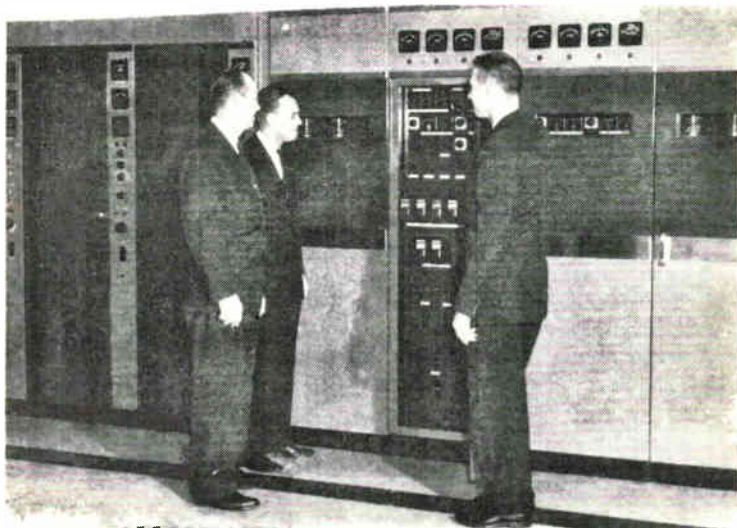
airwaves with an effective radiated power of 115 kilowatts. For the next 10 years WJFM's income was not large enough to pay the power bill, but Fetzer had great faith in the future potential of FM and felt it was in the interest of the radio public to keep the facility on the air.



To realize some income from the operation, a Muzak franchise was purchased, and the first multiplexed operation in Southwestern Michigan went on the air. The anticipated increase in power would eventually produce even greater multiplex potentials, a factor supporting the initial decision to purchase the Muzak franchise. All this, remember, took place during the years when many FM stations were going off the air.

tion for WJFM's antenna.

To keep WKZO-TV's signal on the air during the move from Kalamazoo to Gun Lake, management purchased a new TV transmitter. The two 25-kilowatt TV-power amplifiers at Kalamazoo were designated for the FM operation. These were Type TT-25AL amplifiers, and it was a relatively simple task to raise their operating frequency to 93.7 mc, diplex the amplifiers, and raise the



Carl E. Lee (left), President and General Manager of Fetzer Broadcasting; Arthur E. Covell (right), Chief Engineer of WKZO-TV; and the author standing before the control panel of the FM final amplifiers.

### WKZO Moves to Gun Lake

During 1960, Fetzer management decided it was time for a modernization program. Their conclusion: to locate the WKZO-TV transmitter and antenna at a point midway between Kalamazoo and Grand Rapids, to serve both communities. Management further reasoned that the new antenna tower would be an excellent loca-

tion for WJFM's antenna. To keep WKZO-TV's signal on the air during the move from Kalamazoo to Gun Lake, management purchased a new TV transmitter. The two 25-kilowatt TV-power amplifiers at Kalamazoo were designated for the FM operation. These were Type TT-25AL amplifiers, and it was a relatively simple task to raise their operating frequency to 93.7 mc, diplex the amplifiers, and raise the

### Amplifier Conversion

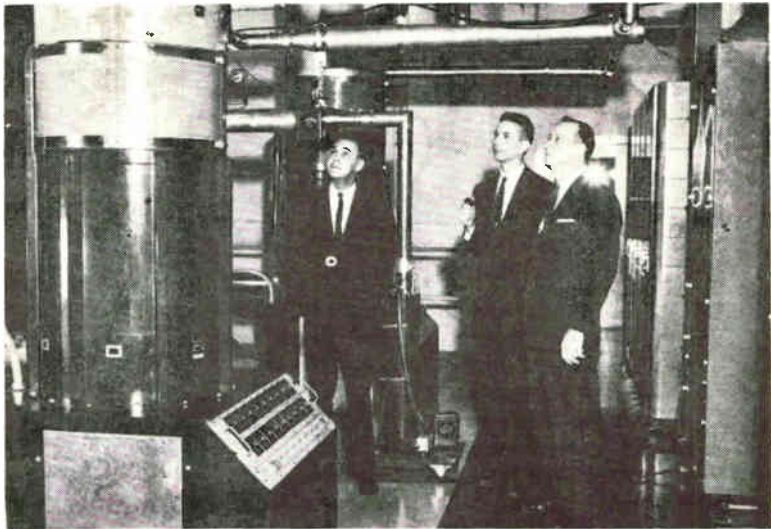
The power amplifiers use the well-known cluster of seven 5762 triodes operating in a parallel, grounded-grid configuration. This cluster design, owing to the physics of VHF frequencies and the mechanics involved, lends itself

excellently to frequency conversions. The modifications resulted in the first BTF-50B transmitter, and system performance has proved very satisfactory.

#### Side-Mounted Antenna System

WJFM uses a 12-section, gapped-ring antenna to one leg of the TV tower at the 800-foot level. Center-fed, this array provides a power gain of 12.5 and raises the 50-kw transmitter out-

ters are housed in a modern, well-engineered building of prestressed concrete. The 1100-ft antenna tower stands immediately outside to minimize outdoor horizontal runs of transmission lines. Locating the tower so close to the building presents a falling ice problem during Michigan winters; this was overcome through a specially-designed roof that withstands potential damage.



FM power amplifiers and associated transmission line.

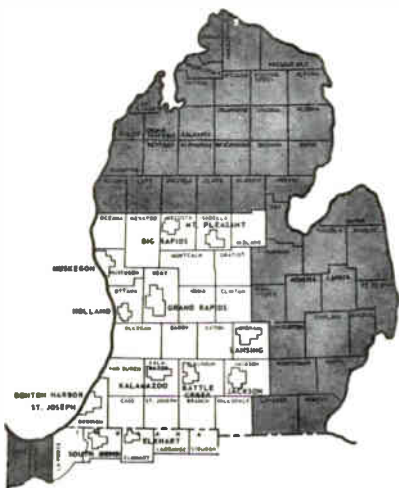
put to 500-kw ERP. Mounted on one leg of the triangular cross-section tower, the antenna provides substantially circular coverage over a 25,000 square-mile area (90-mile radius). This area includes Kalamazoo, Battle Creek, Grand Rapids, and Lansing, plus dozens of smaller municipalities at all points of the compass. In addition, the signal covers a large rural area that would not otherwise receive FM service.

#### Building Features

Both the TV and FM transmit-

All the electronic gear associated with the transmitters is located on the basement level with the power transformers and blower equipment. This setup keeps the transmitter room on the floor above extremely quiet. Further, this arrangement considerably reduces blower vibration in addition to increasing accessibility to the equipment. All of the air is filtered prior to its entry, eliminating the need for individual air filters for the blowers. Outdoor air is first filtered through spun-glass

## WJFM area coverage map



### WJFM PROGRAM SCHEDULE\*\*

NEWS ON THE HOUR EVERY HOUR

Monday - Friday	Saturday	Sunday
6:00 Sign On	6:00 Sign On	7:30 Sign On
6:05 Clean Tone	6:05 PM to the A.M.	7:30 PM Sonnets
6:30 PM to the A.M.	6:15 Agriculture R.I.A.	8:25 Church of the Air
8:00 World News	6:30 Local News	9:10 Voice of the Liberal
8:15 Opportunity for Women	6:35 Food for Thought	10:05 Subscription to Learning
10:10 Arthur Godfrey	6:50 PM to the A.M.	10:30 Jay Walker Hour
11:10 Opportunity	6:55 World News	11:05 Football Highlights
11:30 Mid After Today	8:15 Make My Week	11:35 Bill Laker Submarine
11:35 Easy News	9:25 Educational Features	12:10 Football Highlights
11:45 International Features	10:10 Hook for Everyone	1:05 Laundry Station
12:10 Farm Show	12:30 Studio Games	1:25 Educational Features
12:15 12:15 on FM	2:00 Soapbox Open***	2:00 Football Highlights
1:11 Musical Highlights	5:30 Studio Minutes to Stars	3:00 New York Performance*
1:11 Classic New Show	5:40 Radio Hour	5:00 Football Minutes to Stars
3:10 Dance Bandstand	5:70 Advertisers to 10 Fidelity	5:20 Capital Checkbook
5:11 Keyboard Report	5:40 The Big Band Second	5:40 Boston Post Comment
5:30 Radio Show	5:50 News to Report	5:40 Lawrence Walk Show
5:55 Golden Bear	11:00 PM to the A.M.	7:10 Advertisers to 10 Fidelity
5:55 Laurel Thomas	2:00 Sign Off	9:05 Classic New Show
5:55 Sports Time		10:00 Stone Symposium
7:10 Advertisers to High Fidelity		12:00 PM to the A.M.
8:10 Big Band Sound		3:00 Sign Off
10:10 Broadway to Stars		
11:10 Classic New Show to Stars		
12:00 PM to the A.M.		
3:00 Sign Off		

(\*) Broadcast to Stars  
 \* New York Performance to begin October 4, 1964  
 (\*\*) In order to bring you the very best... programs may occasionally change.  
 \*\*\* Soapbox Open to begin December 1, 1964.

filters, then passed through electrostatic filters to axial fans which "pressurize" the basement room and thus make it a massive plenum chamber.

The blowers, mounted on concrete piers, push the filtered air upward through the basement ceiling and into the bases of the transmitter equipment. Ducting, at the top of the transmitter cab-

ines, is thermostatically controlled so that the warmed air from the equipment goes directly outdoors in summer, or indoors in winter to heat the transmitter room. This loop system, using outdoor air, reduces the BTU requirement of the air-conditioning equipment in summer and delivers fresh, warm air in winter.

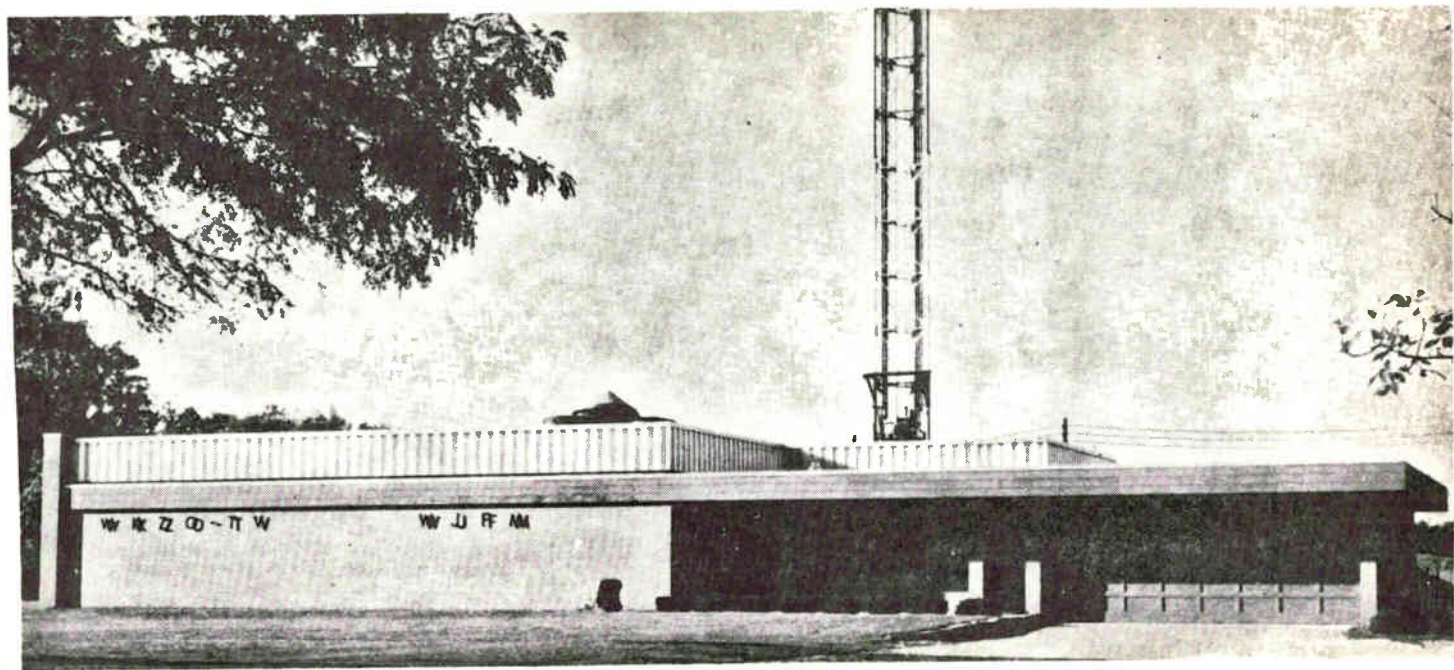
In addition to providing a dustless atmosphere in the transmitter room, another advantage in prefiltering the air is the elimination of a settled-dust problem in the basement. This, of course, simplifies maintenance.

## WJFM Programming

When the station went to the half-megawatt power, management decided it should be an entity in itself and should therefore generate its own programming. The staff spent many months making audience surveys to devise the programming that is now a part of everyday operation. As a result, WJFM programs its educational and informational shows throughout the day instead of just during the early hours of the morning. The surveys also indicated that listeners desired large blocks of time set aside for each musical category. As a result, WJFM maintains a considerable disc and tape library which provides an excellent range of musical selections.

## FM Stereo Programming

From 8:00 A.M. to Midnight each day, WJFM transmits multiplex stereo, using a stereo sub-carrier generator mounted in the center cabinet of the FM transmitter. Since introducing stereo programming, WJFM has built up



WJFM/WKZO-TV transmitter building at Sun Lake.

**WJFM FM Survey**  
**November 1963**  
**Battle Creek, Grand Rapids,**  
**Kalamazoo, Muskegon, Mich.**

FM PENETRATION

FM STATIONS	FM RECEPTIONS
26.9%	14.6%

VEHICLE CUMULATIVE AUDIENCE - 1963

	35.3%
--	-------

LISTENED TO RADIO

EARLY MORNING (6 AM - 9 AM)	15.1%
LATE MORNING (9 AM - 12 MID)	16.7%
EARLY AFTERNOON (12 MID - 3 PM)	25.0%
LATE AFTERNOON (3 PM - 6 PM)	22.0%
EARLY EVENING (6 PM - 9 PM)	20.0%
LATE EVENING (9 PM - 12 MID)	21.2%
NO PARTICULAR TIME	11.3%

**GENERAL RATES**

**CLASS A**

UP TO 15 MINUTE ANNOUNCEMENTS	1 - 1 WEEKLY	2 - 1 WEEKLY	3 - 1 WEEKLY	4 - 1 WEEKLY
1 TO 15 WEEKS	\$45.00	\$ 25.00	\$ 20.00	\$ 15.00
16 TO 25 WEEKS	50.00	35.00	30.00	25.00
26 TO 35 WEEKS	55.00	40.00	35.00	30.00
36 WEEKS	60.00	45.00	40.00	35.00

**PROGRAMS**

30 MINUTE PROGRAM	1 - 1 WEEKLY	2 - 1 WEEKLY	4 - 1 WEEKLY
1 TO 15 WEEKS	\$45.00	\$40.00	\$ 37.00
16 TO 25 WEEKS	50.00	45.00	42.00
26 TO 35 WEEKS	55.00	50.00	47.00
36 WEEKS	60.00	55.00	52.00

30 MINUTE PROGRAM	1 - 1 WEEKLY	2 - 1 WEEKLY	4 - 1 WEEKLY
1 TO 15 WEEKS	\$45.00	\$ 30.00	\$ 27.00
16 TO 25 WEEKS	50.00	35.00	32.00
26 TO 35 WEEKS	55.00	40.00	37.00
36 WEEKS	60.00	45.00	42.00

15 MINUTE NEWCAST	1 - 1 WEEKLY	2 - 1 WEEKLY	4 - 1 WEEKLY
1 TO 15 WEEKS	\$35.00	\$ 20.00	\$ 18.00
16 TO 25 WEEKS	40.00	25.00	23.00
26 TO 35 WEEKS	45.00	30.00	28.00
36 WEEKS	50.00	35.00	33.00

CLASS B TIME 4:00 PM TO 5:00 PM - 1:00 PM TO 2:00 AM  
 UP OFF CLASS A TIME

spot announcements, permitting greater use of the turntables for program material. The cartridge-tape facility serves for both stereo or monophonic announcements.

**Muzak Programming**

The SCA subchannel programming comes from two long-play tape machines located in the main control center adjacent to Studio 1. These two machines operate almost completely unattended, using Muzak tapes pre-programmed for such operation. The signal from these machines travels via multiplexed microwave to the transmitter site. Here it modulates a 67-kc subcarrier of a Type BTX-1A multiplex generator which, in turn, modulates the BTE-10B Exciter in the FM transmitter.

**Audience Response**

WJFM's primary signal-coverage area encompasses more than a million families. Over half of them could not previously receive an FM signal, and WJFM was the first FM station many of them ever heard. In many cases, the primary reason for buying an FM receiver was word-of-mouth praise for WJFM programming. Most of these new listeners are located in rural areas and, quite possibly, would have no FM service were it not for the half megawatt signal.

Fetzer Management believes that high fidelity and high power go hand in hand. Engineering ingenuity made it possible to transmit the most powerful, high quality FM signal on the air today. Programming excellence stimulated the growth of a large and loyal audience. Fetzer's 18-year old dream of providing FM service to the people of Western Michigan has been fulfilled.

a separate stereo-record library of nearly 2,000 albums.

Commercial stereo tapes are run through a four-track playback head. The recorder is also equipped with separate erase, record and play heads for two-track stereo tapes. The machine plays virtually all quarter-inch tape recordings—full track, half-track, half-track stereo and four-track stereo tapes.

The dual-channel consolette is in the center of a horseshoe arrangement, with turntables on both sides of the announcer's station. Each turntable contains two preamps for stereo reproduction. Cueing is incorporated within the consolette. An RT-37A cartridge-tape machine serves ideally for

## **THE STORY BEHIND THE STORY**

### **What's The Philosophy Of WJFM?**

One of the first questions that come to mind about WJFM, quite naturally, is "Why so much power, and for a broadcast service which couldn't, at least in earlier days, support itself?"

The answer lies in Fetzer management's philosophy—the belief that serving the public should be the first and foremost responsibility of every broadcaster. WJFM symbolized a strong faith in the future of FM both as a public service and as an entertainment medium. Located in a section of the country devoid of major population centers, but with several unserved medium-sized cities and towns spread over thousands of square miles, quality FM reception could only be provided to a mass audience with every kilowatt of power that could be mustered.

### **What About Profit?**

Did Fetzer anticipate that WJFM would pay its way? Initially, no—only the dream that FM radio would eventually become a widely accepted, worthwhile broadcast service. Except for the SCA background music service, the station had no other income. No attempt was even made to sell time until two years ago. Today, WJFM is "paying its own bills," including costs for power (which alone average between \$2,000 and \$2,500 a month) and a rather substantial equipment amortization.

### **What About Audience?**

The latest Pulse Report indicates that the number of FM households in the four major markets served by WJFM exceeds 140,000. Indications—such as the steady sale of FM receivers by Southwest Michigan merchants, and the quantity of mail received from new listeners—point to an increase of perhaps 50% in the FM households in these markets.

### **What About Sales?**

All of WJFM's evening commercial time is sold on contract, and both sponsored programs and spot announcements are booked solid for several months in advance.

During the first 10 months of 1964, WJFM sold a total of 2,415 spots—2,169 local, 246 national. Additionally, 935 programs were commercially sponsored during this period. While WJFM's 500-kw power is significant in selling national advertisers interested in large area coverage, local merchants are not concerned with such "total coverage." Thus, WJFM sales people stress the listener acceptance of program material and the high quality signal received in the areas pertinent to the client. The fact that the 500-kw signal blankets several good-sized communities adds considerably to the number of prospective time buyers.

# ***WKLS—Georgia's 1st FM—Only Station***

By Don Kennedy

**I**N 1960, THERE were only a few FM stations enjoying any measure of financial success, except those tagging along on the skirts of a successful AM sister. This gloomy outlook did not, however, deter the establishment of WKLS. On December 2, 1960, WKLS became Georgia's first independent commercial FM outlet.

When WKLS went on the air, Atlanta's FM programming was haphazard. There were no independent FM stations, with the exception of an educational FM. The others duplicated their AM rock n' roll and network broadcasts. Our initial programming consisted of a limited number of tasteful commercials, easy-listening instrumental music, and adult-slanted programs.

During the past 5 years, WKLS has grown from a 6350-watt monaural fledgling to a maximum power stereo outlet with dual antenna polarization. WKLS was the first FM station in Atlanta to limit the number of commercials each hour, the first FM station to play mostly instrumental music, the first to feature a weekly Broadway Show, the first to present a full 4 hours of dance band music on Saturday night, and the first to broadcast in stereo. On Nov. 11, 1965 WKLS began broadcasting with 100,000

watts horizontal and 100,000 watts vertical, to become the first Atlanta FM station to make use of the new twin antenna idea using present maximum allowable FM radiated power in two different planes.

Certainly the ideas used by WKLS were not new or unusual for FM. The fact is, many of the nation's successful FM operations were visited, and techniques and ideas were borrowed from various operations in different parts of the nation.

## **Programming**

In 1960, FM radio in Atlanta was simply a duplication of AM programming, except one which carried classical music. It was our feeling that we should appeal to the large middle segment of the audience—the general area between rock n' roll and classical. We further reasoned that there were persons at each end of the music lover's spectrum who could be wooed away to middle-of-the-road type music at least part of the time. Then, too, since we were the lone FM-only service, we knew that we were destined to make our program service fairly general, with, perhaps, later specialization to reach particular audience segments.

Our decision to make our pro-

gramming all-instrumental, with the exception of special shows, was a result of this thinking. Many persons may be thrilled when, say, Frank Sinatra sings; others may detest him. We simply decided to avoid this choice. Cowardice, maybe . . . but remember, we had to reach a maximum number of a very small potential audience at that time. Since most of our potential audience would be in their late twenties, thirties or forties, we planned to liberally sprinkle our

Even though one of us *had* to be there, we could be doing double duty—recording music, making announce tapes, keeping the books, phoning prospects, or typing letters—while the station ran itself. For economy plus consistency, all the music was recorded from discs onto tapes for use in our self-designed automation system.

Music was selected for its general appeal following the guidelines previously outlined, then split into fast and slow tunes. All slow music was recorded on one set of tapes, while fast music, including novelty tunes, marches, up-beat dance band tunes, and small combo music was recorded on another set of tapes. We began with a meager library of about 60 hours of slow music and half that much fast music, adding as we went and eventually building a fine set of tapes.

In the morning from 7 to 9 we programmed one fast and one slow tune (wakeup-type music). From 9 to 12 a ratio of three slow to one fast were used; at lunch, dinner time and late evening we stayed with slow music. At most other times three slow and one fast are used. This tempo balance has changed somewhat from time to time, but regardless of our desires or listener demand, we've been able to control the general overall tempo and "feel" of our programming at different times using the same system and taking advantage of *all* our music. We can use old or new tapes and still carefully control the music, selecting the ratio needed at any particular hour. It's a system that's worked out well for us.

We do deviate from our general format by using Broadway Show or sound-track albums on a Wednesday night program. Saturday

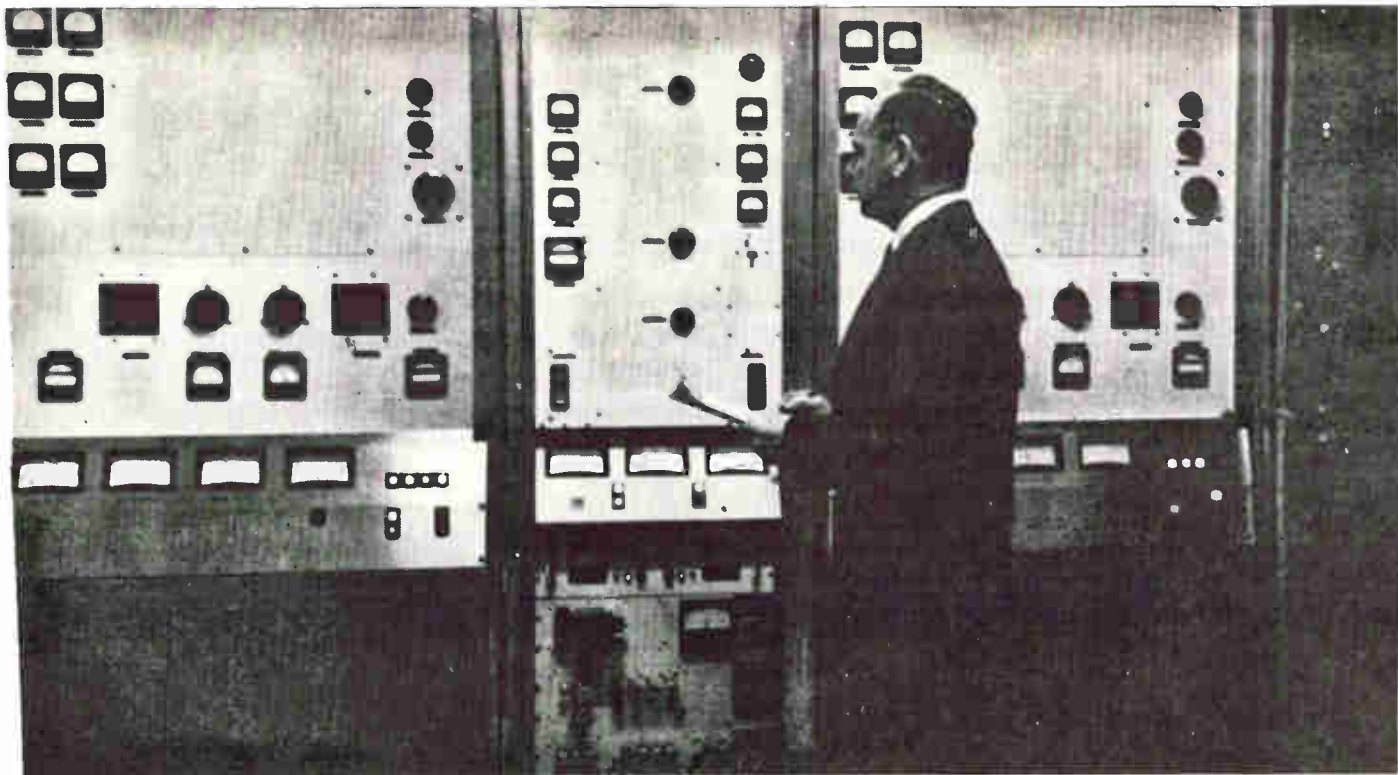


Operator-secretary Barbara Goltz keeps automated system tapes up-to-date in addition to her secretarial duties.

programming with big-band music of the '30s and '40s, mixing this with standards by Percy Faith, Montovani, Andre Kostelanetz, etc., plus bright little groups and some novelty music to inject the "pepper" to what would otherwise be a bland dish.

Only three of us would be operating the station 17 hours a day at the outset; therefore, it was imperative that we automate.





Chief Engineer Gordon Swan logs meter readings of the Rust FMT-15-HV transmitter. Twin 15-kw final amplifiers feed separate transmission lines.

Dance Date runs on Saturday from 8 until midnight, featuring names of the big-band era in half-hour segments. The morning program features weather every 10 minutes and time-temperature every 3 minutes. Three editorials, clipped from different newspapers, are broadcast at 12:30, 6:30, and 11:30 PM. Weather reports are programmed every hour. Total number of announcements are held to six per hour, with no double spotting.

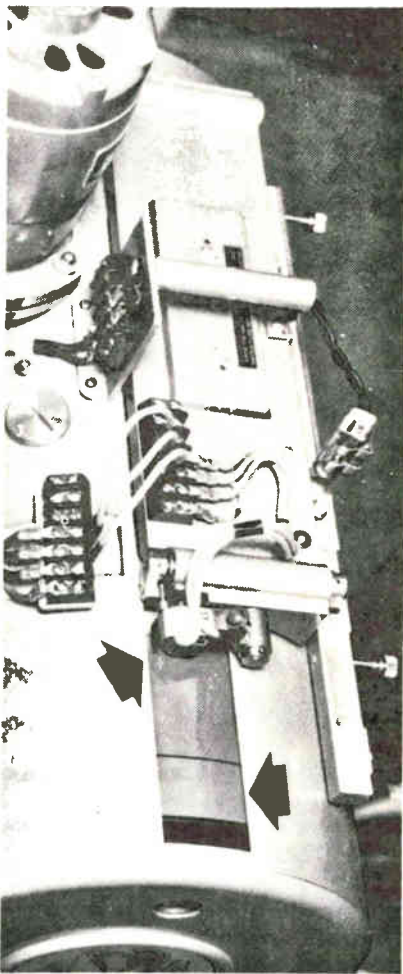
### On-Air Image

Many stations install elaborate equipment to insure the finest sound, purchase the finest music libraries, and program outstanding music—then hire green high-school kids to announce. A station's total image is carried by its announcers. Anyone can play records, but the announcers carry the station message into the home. They must be professional. We couldn't afford to hire fine staff announcers, so we did the next best thing. We brought in the finest available local men on talent fee to tape many station breaks and promotional announcements. They had to be pleasingly presented, with reasonably slow pace and professional phrasing. We think it's paid off.

One other consideration: music was recorded on tape with 10 seconds silence between tunes to give the station a slow, easy-going pace. This pointed up the difference between us and the frantic AM programming. No jumping cues or snappy play-offs, but relaxed, adult presentation of both music and announcements. We had no objection to selling our sponsor's products, but strived to do it in an adult fashion.

Finally, we decided to omit

news because it is so well covered on many other stations in Atlanta. We couldn't do better than one of the big AM stations with the finest news staff in the state. Of course, this decision also saved us some money.



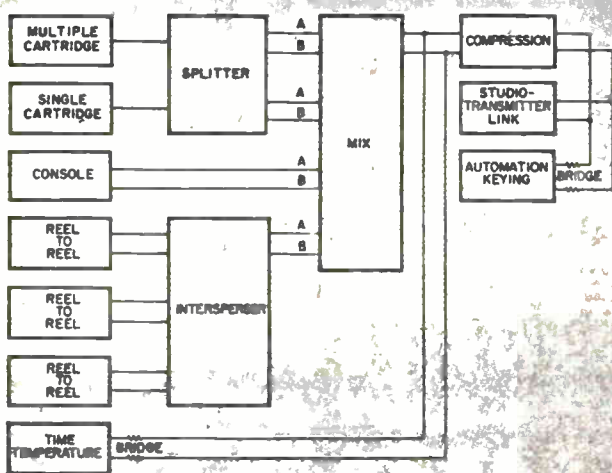
Top view of time-temperature machine. Time drum is shown uncovered, with the head (left arrow) just completing a time announcement cycle. Small part of drum (right arrow) has 12-hour tracks; larger part has 60 one-minute tracks. Total time announcement reads: (small drum) "Six (large drum) thirty-two."

## WKLS Engineering

In the beginning money was a vital factor (as is usually the case). We reasoned that power wasn't of top importance because we were offering a somewhat exclusive service, and listeners would come to us. This was true at the time. Antenna height was important in order to reach as many potential listeners as pos-

studio window looked directly out on the automation system so the man on duty could be recording or making announce tapes and still see the equipment in operation.

The automation system utilizes Ampex 450's, with a silence-sensing circuit. An intersperser switches to a different key function after every period of silence, selecting the tape deck as switched



Block diagram of the WKLS automated programming equipment setup.

sible, so we placed our equipment on a hill near Atlanta. It was more economical, anyway, to buy a hilltop lot in a rural area than to build that much steel downtown. We used a 1-kw transmitter and an 8-bay antenna mounted on a 270-foot tower, resulting in an ERP of 6.35 kw and a radiation center of 510'.

For economy, the WKLS studio was located in the transmitter building, a frame structure housing a cement block studio to assure good sound-proofing. The

by that key. A 10-minute timing cam inserts an announcement every 10 minutes at the end of the music. The announcement comes from another Ampex 450, followed by a 25-cycle tone which restores the music cycle. With the advent of multiplex stereo, we simply changed the heads on the 450's, added a stereo simplifier, and continued much as before.

When WKLS began stereo operation in May 1962, it seemed advisable to raise power. We applied for 32,000 watts, but were

given only 19,000 as a result of the FM freeze that was then in effect. Increasing competition and the advent of vertical polarization eventually indicated the need to make the final move to maximum power in both planes, which was accomplished in November 1965. A Rust FMT-15-HV transmitter with twin 15-kw power amplifiers feeds two independent transmission lines, one to each antenna bank (a Jampro 8-bay vertically polarized antenna was installed on the tower beneath the existing

chine that automatically reads out the correct time (to the minute) and accurate temperature upon a signal from the announce cartridge. The time and temperature announcements have been invaluable from a sales standpoint, and have added a vital service that most automated stations do not offer. The time-temperature service is a highlight of our morning program from 6 to 9 AM.

### Station Promotion

Listeners have to find out about



Don Kennedy, General Manager of WKLS, doubles as announcer and part-time salesman.

antenna). If one or the other transmitter amplifier fails, we can still operate with reasonable receptivity until repairs can be made. Studios were moved to downtown Atlanta, and most existing equipment updated or replaced. A twin Moseley STL carries the programming 12 air-line miles to the transmitter site.

Recent equipment additions include an ATC-55 automatic cartridge machine from which all announcements now come, plus an Audichron time-temperature ma-

a radio station, of course; it's vital to have a group of loyal listeners. But, if the programming is good enough, and the signal adequate, listeners will find you naturally through word of mouth.

Advertisers are a different story. If limited money is to be spent for promotion, it's only logical that it be spent telling the prospective advertisers about the station, and telling them in a clever and memorable way. We don't claim to be star promotion

men, but here are some of the things we did—a few of them terribly corny in retrospect.

Tiny postal cards were sent out before going on the air, with the caption, "FM IS GROWING IN ATLANTA. SOON ON THE AIR—WKLS, 96.1 mc." With each mailing the size of the card was increased until the final card, timed to be received right before opening day, told of the on-air date.

Mailings offering a cash prize for knowing the call letters of

combo, with slides to match showing the instruments and their positions, to demonstrate what stereo is, then briefly plug WKLS as the pioneer FM-stereo station in Atlanta. It's effective and impressive.

We often rubber-stamp the outside of direct-mail envelopes with a curiosity-tickling phrase such as: *Message from Alexander G. Bell* inside, to announce sponsorship by the telephone company, or *202,000 FM Homes Now in Atlanta*, to pique interest in more



Georgia's Governor, Carl Sanders, delivering congratulatory remarks during WKLS dedication. Sales Manager Jim Lathom is at right, Manager Don Kennedy at left.

the new FM station were sent out to agencies and prospective sponsors, with a blank for the answer. Returned correct answers received new pennies. Not much, but a cash prize nonetheless.

A slide presentation explaining stereo FM along with a stereo tape will attract the interest of service clubs and get the story across. It's surprising how many people have questions about FM, and how many go out and buy FM sets when they see the slide presentation. We use a live taped

details. In one instance, we sent a sheet introducing a program sponsored by an airline in one of their ticket envelopes. Comment was liberal.

An antique automobile with a sign on the side, "Good Old Music—WKLS," was another of the early promotions that proved effective. We drove it all over town on sales calls, and parked it near the expressway during morning and evening rush hours.

In all methods, we've followed two basic rules: Don't say too

much, for most persons get a great deal of mail and must read quickly. Send out pieces regularly, so people won't forget you. Large city or small, big promotion effort or small, some promotion is vital to establish a station as an important, permanent business, to keep people from forgetting you.

### Sales, Sales, Sales

When you boil it all down, sales is what you're in business for. Everything you do points to more sales, or it should. Pro-

ing just radio. Here are the most vital:

1. We sell FM as a separate entity. Just as TV and AM are separate, we feel that FM is separate, requiring a separate budget and separate approach to advertising copy.

2. Sell only those prospects who have a product or service for your FM audience, whatever audience you may be shooting for. (In our case, we can't sell black leather jackets or lollypops, and we don't try.)

3. Sell something specific. Woe

#### WKLS Market Coverage

The number of FM homes in Atlanta grew as WKLS grew, as shown in this comparison:

	Year	WKLS Power	FM Set Penetration	FM Homes In Metropolitan Atlanta
WKLS Opened	1960	6.35 kw	19.2%	53,000
Stereo Introduced	1962	19 kw	25.5%	130,000
Power Increase	1963	19 kw	38.6%	150,000
Power Increase	1965	100-kw V 100-kw H	42.9%	202,000

The new WKLS 50- $\mu$ V contour encompasses 59 counties in Georgia, 5 in Alabama, and one each in North Carolina and Tennessee, covering over 2 million persons. Reports from listeners bear out the effectiveness of the new vertical antenna and twin 100,000-watt transmission. Reception on small table-model receivers is greatly improved—automobile reception is good many miles beyond the metropolitan area.

gramming is important, so you have a good product to peddle, but if you don't make any sales, all the fine programming in the world won't make the station a financial success. Some of the points we're about to mention are elementary, but it's surprising how many stations bumble along for years without focusing attention on the all important sales function. We certainly made some grave errors until we discovered a few of the unique approaches to selling FM as opposed to sell-

to the FM salesman who goes in to the prospect's office and says, "You wanna' buy some FM time, Mister?" Tell him what he wants to buy. Size him up before you go in, and have a package ready, even if it's one spot a day for two days. Be specific. Tell him when his programs will run and why. Sell him a predetermined number of shows that'll do his job and he'll respect you for it. Even if he doesn't buy your specific offering, it's surprising how often he becomes a prospect for some-

thing else. You have more confidence and he has more respect for you when you *sell something specific*.

4. Have the right tools for the sale. Prospects are going to ask questions and they have a perfect right to know the answers as accurately as you can give them. Be prepared with attractive charts that show your listeners' age and income group . . . often they buy cars . . . how much they spend on groceries . . . how much their homes cost . . . how many live in apartments . . . how many phones they have. You can easily get this information by sending a questionnaire to your listeners. Tell them on the air you'd like to know who and where they are, then send them a sheet of questions. Compile the answers neatly and use them liberally. These same letters can show *where* your listeners are, by city or county. It's impressive for a prospective advertiser to see a list of percentages showing who you reach and where they live.

Follow-ups and clear records are also necessary for efficient

salesmanship. We always send a memo to thank a prospect for his time—whether we make the sale or not! If he's a live one, it certainly doesn't hurt to send him a proposal in writing, or a letter outlining what you discussed with him. Let him know you're there, and don't forget to add him to the regular promotion mailing list.

Finally, there are lots of folks out there to sell, and all you've got to do is see them. It's as simple as that. List the prospects who would be right for your FM station, see them systematically, and sell them.

### Conclusion

FM means many things to many broadcasters who have experienced success with varied formats. Whatever the format or approach FM stations use to specialize their programming for specific audiences, it's our contention that the future of FM is assured. Past experience proves it and, for the future, reinforces the value of FM to both listener and advertiser alike.

# ***Building an FM Station— From CP to Sign-On***

By Carl B. Haeberle and James W. Davis

**I**N MARCH 1964, WAJR management requested production and engineering to (1) develop a new concept in FM programming; (2) build a maximum power stereo station within the confines of the present staff and physical plant; (3) produce the end result in a minimum time; (4) continue present duties; (5) sign-on with minimum expenditure but maximum flexibility.

Less than 8 months later, WAJR-FM signed-on with complete stereo facilities including locally recorded events—anything from a basketball game to a tiddly-winks tournament. Three million people now have quality music and news programming 17 hours a day, 7 days a week. One million of the potential listeners had never been able to receive quality FM without more noise than music. The budget to build these facilities, although sizable, was squeezed in every possible way. Over \$10,000 was saved by local design and construction.

When you set out to build an FM station, you soon learn that there is not an abundance of available basic information to guide you, and there are few

sources of paternal counsel to steer you in selecting equipment and efficiently operating a stereo facility. In spite of these conditions, we were on the air in just a little over seven months after our CP was granted.

We felt there was a definite need for WAJR-FM. Adjacent counties were not being reached by local radio, and the statewide Mountaineer Sports Network needed a feed signal. Then, too, it was felt that many people were not completely satisfied by a middle-of-the-road AM outlet and the other local station.

WAJR-FM came into being in 1947. By 1962 the old transmitter was outmoded—antique, in fact—and was taken off the air due to instability. The operation had befitted the term "experimental"—a poorly programmed and staffed AM stepchild. Programming was provided via an automatic record changer or by simulcasting with AM. To replace and improve the facility, the station applied for, and was granted, a new channel and a power increase to 25 kw ERP. A new transmitter was ordered and shipped just in time for the FCC



## Here's what it takes—

An unofficial cost list taken from sales estimates and purchase orders. Additional costs in administrative supplies, engineering and legal fees, transportation, wages, etc., increase the total cost figure. Comparatively minor items, such as bulk tape erasers, which cost in the neighborhood of \$15, are not included in this break-down. Figures on labor and locally constructed electronic and mechanical units are not included in the estimates.

### Electronic Equipment

Transmitter and antenna equipment: Collins 830H-1A 20-kw transmitter, 8-bay antenna and 8-bay vertical antenna, 26 U-2 limiter, 900 C-1 modulation monitor; McMartin TBM-3000 frequency monitor . . . . . \$55,000

Transmitter Studio: Gates Stereo Yard-Wide console; two Empire Troubadour turntables with Shure M3D cartridges and Audio-Empire Dynalift arms; RCA RT-37A cartridge playback unit; Ampex 354 playback tape deck; locally-constructed console table and storage shelf unit; standard equipment rack . . . . . \$7,000

Production Studio: Gates stereo "Executive" console; two Gates CB-77A cartridges; Ampex 354 record tape deck and PR-10-2 record tape deck and portable case; RCA RT-37A record playback unit; locally-constructed console table and cartridge storage rack; two standard equipment racks . . . . . \$10,250

### Construction\*

Transmitter studio and building modification . . . . . \$ 1,500

Production studio and office . . . . . \$ 800

### Office Equipment & Furniture\*\*

Transmitter studio: desk . . . . . \$ 100

Office: typewriter, file cabinet, table, card index, three desks . . \$ 850

Records . . . . . \$ 800

Reel tapes . . . . . \$ 200

Cartridge tapes\*\*\* . . . . . \$ 350

Advertising: newspaper and mail . . . . . \$ 500

**Estimated Total** . . . . . **\$77,350**

\*Does not include labor.

\*\*New furniture was purchased for other offices where needed. Older furniture was released for FM use; however, costs show new furniture purchases.

\*\*\*Since all air announcements are pre-recorded, more tape cartridges and reel tapes are required.

freeze in 1963. The transmitter made an about face and went back to the factory.

The matter rested for over a year while allocation procedures were ironed out. Finally, in March 1964, WAJR was assigned a frequency of 101.9 mc and granted a CP for a 50-kw FM station. Then, with the advent of vertical polarization, management felt that

the mountainous terrain would be best served by vertical as well as horizontal polarization. FCC approval was then obtained for 50-kw dual polarized transmission.

As of March 15th, 1964, the station was a paper tiger! It had received thought as to means and methods of programming, but concrete construction plans were non-existent, even though an on-

air date of September 1st had been arbitrarily set.

On March 22nd, 1964, a member of the AM staff was designated as FM Production Director and assigned the responsibilities of developing the physical plant, the basic administrative structure, and the programming. The Production Director was also charged with the promotional aspects of the FM station. The AM Chief Engineer received the additional duties of FM engineering. His duties were expanded to the development of technical details, including wiring, equipment selection, construction procedures, and the problem of how to set up a "new concept in radio."

In these opening stages, we established that a "quality" sound—from both engineering and programming standpoints—was a

basic prerequisite. The music policy was tentatively set—good music with an upper middle-of-the-road approach, stressing instrumental music, with all, or as much as possible, programmed in stereo. As the market was reasonably open there was no reason to specialize in any one area of music. To allow ample room for error, all steps taken prior to sign-on were made carefully, with the idea of a complete middle-of-the-road format at sign-on. As comments are voiced on likes and dislikes, the station expects to move into new fields. Down to the initial order of records, we developed only a framework program schedule. We ordered only "standards"; i.e., music which would definitely be used regardless of possible variations in the final program structure.

### **Advantages of a Transmitter-Site Studio**

From cost, to overall sound, to proficiency, we feel that having production facilities and offices downtown, and the on-air studio at the transmitter offers more advantages than disadvantages. The biggest problem is providing the engineer with enough information to ensure proper insertion of prerecorded announcements and intros, but with practice and training the problem resolves itself. Had we used a downtown location for the on-air studio, we would have had to hire three new announcers or used a packaged program unit, not to mention that there just wasn't enough space for the studio. Then, too, our transmitter engineers' time is put to better use.

The dual balanced 15-kc phone lines required by stereo presented some problems; the telephone company has the equipment, but is short on staff. They didn't appear overjoyed at the thought of installing and maintaining the facility. Also, we received a report that one station was having phase shift problems on their phone lines, resulting in a signal loss by the time it got to the transmitter. A 15-kc line is fine for AM, but the high audio frequency fall-off reduces FM quality considerably. We have discovered that our transmission has more "presence," more consistent audible levels of music and talk.

## Transmitter and Studio Locations

Since the station already had an FM transmitter site, the logical thing was to locate the new FM transmitter there. The old FM had been operated by remote control on a hill within the city limits. The AM transmitter location—5 miles out of town with directional 5,000-watt daytime, 500-watt nighttime pattern—could also serve as an FM transmitter location, complete with an engineering staff.

We learned during our initial research that stereo stations encounter difficulty sending the two audio channels through two pairs of telephone lines without some

phase and separation loss. Therefore, we concluded the best studio transmitter location would be on Bethel Hill with the AM transmitter. With this setup the AM transmitter engineers—then only reading meters—could run the FM programming from logged music sheets, using prerecorded commercials, show openings etc.

Since Bethel Hill is some 5 road miles from the downtown offices and AM studios, we decided to build a production studio at the downtown studio site to reduce the administrative and announcer problem. Here we would "build" the programming material for FM—record the commercials, show openings, etc. The engineer at the

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## Sales—

We were lucky in as much as we did not have the requirement of "profit within 'x' number of days." The ownership and the highly successful AM side of our operation gave the FM time to work out its major programming ills and to establish itself within the community before it had to start a sales campaign in earnest.

Concentrated sales efforts were begun this past July. We designed and ordered several printed sales aids and salesmen were on the street with the new packages by the first of September.

The primary printed aid is a brochure-cover unit which contains brief statements concerning the station's services to the community and aimed at the local sponsor, his agency, and as an aid to the station representative working on national business. Printed on tan glossy stock in brown and black, it exudes a "quality" station image. It includes coverage maps of both the AM and the FM signals, SRDS information on the coverage area, and additional sales information.\* (Total cost for 1,000 was less than \$100.)

A second unit is a style-matched rate card. The AM and FM use separate cards; however, they are designed to complement each other and are cross-referenced for combined time-buying. The rate cards are also printed on tan stock. By use of a single ink (black) and half-toning, a quality appearance was produced at a minimum cost.

The third unit is a simple presentation folder—a legal-size sheet with the bottom third folded up. It holds any material the salesman wishes to give the client (including the contract) and is pre-printed with the station call letters and address. The client's name is imprinted at the appropriate place. The personalized presentation for the client gives the salesman somewhat of a head start.

Additionally, we utilize an individual presentation for each sponsor. When the salesman arrives at the client's door he has in his hand the complete package including his conception of what his client should

transmitter studio would play the records, according to the music sheet, and insert announcements. For news, we would merely simulcast with AM.

### Studio Design

After establishing the concept on paper, the next step was to formulate the studio design and operations guide. As of that date, a very limited amount of information was available as to the "best way" to do anything in stereo broadcasting or programming. Thus, all old patterns were basically scrapped. A design for the production studio was set up by a three-man group, the pro-

duction director, the chief engineer, and the station manager. These ideals were established: The studio must serve as a show room and part-time sales-demonstration room. A demonstration of equipment and prerecorded sample spots seems to aid sales. The room must present a relaxed atmosphere, uncluttered with equipment, an advantage to both operation and sales. The operation has to be flexible and semi-moveable in case of a location change in the future. Any operation has to be efficient. If all recording is to be done from one location, and done inexpensively, a limited amount of wasted time is of prime importance. With these mandates in mind, we arrived at our studio design.

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### of Course!

have on the air. The order is all pre-written and ready for signature.

To introduce the FM station to a new client, and to soften up sales resistance, we used an idea from CHUM-FM in Toronto, Canada, and adapted it to our use. This classical music station used a 6-minute tape presentation which they call an "Emotional Approach to FM Sales." It must be effective—the Canadian station was almost sold out at sign-on!

To allow maximum sales, we set up our programming to accommodate virtually anything from one-minute spots to a 2-hour show package. Spots are available (in 60-second time length only) adjacent to the hourly news and on weekends. The remainder of our weekday commercial time is devoted to 25-30 minute and 55-minute blocks. If a sponsor buys, say, a 55-minute package, he receives 25 fifty-five minute shows per year; approximately one-third are programmed in the morning, a third in the afternoon, and the remainder at night. This rotation gives the sponsor maximum audience saturation at a minimum cost and gives us a minimum of production problems. Rates were set, for these packages, by the use of a relatively simple formula. The cost of operation (all payments, wages, etc., included) is divided by the number of commercial-hour availabilities per week-day per year. The less than one-hour shows are priced according to the cost per hour figure.

To provide a "profit margin" for the station, and to offer clients a show which they can "call their own" we also set up three production shows and have developed three holiday shows. These packages are not sold at the lower rotation show rates but are included at the regular rates.

Two daily national newscasts, several local newscasts daily and the annual West Virginia University football and basketball shows, are sold at the standard "card-rate" or combined with the AM sales.

Assuming all rotating blocks were sold, the remaining sales would be profit. Even with only about  $\frac{3}{4}$  of our total availabilities sold we are in a slight "profit" position.

\*Mark Data Associates, Albuquerque, N.M.

### Broadcast Studio (Bethel Hill)

- 1 Gates Stereo Yard-wide console
- 2 Empire Troubador turntables with Shure M3D cartridges and Audio-Empire Dynalift arms
- 1 Ampex 354 tape deck (playback only)
- 1 RCA RT-37A cartridge playback Unit
- 1 Locally-constructed console table
- 1 Locally-constructed storage shelf unit
- 3 Standard equipment racks

### Production Studio (Downtown)

- 1 Gates Stereo Executive console
- 2 Gates CB 77A turntables with Audio-Empire Dynalift arms and Stanton 481-AA cartridges
- 1 Ampex 354 record tape deck
- 1 Ampex PR-10-2 record tape deck (plus portable case)
- 1 RCA RT-37A cartridge record playback unit
- 1 Locally-constructed console table
- 1 Locally-constructed cartridge storage rack
- 2 Standard equipment racks.

Other normal studio equipment, including patch panels, microphones, etc., were also listed, debated, and purchased.

We found that no reasonably priced commercial turntables have (or did not at that time) sufficiently low rumble and wow characteristics needed for stereo "quality" programming.

A rumble or wow, undetectable in AM or in monaural FM, can sound like a wind-storm in stereo. Thus, the two belt-driven "home use" machines were purchased. These are critical to the extent that even tightening the drive belt beyond recommended specifications can induce rumble. A heavier drive belt may also cause audible rumble. The lack of close cue, due to the extremely slow starting characteristics inherent in a belt-driven unit, creates something of a problem in programming until the operating engineer becomes accustomed to the mechanical operation. Critical to broadcasting also is the fact that back cueing is impossible due to a required rubber turntable pad. Actually, with less than two duty shifts using the turntables, the engineers develop their timing sufficiently to provide the desired programming.

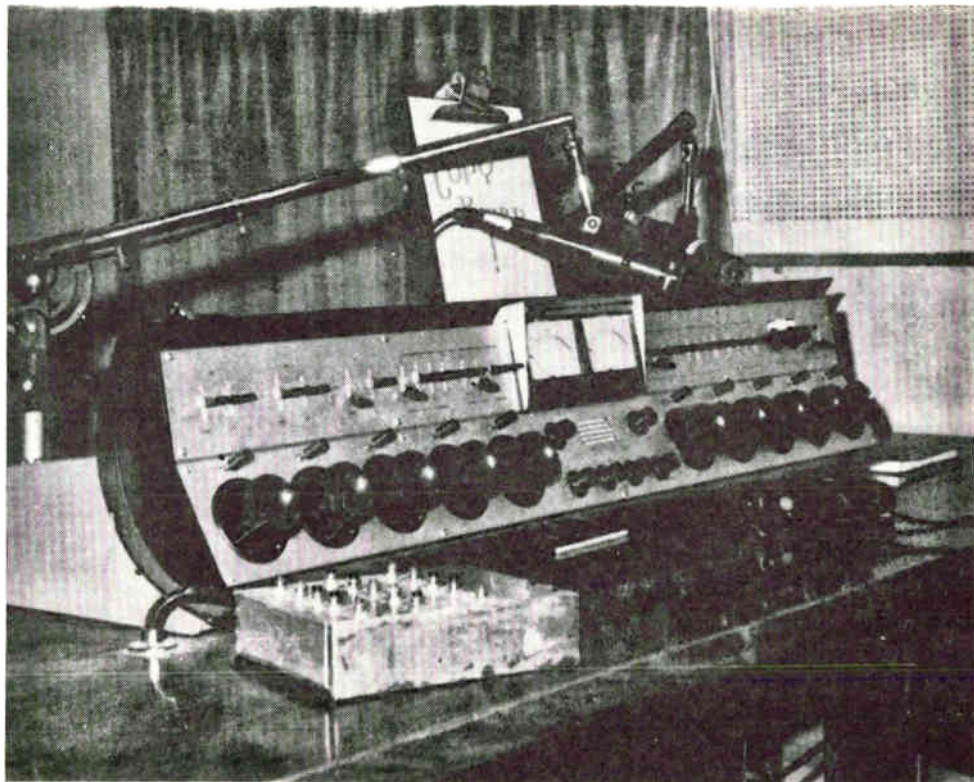
We have found, too, that a tape recorder instead of just a playback unit should have been installed at the transmitter studio. With a recorder unit, we could record "on-air" material for later use. Comprehensive air checks could also be made in this manner.

### Ordering Equipment

As the operational plans were completed, equipment procurement began. Again, expense came into focus as equipment was checked. The "mail-order" system of obtaining multi-thousand dollar equipment units was employed. This proved, at best, a poor means of spending company money. Too

late, the value of attending one of the yearly NAB conferences and equipment displays was discovered. In our particular case, however, all equipment obtained *did* perform as hoped, or nearly enough so, that with local changes by the Chief Engineer, the station could operate efficiently. Had we attended a display, though, some of the equipment purchased

Even announcements are in stereo at WAJR-FM; one of two boom-mounted mics feed each stereo channel. This is WAJR-FM's downtown production facility using a dual channel console, where all voice program portions are recorded. The "box" lying in front of the console is a remote control panel for tape recorders, cartridge machines, and turntables.



would have been overshadowed by other available units.

An "optimum" list was developed, including everything possible for a "perfect" station. The use and importance of each item was then discussed and debated. If the unit was a luxury item, or

one which could be omitted and still maintain the programming concept, it was crossed off the list. By this means no extraneous equipment was purchased, but there was no last minute rush to buy something that had been forgotten.

## STUDIO LAYOUT AND CONSTRUCTION

**I**N MANY WAYS, our new FM facility was looked upon as an AM stepchild, so we were left to our own devious means of building the facilities with a fixed budget. Thus, we did much of the work ourselves, and resorted to many special innovations.

Construction labor was drawn from local resources—from building the production studio's raised platform, to painting the ceilings. As a result, we saved about \$6,000—6% of our anticipated \$100,000 total investment. This saving is mostly in labor; we found it possible to construct many items not available in pre-built form. As an example, an estimate of \$600 was given by one lumber company to construct the production room console table. The cost, after minor modification, was less than \$150. The finished unit serves better than the one originally planned, since the wiring was installed during construction and modifications were made when "hitches" arose.

Construction of our studios was initiated as soon as the equipment was on order. At that time all dimensions and terminal points of the equipment were known. The transmitter building had to be completely remodeled prior to arrival of the new FM transmit-

ter; thus, it took precedence over the production studio in most instances. Design and construction, however, were inaugurated for the two areas concurrently, so that similar construction phases could be tackled simultaneously. As the transmitter studio is engineer-operated, the engineers were consulted. Everything had to be put into a compact, efficient cube which would allow maximum use of necessary equipment with as many time saving innovations as possible. Due to our almost exclusive use of "student" engineers (students at the University), shifts are often long to accommodate class schedules. In spite of the fact that they are part-time students, they are outstanding and willing workers.

It was decided that a "U" shaped work area would best suit the needs of the operators. Three racks form the left leg of the "U" while the turntables form the right leg. The console is mounted facing the transmitters; a double-paned window allows all meters and warning lights to be viewed. In the racks we mounted transmitter monitoring equipment for both AM and FM, the tape deck, and the cartridge playback unit. The room is also provided with a specially built shelf



Fig. 1. View of transmitting studio, showing console, turntables, and rack equipment.

unit immediately behind the "U" to hold logs, records for the day, and necessary programming tapes. An air-conditioning unit was installed to replace two windows. (The windows were considered a detriment to silence, plus, with a beautiful view of "those West Virginia Hills," something of a work deterrent. The window areas were sealed inside and out with exterior grade 3/8" plywood

sheeting, then treated as regular wall areas.)

We foresaw one major problem: By locating the studio near the 5-kw AM transmitter, a 50-kw FM transmitter, the associated antenna system, and the required cooling fans, we would undoubtedly swamp the audio equipment with RF and the studio with noise. At the outset, the studio area was stripped to bare floors,



joists, and rafters, and a "quadruple" wall system was designed and constructed.

First, a rock wool insulation material was stapled between all joists and rafters and stuffed between door jams and joists. Next, a copper screen cage (using window screen type material) was built to completely enclose the area. It was stapled to all joists and rafters and laid on the floor. All seams and joints were then soldered and the system was connected at appropriate points to the station ground system. An industrial grade floor covering was installed over the screening on double felt mats. All of these were bonded together and to the concrete floor through the screen with mastic. Panels of Celotex were rough nailed over upper wall and ceiling screening. Finally, acoustic tiles were installed on the upper wall areas and the ceiling. Pegboard was used up to the 4-foot wall level to provide a more durable surface.

The room turned out to be "studio quiet," yet still live enough for quality air work if an emergency arose and the announcers were forced to work "live" at the transmitter studio.

### **Production Studio Construction**

Concurrent with construction of the transmitter-site studio, the production studio at the downtown offices began to take shape. Every effort was made to make the 15 x 11' studio appear large and unobstructed. The room was painted in light tan tones with a white ceiling. The production area was raised seven inches by use of 2 x 6's and a double 3/4" plywood floor. The reason for the heavy construction was the stability re-

quired for lightweight tone arms. Other stations we visited during our research study had used 2 x 4 beams on 2 x 6 sill plates. These had developed—over a period of months—a bounce which had to be eliminated with structural reinforcement. The flooring was both nailed and contact-cemented to produce as near a perfect bond as possible. Raising the floor allowed the racks to be placed away from the work area while still electronically accessible to the console.

Six 1" conduit pipes were run between the joists from the rack position to the console location. Four 1" conduit pipes were run from the rack position directly through the studio wall into the AM studio to interconnect the two. After completion of the floor area, a wall-to-wall carpet was installed in the interest of appearances and acoustics.

### **Studio Console Table**

The console table was constructed almost entirely with 3/4" birch plywood and cost less than \$150. A hollow leg design proved structurally sound and ideal for wiring. In construction of the base legs, the major leg (larger of the two) was built with two removable sides. The fixed sides are doubled 3/4" plywood. These were bonded with contact cement and nailed from the inside, thus preserving the surface areas. These two fixed sides provide inside surface space for terminal points and wiring mounts. An auxiliary AC circuit provides light and power for maintenance work on the console or other equipment.

The top surface was constructed of two shaped 3/4" plywood panels. Prior to cementing the

top panels together, a 2 x 4 the length of the top was fastened by a series of stove bolts to the bottom of the underside panel to help support the heavy console. After the 2 x 4 unit was in place,

the project was handled with professional results.

The two turntables were placed at the side of the table 6" below the 30" table height. This level was found to be ideal after ex-



Fig. 2. Two views of the WAJR-FM production area. Rack equipment is in close proximity.

the two panels were contact-cemented and nail-locked together. The formica top was also installed by our own "carpenters," neither of whom had ever used a router. However, with five minutes briefing at the lumber yard,

perimentation for visibility and cueing ease. Since that time we have discovered that NAB has adopted this height as a standard!

Boom mics were attached directly to the table top. Commer-

cial stands allow adequate flexibility; however, they give the appearance of giant storks. Thus, the boom, swivel unit, and the arm of two mic stands were mounted on vertical aluminum tubes (do-it-yourself 1" tubes) which are attached to the table by means of a flange mount. Microphone chassis connectors were sunk into the formica top to provide termination for the mic cables. A second mic termination point, at the base of the major console table leg, allows minimum cable run to the open recording area in front of the platform.

In the interest of convenience and better production, we deemed it necessary to devise a means of starting and stopping tape machines and turntables from a central panel at the operator's finger tips. After pricing several individual units which are commercially available, we decided that the combined cost was prohibitive, plus the fact that the individual units would take too much space on the console table. With a little thought and an expenditure of less than \$20, plus 6 hours construction time, a customized control center was built to handle all physical functions of tape recorders, cartridge machines, and turntables. The unit was first placed in an aluminum chassis box so the ideal location could be determined by experimentation before permanent mounting. (After a 4-month period of actual use, we have decided to mount the unit in the console table at the left of the operator, at approximately a 30° angle from the console front.) The unit is a simple 6" rack plate lettered to indicate functions, and a series of *spst*, normally closed, momentary contact switches. The turntables are operated by power

relays which activate the 100v AC motors. Thus, with one hand all the functions can be controlled in whatever order desired. Adapting the remote control to the equipment was simple since all wiring ran through terminal blocks located at the rear of all units except the turntables; a simple wiring change interrupting the line ahead of the mercury switches took care of the latter. To facilitate later modification, sub-terminal blocks were installed in the console table base leg and in the racks. A similar unit was built for the transmitter studio and mounted in a portable chassis box for ease of operation.

### Finishing Touches

In the near future, a foot-actuated time clock will be added to the production studio complex so that we can time longer-than-one-part recordings more accurately. The present wall-mounted clock, positioned so that it is visible directly over the portable copy board, is adequate to time a single spot or uninterrupted recording. However, to record a longer-than-one-part time segment, a stop clock is needed. The foot actuated unit will free the operator's hands for controlling equipment.

An ideal copy board should not block the operator's vision, and obstruct the open-aired, relaxed feeling desired. Thus, no copy board was installed at the time of construction. Instead, we contrived a simple clip board with two legs which gives the announcer a means of holding copy if required. The legs are leftover mounts from the thin speakers used in the control room. (The speakers were wall-mounted—thus four spare legs.) Another

clip board serves as a portable news table with a means of holding script. The console table copy board fits on the console and immediately behind the double microphone array.

As the construction phased from structural to electrical and then to electronic, the staff engineers were called into service more and more. Many items—such as patch-panel wiring harnesses and pre-wired units—were built at the transmitter site while the engineer had only meters to read. These were then installed by the Chief Engineer.

By the fifth month of con-

struction, meeting the original deadline of September 1st was an obvious impossibility. Added to this, the cartridge machines we had were reported "in construction" but experiencing technical difficulties beyond the control of the manufacturer. Due to time limitations involved, other units were ordered by telephone. Within 48 hours, the two machines were at the station, which permitted equipment installation to follow an orderly procedure. As the two studios began to look like functional facilities, we faced the next major phase—installing the transmitter and antenna system.

## EQUIPMENT INSTALLATION

At this point, let us delve a bit into the "whys" of our transmitter selection. Since we planned to run 50 kw into an 8-bay antenna, the smallest unit we could use was 20 kw. For one reason or another, some of the available equipment was not quite suited to our situation. We had to have a transmitter which would fit into the space we had, and naturally, we wanted high quality equipment with good stereo separation. From past experience with our AM transmitter and based on reports from other stations, we finally chose Collins. It comprises two separate 10-kw amplifiers fed by a common exciter unit. In our case, the two 10-kw amplifiers had to be diphased into a single transmission line.

### Transmission Plant Installation

Timing was vitally important at this phase of our schedule. All

equipment had to be on location before any installation could actually begin, since one AM tower had to be replaced with one strong enough to support the FM antenna. This involved disrupting the night-time AM directional pattern; therefore, all work had to be completed within a limited time.

Permission was obtained from the FCC to operate the AM with a non-directional night pattern at reduced power, and to determine operating power by the indirect method. The non-directional pattern was arranged by feeding only the No. 2 tower with 250 watts.

In two days, the old tower was pulled down and the heavier tower, with FM antennas attached, was erected. Before the new tower could take its place in the AM operation, the FM transmission line installation had to be completed. To match the

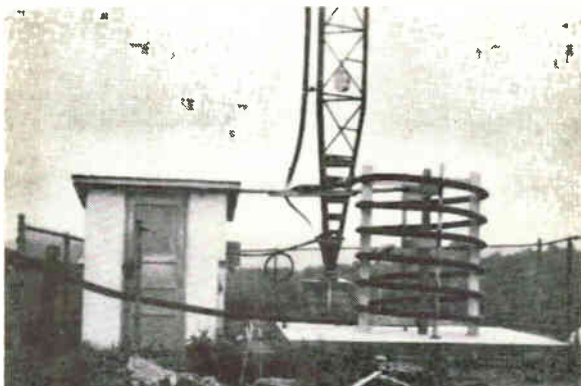
antennas to the FM transmitter, and to isolate the AM signal from the FM, we wound a coil of 3 1/8" Heliax line on a home-made 5 x 5' wood coil form. A variable vacuum capacitor, connected in parallel with the coil, provided the required tuning. With this major phase of the installation out of the way, we were able to breathe a bit easier. After re-proofing our AM pattern, night-time operation was restored to normal.

With the basic transmission system complete, and preliminary

within easy reach of the operator.

### Studio Equipment Installation

Studio equipment installation, while a less monumental task, still harbored its share of bugs. During the construction, all audio wiring had been pulled into conduits, and each cable pair numbered to avoid the confusion inherent in the duplicity of audio circuits required in a stereo installation. All console inputs and outputs were fed through a



Construction of the antenna coupling coil. The form is attached to the base on bolts planted in the concrete pad.

transmitter tests out of the way, we had to install a dummy load in order to fire up the transmitter RF amplifiers. Our dummy requires a constant supply of water to cool it. Fortunately, we had a nearby cistern with an ample water reserve. The dummy was mounted across the room from the transmitter and the specified lines were connected. The frequency and modulation monitors and the limiter were installed; at the same time, all AM monitoring equipment was moved into the broadcast studio,

patch panel, thus providing more flexible use of turntables, tape machines, and microphones. Left and right channel mics at each of the two locations (console and studio positions) are fed to a pair of jacks, and the lines to the console inputs are fed from another pair of jacks directly above the mic termination jacks. Each pair is normaled so that the mics feed directly into the console when patch cords are not in use.

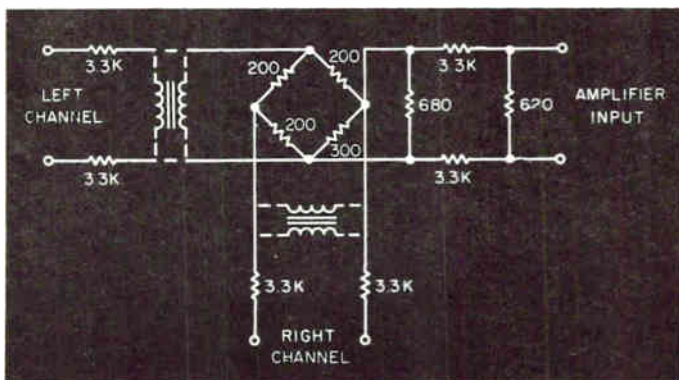
With this arrangement, any or all mics may be fed into any console input or brought out and

connected to any other equipment. By the same token, other mics, or any other equipment, may be fed into the console mic channels. Each channel of the two stereo reel-to-reel tape machines and a stereo cartridge tape machine is terminated in two pairs of input and two pairs of output jacks. This arrangement affords widest possible use of each individual machine: console

studio equipment phasing. With as little equipment as we are using, four patch panels were required. (Telephone lines and associated monaural lines were terminated on two patch panels.)

### Feed AM to FM and FM to AM?

In a stereo operation, feeding AM to FM, and vice versa, involves more than merely running a couple of wires. A means of



Matrix used to combine the two stereo channels into a single channel to feed the AM transmitter.

output may be fed into each machine, a tape may be played back through the console for mixing purposes from any machine, or a tape may be dubbed from one machine to the other, independent of the console, merely by inserting patch cords in the appropriate jacks.

Of course, program lines terminate at the patch panel, and a feed to the AM studio and a feed from the AM studio, as well as a network termination, appear on the panel. A series of "multiple" jacks add to the system flexibility by providing the capacity for feeding several sources from a single output. Also, these facilities have proved valuable in the polarity determination and in

doing it had to be developed, since sports feeds and network news are fed from AM. In addition, we wanted to be able to feed both AM and FM from the transmitter studio when the occasion arose.

To feed AM to FM, signal is tapped off the AM transmitter line, bridged into an amplifier and fed through a splitting network into a spare pot on the FM console. To feed FM to AM, both FM channels are bridged off the FM console output and fed into a matrix, which in turn feeds an amplifier that can be switched into a limiter. Our engineering department came up with the circuit shown in the drawing.

## Testing

With our target sign-on date rapidly approaching, all systems appeared to be in a "go" state. However, when the FM transmitter was turned on, the turntables in the transmitter studio produced a jungle of noise if touched or moved, indicating that RF was being picked up by the

the most serious bug—in the studio, at least.

## Complaints From TV Viewers

Although our transmitter is located a mile and a half from any major population concentrations, equipment and program testing started a flurry of complaints from TV viewers. At first



Transmitter-site studio. The racks contain both AM and FM monitoring equipment and other necessary terminal gear. The operator faces the transmitters through the large double-paned window.

turntable circuitry. To correct the problem, RF chokes were installed on the power lines entering the room, all ground shields were checked, and as a final step, the external transistorized pre-amps were eliminated from the turntables and the pickups connected through equalizers into microphone console inputs. Fortunately, this turned out to be

we suspected second harmonic problems, since most complaints were about interference on Channel 11. Channel 11 audio is on a frequency which is approximately the second harmonic of 101.9 mc. Thus, even though our second harmonic level met and bettered all specifications, we went a step further and installed a second harmonic filter on the

### Methods of Eliminating FM Interference

A quarter-wave open-ended stub, constructed of 300-ohm lead-in wire, is attached to the back of the offended TV set at the antenna terminals, or at the antenna itself. The back-of-set location is simpler, of course, but if a booster is used on the antenna, the stub must be connected ahead of the booster. The formula for computing stub length is:

$$(\text{length in feet}) = \frac{246 V}{f}$$

All boosters had to be equipped with a built-in trap or a trap installed ahead of the booster, such as an absorption-type made from a length of 300-ohm lead-in wire and taped to the TV antenna lead-in.

transmission line. The complaints persisted. Finally, we discovered the interference was the result of severe receiver overloading, which produced a second harmonic component within the mixer of the receiver itself. Most of the sets suffering from the interference were within seven or eight miles of our tower, and the TV antennas, oriented toward Pittsburgh, were aimed right at our tower. This, obviously, furnished them with a healthy supply of our RF.

In spite of the fact that we were in the right, the station wasn't making any friends, and it was imperative that we solve the problem before we could begin regular operation. Correction involved installing traps, tuned to our carrier, at each offended TV receiver (see box). In most cases, each set owner either had a trap installed or devised his own trap, at a nominal cost in either case.

Not content to let the matter rest there, we made a tour of all radio and TV sales and service establishments, told them of the problem and its cause and cure. As a service to ourselves, and to the CATV and TV service companies in the area, we personally worked with them to correct the problem. We also discovered since that our case was by no means isolated; most high power FM stations have had this TV set overload problem.

### Program Tests

Two weeks of program tests were allowed in our revised schedule, and by mid-October it appeared that we were at least partially ready to take on a broadcast schedule. On November 1, 1964, with appropriate fanfare and last minute sign-on jitters, we were a member of the growing minority of stereo broadcasters!

## DETAILS OF TRANSMISSION SYSTEM

**T**HE DESIGN and installation of our FM antenna and transmission line called for a series of necessarily well-timed, coordinated operations — the night-time AM DA had to be taken apart, the FM antennas added, and then the system put back together again.



We had our moments of mixed emotions in trying to time the arrival of all equipment and supplies, but when construction finally started Dame Luck was pretty much on our side.

### Tower Replacement

Our plan was to mount the FM antenna on our #3 AM tower, chosen because it is used only on the night-time pattern. Disturbing the daytime pattern would have been more upsetting to the station economy. The weight of the new antenna, approximately a ton, was much too heavy for the existing tower; therefore, a stronger tower had to be installed. To replace the tower, we obtained permission to operate with reduced night-time power, using a single tower.

Installing a heavier tower meant starting from scratch—new guys, new base, new insulator. A very important consideration in tower structure is the relationship between tower strength and the number of essential guys. Stronger towers, of course, require fewer guys, and additional guys up the cost—cable, insulators, earth anchors, etc. Then, too, the presence of guying cables will disrupt the electrostatic field around the antenna unless they are properly broken up with insulators so that each continuous length is a submultiple of a wavelength.

The original 12" face triangular cross-section tower had to be replaced with one 24" wide on each side. The heavier tower required heavier guys; the original  $\frac{3}{8}$ " cable was replaced with  $\frac{1}{2}$ ", but we eliminated one set of guys. The suitably larger base insulator and heavier tower required a new concrete tower base. By ex-

ercising a bit of care, we were able to use the existing ground system. A new beacon and side lights required by the larger tower cross-section were installed, but we didn't have to replace the lighting choke since no additional power was necessary. The FM antenna de-icers called for a separate circuit (their use may be necessary when the lights are off). Since the de-icers consume about 1400w, we used a 1600w



Fig. 1. FM antenna tower mounting configuration.

choke to get the AC across the tower base.

### FM Antenna Mounting

After the new tower was erected, we mounted the FM antenna. The 8-bay ring type horizontal section, including de-icers (Collins 37M-8), was mounted on a tower face and the 8-bay vertical dipole section (Collins 300-8) was mounted on the opposite leg. This configuration was used to

minimize interaction between the antennas and to more evenly balance their weight. The power divider was mounted on the tower at the base of the antenna assembly. The antenna radiation center is 18 feet from the top of the tower and the antennas occupy 36 feet of vertical tower length (space between antennas is approximately 5 feet, Fig. 1).

### Transmission Line

After the new tower was erected, a 130-foot length of 3 1/8" diameter coax transmission line (Andrew HJ8-50A) was attached to the tower, the outer conductor bonded to the tower just beneath the FM antennas and two feet above the tower base. This length runs from the

of the transmitter run is grounded at both ends with a 2 1/2-inch copper strap running to the antenna ground system and common station ground. The coax shield of the isolation coil is also grounded at the bottom end by virtue of the transmitter line ground.

Two coax splices were necessary, one at each end of the isolation coil. This procedure is tricky. We used the recommended connectors and followed the manufacturer's instructions to the letter. If the outer and inner conductors of the coax aren't solidly attached to the connectors, many problems (fortunately none for us) may crop up.

The air dielectric transmission line is pressurized with 5 lbs.

Table I. Elevation & Contour Data-WAJR-FM

Radial and Bearing (Degrees)	Average Elevation 2-10 Miles (Feet AMSL)	Effective Antenna Height (Feet)	Effective Radiated Power (kw)	Distance to Predicted Contour	
				1 mv/m (Miles)	0.05 mv/m (Miles)
A 0	1117	291	50	26.5	76.5
B 45	1040	368	50	29.5	78.0
C 90	1089	319	50	27.5	77.0
D 135	1254	154	50	20.5	70.0
E 180	1079	329	50	27.5	77.0
F 225	1215	193	50	22.5	72.0
G 270	1195	213	50	23.5	73.0
H 315	1183	225	50	24.0	74.0

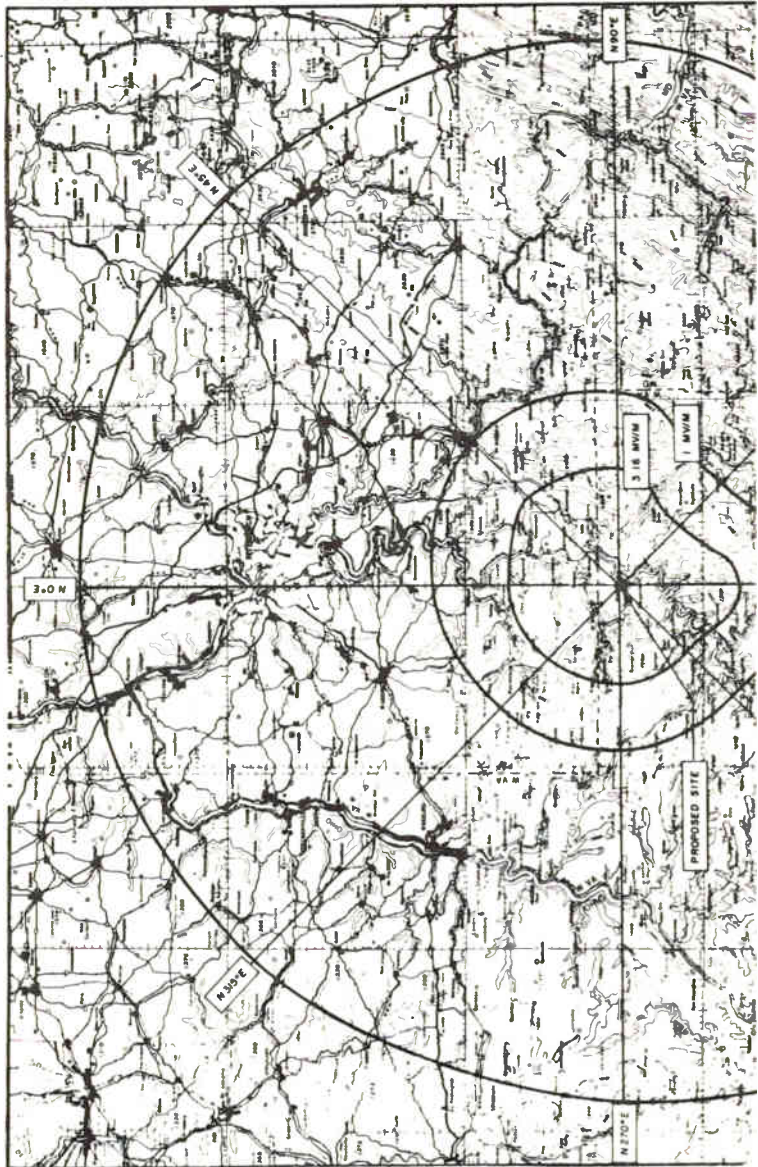
Height of radiation center above mean sea level, 1408 feet.

Height of average terrain above mean sea level, 1146 feet.

Height of radiation center above average terrain, 262 feet.

power divider to the isolation coil at the base. Another 100-foot length was used to wind the isolation coil and an additional 100-foot length runs from the isolation coil to the transmitter, supported on the AM transmission line carriers. The outer conductor

of dry nitrogen. We've had some leakage problems at the antenna junction, but even so, a 2,000-lb. tank of nitrogen lasts about 30 days. The line pressurization fitting and gas tank are located inside the transmitter building where operators periodically



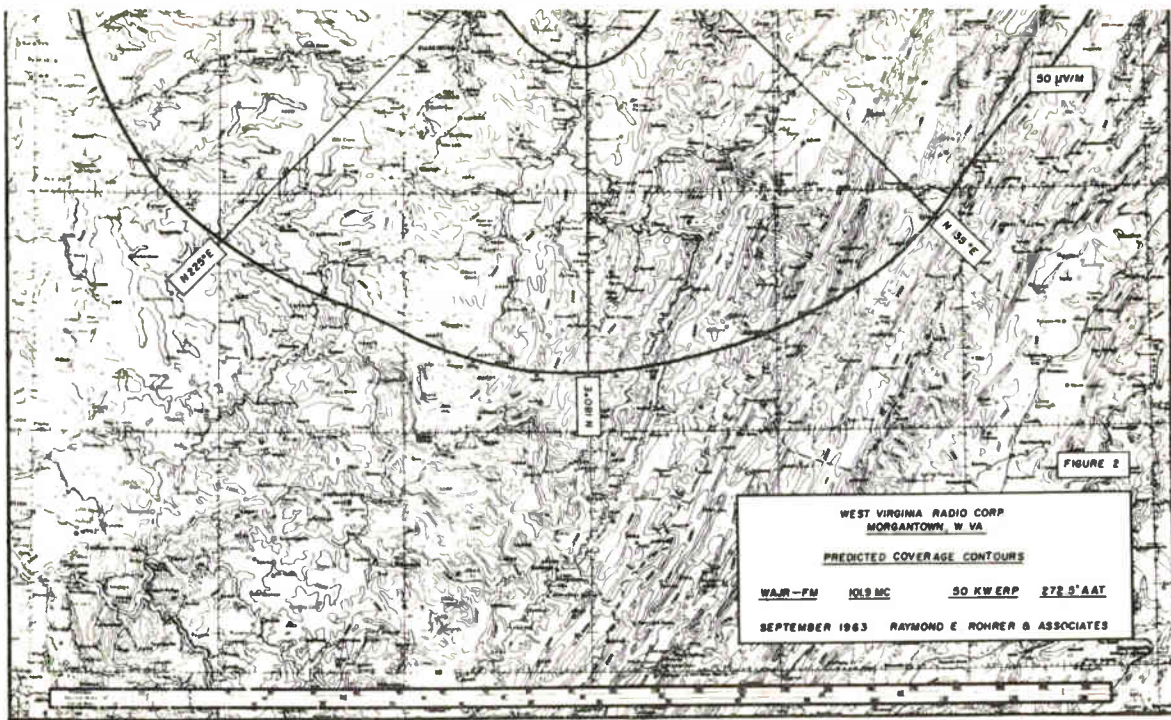


Fig. 3. WAJR-FM coverage contours.

check the pressure and gas supply. Since the RF diplexer, combining the output of the 10-kw amplifiers, is not pressurized, a gas barrier was inserted between it and the transmission line.

### Tower Base Isolation

Obviously, the tower must be insulated from ground at the AM carrier frequency. To maintain this condition and at the same time get the grounded outer conductor of the transmission line across the tower base, we constructed a coil to form a parallel resonant circuit with the base capacity of the tower (base capacity and the inductance of the coil formed by the outer coax shield). The resonant circuit offers a high impedance to the AM carrier when tuned to the carrier frequency, 1440 kc. A 20-180 mmf vacuum capacitor, connected in parallel with the coil, serves as a trimmer to tune the circuit precisely (Fig. 2).

Winding the 3" diameter coax on the coil form required a bit of patience and improvisation. The form had been prepared in advance, with notches (12" on center) cut deep enough into the form members to receive the coax. The minimum bending radius of the coax was 30 inches (according to manufacturer's data); therefore, the coil had to be 5 feet in diameter. Calculations indicated that we would need 6 turns on 12" centers to give us the 40-uh inductance, requiring a form 5 feet long. To wind the coax on the form, we stretched out the 100-foot length of cable on a clean area, then placed the coil form on the cable at the point where winding was to start. Slowly, we rolled the

form, carefully placing the cable in each notch, until the end of the transmission line was reached. As the cable was placed in each notch, a 3/4-inch wide stainless steel strap was fastened across the notch to hold the cable. As it may sound, this was a slow process, but with the almost unwieldy stiffness of the cable, it was impossible to hurry. The

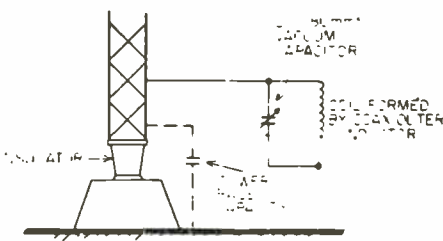


Fig. 2. Schematic of tower base isolating circuit.

vacuum capacitor was attached to the inside of a coil form member and connected to each end of the coil by 2 1/2" copper straps. It is tuned by reaching through the coil turns.

### Operating Parameters

Each antenna section, horizontal and vertical, has a gain factor of 8.3. This required 6.03-kw input to each antenna for the licensed radiation of 50 kw, and an input at the power divider of 12.06 kw. The manufacturer's specifications indicate a transmission line efficiency of 91%; therefore, the transmitter output was adjusted to 13.26 kw to overcome the transmission line loss of 1.20 kw. The design and pretuning of the system was such

that our vswr was nil when it was put into operation. Had we not been extremely careful during construction, including transmission line splices, the situation may have been different.

### **Effect On AM Pattern**

The new tower and associated

circuitry changed the base impedances of all three towers used in the night-time pattern, necessitating recomputation of all parameters. Upon completion, the new engineering data was submitted to the FCC and permission granted to resume operation after reproofing the entire system.

## **PROGRAMMING**

**W**HILE IT WAS NOT our intention to program for specific ethnic groups, we felt that there was a need for more European-style music, at least during some time periods. Also, in conjunction with our "foreground" music concept, we wanted to establish a distinctive sound, so that when a listener tuned across the dial he would immediately recognize WAJR-FM without hearing the call letters. Music preferences were made known to us as soon as the intention to build the station was announced. Through letters and personal contact, many people were quite generous with advice. Then, too, we had an accumulation of comments on music tastes in our AM file. With these guideposts, plus the manager's 20 years experience in the market, we developed our program structure.

### **Programming Techniques**

To prepare programs initially, a trained musician and two temporary programmers were hired, each schooled in certain types of music. The intention was to set up a 6-month schedule, after which the permanent programmer could handle the job by merely inserting new material with the best of the previously used music. Before planning a daily schedule, the programmer checks the preceding week's list to avoid duplication of feature material, thereby guaranteeing a 2-week separation of featured artists and music.

A feature artist is selected for each 45-minute time block. Two cuts by the featured artist, then a cut from a blending orchestra or group, then back to the featured artist for another one or

### Prefix

The Orchestra section is filed under the prefix "OR" and albums coded with an orange magic marker. Dinner music is listed under DM and labeled with blue magic marker. The Male Vocal selections have the prefix MV and are marked with red. The Female Vocal discs are filed under FV with a green marker; Vocal Groups are headed VG and indicated with yellow magic marker. The double coding system insures correct filing.

### Numerical System

Each separate group is individually numbered—from one to infinity. To keep individual artists together we estimated the additional disc probability of major known artists, then left holes throughout the file to allow for additional releases, artists, and music types.

The new discs are checked against order forms and logged in, and assigned a prefix, and if a Promotional Issue or received from a Music Service, checked. If not usable within our programming concepts, it is removed from circulation and held for future promotional use. Usable discs go to the librarian and are assigned a number. We maintain a long sheet with all music on hand and the number availabilities. The librarian "builds" the file cards, inserts them into

the card file, and releases the disc for air use. By holding out new discs until they are completely filed, the card file is up to date at all times.

### File Cards

Pre-printed legal length spirit stencils are imprinted with the card file headings of ALBUM TITLE, COMPOSER, ALBUM NUMBER (ours and the publishers), ARTIST, and SONG TITLES. By use of a letterpress process, we are able to apply enough pressure to not only mark the headings on the master but to force an imprint from the transfer sheet, thus providing headings on all duplicated material. Three-up cards are cut to the proper width, and serated every 4" to provide the desired 4 x 6 card size. These are not split apart until after run-off. Both BROADWAY and CLASSICAL records are color coded black. BROADWAY discs are prefixed SM (show music), as we include movie themes, and orchestral records featuring one show. In numbering new SM discs, a cast album is given the next consecutive number in the file (no holes left for additions) and all adaptations from the original are assigned its number and a letter. The classical file is handled by the publishing company number only. All RCA Classical discs are filed in one group, all Columbia in another.

two cuts, make up a typical segment. A third element adds another blending or contrasting group, then a switch back to the featured artist. The "featured artist" policy permits a complete day's programming with a minimum of duplication, even though different programmers work on separate blocks. These are distributed so that the programmers' style does not get stale to a constant listener.

In stereo programming the lack of music in some categories becomes a critical factor. Due to a shortage of records and a strict music policy, the programmers were virtually forced to follow a set format in major daily programming blocks.

Initially, we figured a programmer would need only 15 minutes to program each hour; this, however was a 50% error. We quickly discovered that it takes approximately 30 minutes to program an hour of music, if the desired quality is to be maintained. Five normal cuts are programmed per quarter hour. The transmitter studio operator justifies the program list at the close of the hour by deleting unnecessary cuts. To properly close the hour, the last indicated disc is back-timed. If it appears that he will run short, the operator inserts additional music listed on a standby disc prior to the last scheduled cut. The standby records are chosen so that, although the given selection may not be ideal in that given position, it will not be entirely out of place.



A music slot for each day has a folder for program data sheets prepared in advance. Programs are planned 8 weeks in advance to allow for printing time.



### Program Concepts of WAJR-FM

**7:00-9:00 A.M.** "Daybreak," a light, airy, "Doris Day Movie" approach designed to lift the listener at the beginning of his day.

**9:30-11:30 A.M.** Caters to an audience segment of mixed nationalities without sounding like a foreign language station.

**11:30-1:30** (Noon break for 15 minutes of news and sports): "Cafe Internationale" relies heavily on light European themes, music found at any street cafe. This show has required more work than any other to stay within our concept, due to the limited amount of available stereo music.

**1:30-4:30 P.M.** "Contempore" features instrumental American movie themes, with a tempo slightly faster than the mid-morning show. Music from the swing era, sprinkled in periodically, serves as an accent element.

**4:30-6:00 P.M.** "Club Rendezvous" features combos and quiet group—a drive-time show with a different approach to relax and soothe the listener after a day's work.

**6:30-8:00 P.M.** (following half-hour news break): "International House" produces a restaurant format music block with a sound more suited to the family dining room than to a commercial establishment. The foreign element is again injected to enhance the program image.

**8:00-11:00 P.M.** "Jetstream" swings from classical to subtle jazz to Broadway and back again—music with a bigger, more dynamic sound—Mancini, Leroy Anderson, Percy Faith types. Provides feature music in direct competition with TV's major time block. (TV reception is poor in several portions of WAJR-FM service area.)

**11:00-Midnight:** The final hour, "Quiet Village," provides a typical late show musical fare in a lush relaxing vein.

Throughout the day individual vocal artists are limited to the 7-9 A.M. block and the 11-12 midnight show. Group vocals are used from sign-on until 11:30 A.M. All other music is instrumental except "Passport to Broadway" on Saturday afternoon and one hour of "Jetstream," two times a week. Other areas of tight control include the use of brass, used only during "Contempore" and "Jetstream." In both cases, wailing or screaming material is prohibited. As a standing rule, modern two-beat music is used with extreme caution—if at all—even though performed by name orchestras. Show themes were chosen to maintain sound continuity with the basic program concept. The underlying or overall goal was to develop an individual sound without resorting to jingles and other identification builders.

## **Production Liaison**

Program openings and closings and half-hour announcements and breaks are recorded on reel-to-reel tape; promos and commercials are recorded on cartridges. The operator at the transmitter studio need only start the reel-to-reel tape for beginning, half-hour break, and closing. The music sheet prepared by the programmer tells him which cuts to play on each album. Since the operator works a 9-hour shift, as many breaks as possible are figured in the program schedule, even though they may be only 3 or 4 minutes. Most featured material for each program is selected from the same album, thus, the operator has to change only the accent disc. Records and tapes are transported between the program department on a daily basis, except for the week-end material, which must all be packaged on Friday. Announcement and intro tapes are recorded by an AM announcer who devotes about two hours a day to provide control and direction.

We had hoped to operate with one part-time secretary-librarian. This turned out to be a 50% time study error. With traffic, posting programmed music to the log, and the rather extensive work of handling record ordering, the job definitely requires a full-time girl.

## **Program Control**

To maintain quality programming, air checks are made by almost all section leaders. The Chief Engineer makes a daily trip to the transmitter if for no other reason than to inspect the area and to check on operator problems. Programmers air-check their program blocks against the music file list to insure continual attention to the log, and management listens for proper program concept. To maintain a logical means of control, engineering problems—including sloppy board work—are referred to the Chief Engineer; administrative problems are taken to the Production Director, and music errors are referred to the Chief Musicologist. All concept questions are settled by the Production Director. Due to the limited contact between operators and programmers, if an indicated record cut is bad, the operator notes the fact on a Daily Problem Sheet which is returned to the program department.

WAJRM FM PROGRAM LOG

OPERATOR OR COPY

NAME \_\_\_\_\_ STN \_\_\_\_\_ CITY \_\_\_\_\_

NAME \_\_\_\_\_ STN \_\_\_\_\_ CITY \_\_\_\_\_

NAME \_\_\_\_\_ STN \_\_\_\_\_ CITY \_\_\_\_\_

PROGRAM

START TIME

END TIME

PROGRAM TITLE AND SPONSOR NAME

CALL LETTERS ANNOUNCED

COMM. TYPE

ACTUAL TIMES FOR PROGRAM AND SPOT

SPONSOR NAME

WAJRM FM

WAJRM FM PROGRAM LOG  
Holds Copy

BSG	BSG	OUT	SCHEDULED TIME	PROGRAM TITLE AND SPONSOR NAME	CALL LETTERS ANNOUNCED	COMM. TYPE	ACTUAL TIMES FOR PROGRAM AND SPOT					SPONSOR NAME
							START	STOP	F	LENGTH		

BSG	BSG	OUT	SCHEDULED TIME	PROGRAM TITLE AND SPONSOR NAME

Fig. 1. The log form serves as both music sheet and official program log.

Fig. 2. The second and third copy of the NCR log form are used to prepare future programs, and do not include the official log information.

## **Program Log Forms**

Program logs presented a challenge at the outset. Since the station was to operate on a tight budget after the initial expenditure, it was decided to repeat some program segments to a limited extent. To do this, the log had to provide a usable copy for re-logging in the future. Also, the program and music logs had to be combined for the operator. After due consideration, we had the log printed on NCR stock (No Carbon Required), bound in units of three. These forms cost nearly three times as much as any other; however, considering the time required to load three sheets of paper in a typewriter and set up the carbons, the cost of the NCR forms is justified.

The left side of the log (Fig. 1) includes a triple column for entry of record number, side, and cut. The official program log requires a minimum of fill-in time. The "cart" column includes numbers of cartridges and tapes to be used at specified times. The white cover sheet becomes the official log with time entries, etc. It is shipped to the transmitter with the daily record stack. The yellow second sheet is filed for a repeat of the music series. Changes will be made in pen and ink, then the new log prepared from it. The pink third copy is used as a dummy for the following week's scheduling, then destroyed. The music list helps identify a listener call-in for a song title. By referring to the list, the record number, side, and cut, the title may be found in the record file.

## **Music Library File**

Building a stereo record library within our requirements has been difficult, due to the unavailability of a vast selection in some categories and further compounded by the fact that some record companies are reluctant to release records to stations for less than the full wholesale price. Several companies offer a music service; however, in our case, as much as 50% of the music received on this basis is not usable because of its content. Even if service costs are low, the cost-per-disc becomes almost the normal wholesale rate. The major companies have been quite helpful with prices and services; one company has established a means whereby unwanted material in their subscription service

ALBUM CONCERT IN THE PARK		NO. OR 338 LBC 2677	
COMP.		ARTIST Boston Pops/Art. Fiedler	
AUSTRIAN PEASANT DANCES: Wedding March; Clog Dance; The Stomper; Hog Dance; Two-Step	9:50	Grand Galop Chromatique	2:48
		Prayer of Thanksgiving	3:26
Funeral March of a Marionette	4:05	Wedding Dance	3:16
		Monquito Dance	0:50
VICTOR HERBERT FAVORITES: The Streets of New York; Every Day is Ladies Day With Me; Moonbeams; Because You're You; Toyland; March of the Toys; Kiss Me Again; Romany Life	10:06	Chester	2:58
	OR 16	SONG FEST: Pick Up Your Troubles; Smiles; Till We Meet Again; In the Shade of the Old Apple Tree; My Wild Irish Rose; Take Me Out to the Ball Game; Sweet Adeline; Put On Your Old Gray Bonnet; There is a Tavern in the	
ALBUM POPS ROUNDUP		NO. OR 334 LN/LBC 2595	
COMP.		ARTIST Boston Pops/Art. Fiedler	
POPS ROUNDUP (Bonanza; Haverick; The Rebel; Bat Mastercon; Gunsmoke; Wagon Train; Wyatt Earp; Have Gun, Will Travel; Rawhide)	6:30	The Yellow Rose of Texas	2:36
		Wagon wheels	3:17
O Bury Me Not On The Lone Prairie	5:55	Riders in the Sky	2:18
		Cool Water	4:05
Red River Valley	2:55	The Last Roundup	3:38
Hone on the Range	5:10	POPS HOE-DOWN (Arkansas Traveler; The Devil's Bread; Chicken Reel; Thunder Hornpipe; Faddy Whace (Irish Jig); Pop! Goes The Weasel; Miss McCloud's Reel;	
Jнопie-Ti-Ti-To (Get Along Little Eagles)	2:14		
Tumbling Tumbleweeds	2:52		

The serated, 4 x 6 3-up cards used for record filing list pertinent data on each album to aid program preparation.

may be exchanged, assuming it is in original condition. One company (Somerset) is now providing full albums for 50¢.

To reduce the over-use of music and to allow ample separation between days of use, the orchestra file was split into 7 stacks. Each stack contains about 60 discs comprising a variety of music. One stack is used for each day of the week, then we go back to the top. Other classifications are maintained in normal file sequence.

Of course, we are constantly adding to our library; we feel justified in purchasing an album if it has at least two cuts we can use. Our initial record order, composed of less than

200 albums, was selected on a general basis, music we were sure to use, even if it became necessary to make format changes. By the on-air date, we had increased our library, since our format had become more finalized.

## IN RETROSPECT

**M**UCH WATER has gone over the dam since November 1, 1964, and many kilowatts of FM stereo music have been radiated from our antennas. In some respects, it seems as though it all began just yesterday, but in others the beginning seems like ancient history. As one might expect, every single plan hasn't been fulfilled, and we still have goals to reach, but generally we have accomplished much of what we set out to do.

WAJR-FM is now a byword in many homes and a target for letters from a few others. More importantly, however, the station has become a fixture within the multiple communities in our coverage area. We have gloried in our first stacks of congratulations and weathered the opening blasts of criticism. During the first few weeks, we could have done nothing wrong; praises of the "new medium" were many. But once the newness wore off, we were just like the boys up the street. Everybody had his opinion. Our concept of joining classical, folk, and jazz into a single format suited to these varied tastes was not easily "sold." It took many personal letters, speeches to community groups, and some community-minded advertising.

### **Station Promotion**

How do you tell people over a 17,150-square mile area that you are on the air without spending a fortune? Logically, you start at home. We utilized advertising media we felt we could afford; obviously, promos on our sister AM were used extensively, plus several ads in local papers. Beyond this, we worked hard to gain favorable editorial coverage. Since the FM investment was expected to be in excess of \$100,000 it ranked with almost any new big business, and we planned our news releases accordingly. Every week or two for a period of three months before sign-on, multicolor ditto news releases

were sent to each newspaper within a 40-mile radius. We also included mats in occasional releases (as inexpensive as photos, but give more assurance of publication). As we approached sign-on, a complete information package, including photos and mats, technical information, and news releases, was sent to each paper. As a result, our sign-on got front page coverage in many area publications.

Shortly after sign-on, we wanted to measure the size of our audience as well as reactions toward our programming. With our quality approach, the typical AM radio contest with lots of ballyhoo and prizes seemed unfitting. Accordingly, we developed a simple contest with FM radios as prizes; the only entry requirement was that the listener send his name, address and if he so desired, the name of his favorite program. Contest promotion copy was slanted toward the humorous. We did not imply that the prizes were anything to be desired—just something nice to have. One promo per hour and short station break promos were the only means by which the contest was publicized; no other medium was used. Until the final week of the contest, we didn't describe second and third prizes by product—just that they would be awarded.

In conjunction with the contest, we conducted a poll of those people we knew listened and those who had written earlier, or were met on the street. From this we discovered that only one in 25 or 30 would bother to enter the contest. This compares to one in 10 to 15 who enter similar contests we had conducted on AM. As we had hoped, we received many comments indicating likes and dislikes, enabling us to better analyze our position and determine what changes were needed. Total cost of the promotion was less than \$400, which was traded out in advertising.

## **Programming**

Our initial program format remained basically unchanged; only minor adjustments in some segments were required. As we progressed, the overall music tempo seemed to drag; much of the available music for a quality format is naturally slow-paced and the rut is easily widened. Only through careful selection were we able to keep the tempo up in some blocks. We also dis-

covered that many of the people who scream for more classical music don't recognize it when they hear it unless it is announced as such. The original vocal-instrumental ratio has not been increased, since the audience hasn't indicated a preference for it. The early morning program dragged almost from the beginning; therefore, we included more brass than we had originally intended had to use. The mid-morning *Bon Jour* has taken on, almost without a noticeable push, a distinct European sound, complete with foreign orchestras and a distinctive Mediterranean beat.

The hardest blocks to program turned out to be the quietest and least noticeable—the lunch and dinner hour periods. Since most suitable music has a tendency to sound like background material, we felt it necessary to give each block a distinct sound. We gave each show a different outlook; the noontime show has a light Vienna and sidewalk cafe touch, while the evening block has a quality supper club theme.

Our prime time period was found to be during the evening hours. The *Jetstream* feature is heavy with the big orchestral sound. We have edged some well-known classical music into this block; it is not announced as classical, so that the classical music hater is not scared away.

### **Specials and Remotes**

No blocks of specialized programming were inserted until the end of the first 6 months, thus giving us time to size up what the audience might want. So far, we have added only three programs—a 2-hour classical show on Sunday afternoon, a 1-hour Broadway show on Saturday afternoon, and a 1-hour Saturday night jazz show.

We have not done as many stereo remotes as we originally planned, primarily because of the manpower and time required. To set up and record a stereo program takes at least two well-trained men and three times as long as a monaural remote. Under current staff conditions, two men sent from the station requires a virtual shut-down of some other operation (and there are 23 on the staff). Response to the two test programs which we did produce was overwhelming, and sharp increase in audience commentary was noticed after each program. This pretty well establishes the fact that



if a fairly consistent number of remote programs from several of the major cities in our area were used, it would markedly strengthen our rating.

### Music Library

A large basic music library is vital to a program format such as ours, and our initial image could have been improved had we purchased more records at the outset. Also, our plan to reprogram music blocks was curtailed; we had to wait until we had enough music on hand to build our basic blocks for repeat programming. At the end of 6 months, we had hoped to reuse the previous program schedules and start over again, changing only necessary selections. We finally had to settle for a 4-month program package which began in late March. By that time, we had enough material to build without padding. Changes are made only in the case of a record deletion or to insert some new material.

Record procurement was a major problem. After about 6 months, we had obtained records from all but two desired labels. Prices ranged from \$.50 to an almost prohibitive \$2.50 per album. Before we spent \$2.50, though, we made certain that at least 6 cuts would be suitable to our format, and on the \$.50 albums we made sure that two cuts were suitable.

Subscription buying can be expensive, even though the cost is only a dollar for each disc. By the time half or more of a proffered album selection is discarded, you quickly have the \$2.00 investment per album again. So far, we have found only one company which will trade back unwanted discs. In view of this, we try to make quarterly record orders serve our purpose, except in the cases where we trade unwanted discs. We have also considered trading advertising for records, locally, on a dollar for dollar basis. This method has worked well in larger markets; however, few local agents want to spend that much money in advertising.

Our filing system works well, that is, if all available music is *filed*. In the beginning, we got behind in our filing, and it has only been in recent months that the mass of cards has become a usable fixture. Upon arrival of a new disc, we now mark each musical number according to program block. This immediately separates the selections and keeps the shows sound-

ing as we think they should, as well as reducing programming time considerably. At the same time, discs are assigned to a particular day of the week; all orchestral records are separated into 7 groups, thereby keeping any repeats at least 7 days apart. All incoming music is carefully auditioned to determine its exact sound and how it will fit into a contemplated program.

Records have held up well; some have been used for more than a year, and with the limited number of discs at sign-on, some have had repeated use. Only nominal care is taken of records—no special gloves, cloths, etc. In fact, in all but seldom used albums, the paper liners were discarded shortly after the record went into use. At the suggestion of a California BM/E reader, we are using spray Windex to clean finger prints and other dirt from the record surface. The aerosol spray is used sparingly, then the residue is wiped off with a felt cloth dampened with water. In cases of deep-seated dirt, the chief programmer uses a mild detergent and warm water.

### **Personnel**

We quickly learned that a first class license holder was not necessarily capable of handling the programming part of his duties. During the first year, we lost three engineers and every student operator (full-time university students). Thus, we had to replace the full-timers and add another full-time man. In each case, a salary increase was necessary due to the additional ability required. We had allowed for a certain personnel turnover, but not for an increase in salaries. At sign-on, we had men working 9-hour shifts; this had to be reduced to 6-hour shifts to maintain program efficiency.

In programming, our luck was better. Two part-time programmers were phased out, although some months after we had originally planned. We did have to add a part-time recording engineer to handle necessary taping. Our programmer is an ex-musician who, although he had no radio background, had sufficient musical knowledge to set up basic programming and assume many duties formerly handled by other staff members.

### **Engineering**

When our equipment was purchased, it was

what we considered the best available for the money. At that time, however, there was only one recognized stereo console. Availability of professional stereo equipment for studio use was limited; in fact, much of it was still in experimental stages and not yet time-proven.

Our biggest problem has been with our turntables; the production turntables are noisy and the on-air turntables are extremely slow-starting. In addition, they cannot be used for back-cueing. Currently, we are considering several new models as replacement units.

Pickup cartridges have been changed three times in an attempt to obtain the response and gain required. It appears that the Shure M44-7 cartridges now in use give us better service and greater life expectancy.

The size of our physical plant is proving to be inadequate; both the downtown production studio-office complex and the on-air studio-

#### **The Management Viewpoint: Sales Success**

After 14 months of operation, General Manager L. W. Fleming, Jr. reports that he is quite happy with overall operation of WAJR-FM, particularly with the success of their recent sales efforts. And well he might be! An AM-oriented sales staff has taken the bull by the horns and developed enough accounts to just about "turn the corner." Mr. Fleming indicates that they have attained 25% of their desired commercialization. To accomplish and maintain this, each of the three salesmen must make a satisfactory number of FM sales presentations each week. It's the traditional sales approach; if you see enough people, you're bound to make sales.

The WAJR-FM salesman does not have to rely solely on his wits, however; he has access to a variety of prepared sales presentations, developed by the staff, which point out the salient features of each program segment. From this information, the salesman can tailor his presentation to each specific potential client. Also, a 6-minute recorded sales aid, detailing WAJR-FM's foreground sound ideals, is available for sales use. Thus, armed with the proper sales preparation and enthusiasm (which Mr. Fleming appears to be quite capable of instilling),

transmitter location are just about half the size they should be. The programmer and his secretary should have a separate office, as should the FM director. The production studio should be sound-sealed from the office area. Presently, a partial (8') dividing wall is all that separates the studio from the office which houses all FM employees. Originally, we felt that the production studio would be used only for short periods; however, the FM studio is used as much for AM production work as the regular AM production studio. Consequently, there are many hours when FM office work must be confined to pen and pencil and "silent running."

It is hoped that others contemplating an operation such as ours will profit by our mistakes. It's very seldom that anyone ever started anything of this stature and scope and not wished he had made a few changes in his original plans. Fortunately, most of ours are of a comparatively minor nature.

the salesman can show his prospect how to put advertising dollar to good use.

The WAJR-FM commercial schedule allows a maximum of five spots per hour—before and after the hourly news summary and on each quarter-hour. Major news programs (7-8-12N-4-6), while simulcast with the sister AM, are sold separately. West Virginia Sports Network programs, originated by WAJR, are sold separately on AM and FM.

WAJR-FM's active client list includes two banks, a limestone company, numerous color TV and stereo equipment dealers, two of Morgantown's leading jewelers, and a Cadillac dealer. During the past holiday season, one dealer alone sold 43 stereo combination consoles, which is some sort of record in a town that size. Prior to the existence of WAJR-FM, the area had been at least partially indoctrinated with FM and there were quite a number of sets in operation. Since the advent of WAJR-FM, set penetration has increased markedly and is still growing, according to reports from receiver dealers.

As a further indication of WAJR-FM's growing success, several listeners have complained about commercials, a "brickbat" more FMers would be delighted to get!

# Improve FM Coverage with Dual Polarization

By Harry A. Etkin

**FM** stations radiating a horizontally polarized signal experience a definite loss in transmission effectiveness because of the vertically polarized whip or line cord receiving antennas used with many modern FM sets. Transmission of a vertically polarized signal, in combination with a horizontal signal, will considerably improve coverage of the authorized service area. The advantages of a dual polarized FM antenna system are:

1. Increased signal pickup by vertical car whip antennas.
2. More signal into home FM receivers with line cord and built-in antennas. (These antennas are widely used in console FM combination radios.)
3. More signal into transistor portable FM receivers with whip antennas.
4. Increased signal level in the null areas of the horizontal antenna.
5. Improved reception in multipath areas; more listeners in hilly terrain.
6. Improved reception of monaural, stereo, and SCA signals.

This article will provide the FM broadcaster with detailed electrical and performance characteristics for the proper installations of a dual polarized antenna system.

## Technical Considerations

The addition of vertical polarization is not a cure-all in providing increased coverage. In some cases the addition of vertical antennas will not increase signal in a deadspot for the horizontal system. Vertical radiation will



Fig. 1. Basic folded dipole.

not cure the multipath effect, but used in conjunction with the horizontal system, improved reception in areas with multipath problems often results. The dual system also does not increase signal pickup of a horizontally polarized receiving antenna.

Broadcast engineers should note that operation of both types of antenna systems does not degrade

the horizontally polarized ERP when the vertically polarized antenna is installed. Existing FCC Rules authorize radiation of the same amount of power in the vertical mode. For example, a Class B station having a 10-kw transmitter and a 4-bay horizontally polarized antenna with a gain of 4 will radiate a horizontal ERP of approximately 30 kw. A vertical antenna system could therefore radiate an equal 30 kw in the vertical mode.

Horizontally polarized vee, ring, and circular shaped radiating antenna elements have earned an excellent reputation, and their technical characteristics are well known. The vertically polarized antenna is basically a folded dipole, usually constructed of copper tubing or transmission line copper (see Fig. 1).

These dipole elements, or bays, are spaced approximately one wave-length apart. The bays in some makes of antenna are then fed in phase along a transmis-

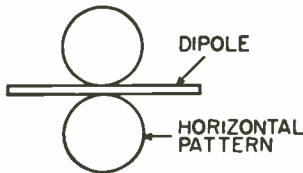


Fig. 2. Pattern for a half-wave horizontal dipole.

sion line that will support from one to sixteen elements connected in parallel. The impedance of each dipole is made greater than the transmission line impedance by the number of elements. Thus, the input impedance of the antenna must be 50 ohms to match the transmission line impedance following the standard Ohms Law formula for parallel

impedance ( $1/Z_{in} = 1/Z_1 + 1/Z_2 + \dots + 1/Z_n$ ).

The standard FM antenna is a modified half-wave horizontal dipole. Fig. 2 shows the horizontal radiation pattern, the typical figure 8. According to the position of the antenna it is possible to radiate a signal which is either

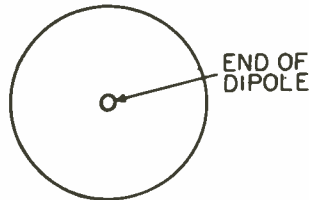


Fig. 3. End view pattern of a half-wave horizontal dipole.

vertically or horizontally polarized. When the dipole is horizontal, the signal is horizontally polarized; when the dipole is in a vertical plane the radiated signal is vertically polarized.

To produce a circular horizontal radiation pattern, the most common antennas in use today are the circular ring and vee type. These antennas will radiate a uniform omnidirectional circular horizontal polarized pattern. The circular dipole is usually end-loaded to provide a more uniform current along its length. The appearance of the radiation pattern, when viewed from an end of the dipole, is shown in Fig. 3. The circular or ring antenna is simply a folded dipole bent in a circular shape, which gives a circular horizontal field pattern. The vee antenna is a folded dipole formed into a truncated vee shape. As the number of horizontal bays is increased, the vertical radiation beamwidth is decreased or "squeezed down." To step up the vertical radiation pattern, vertical antenna elements

## FCC RULES ON DUAL POLARIZATION

The FCC Rules and Regulations, Volume III—January, 1964, Part 73—Radio Broadcast Services, designates in Paragraph 73. 310 FM technical standards that the definition for effective radiated power is as follows:

The term "Effective Radiated Power" means the product of the antenna power (transmitter output power less transmission line loss) times (1) the antenna power gain, or (2) the antenna field gain squared. When circular or elliptical polarization is employed, the term "effective radiated power" is applied separately in the horizontal and vertical components of radiation. For allocation purposes, the effective radiated power authorized is the horizontally polarized component of radiation only.

**It should also be noted that Paragraph 73. 316, Antenna Systems, sub-paragraph (a) specifies that:**

It shall be standard to employ horizontal polarization; however, circular or elliptical polarization may be employed if desired. Clockwise or counterclockwise rotation may be used. The supplemental vertically polarized effective radiated power required for circular or elliptical polarization shall in no event exceed the effective radiated power authorized. The rules therefore provide that the amount of power authorized for horizontally polarized radiation may also be radiated in the vertical mode. Under Paragraph 73. 257, FM broadcast stations are required to apply to the FCC for a construction permit, requesting authority to install a vertically polarized antenna as addition to the existing horizontally polarized system.

must be used in combination with the horizontal elements.

Using a half-wave dipole in the vertical mode, the horizontal becomes the vertical and the radiation pattern is circular, like the doughnut pattern in Fig. 4.

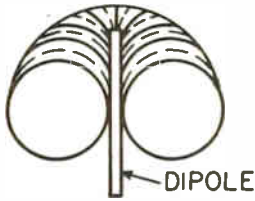
### Installation Details

There are three basic configurations to be considered in the installation of dual polarized antenna systems. The first, shown in Fig. 5, is the stacked arrangement, with the horizontal elements mounted above the vertical elements. Notice that the center of vertical radiation is lower than

the center of horizontal radiation. A large tower section must be used for mounting the complete antenna system.

The second method, shown in Fig. 6, is the "back to back" mounting, which distributes the weight of the dipoles equally. The vertical antenna elements are mounted on one side of the tower and the horizontal elements on the opposite side, at the same height above ground.

The third method is interposing or interlacing. This system of mounting places the vertical antenna in the same plane as the horizontal antenna with the verti-



**Fig. 4. Pictorial radiation pattern for a vertical dipole (doughnut pattern).**

cal elements between the horizontal antenna sections (see Fig. 7). Notice that less tower mounting space is required than for the stacked system in Fig. 5.

#### Interlaced or Interposed System

Of the three described mounting methods, the interlaced or interposed system is the most effective in improving the station's coverage area. In this system the pole mounted antenna does not affect the pattern circularity.

#### Back-to-Back System

Some engineers prefer the "back to back" system, since this arrangement tends to balance the pole or tower load distribution. However, because the vertical and horizontal elements are facing in opposite directions, the horizontal pattern distribution of their respective signals may be affected.

#### Stacked System

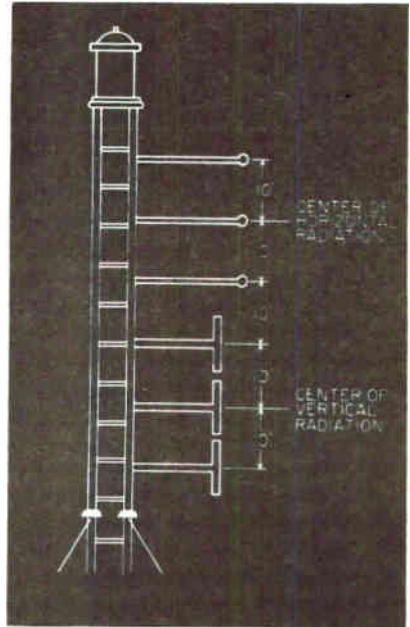
Many recent installations are of the stacked antenna type. These are popular because advantage is taken of the existing FM horizontal antenna. The vertical antenna bays are usually installed directly below the horizontal bays.

The difference in height of the antenna elements in the stacked configuration may affect the line of sight distance to the horizon. When tower-side or tower-leg

mounted, the antenna pattern will be somewhat affected by the supporting structure. The extent of deviation from a circular pattern will vary with the type and size of the structure.

#### Power Distribution

Since normally one transmitter feeds both antennas, the recommended type of installation is a single transmission line from the transmitter output to the antenna. Therefore, to operate with the same horizontal and vertical ERP, a power divider or splitting "tee" with a power division ratio of 50/50, 60/40, or 70/30 can be used to feed both the horizontal and vertical assemblies (see Fig. 8). An adjustable transformer may be used between the power splitter and the antenna elements to adjust for proper matching and power distribution.



**Fig. 5. Drawing of stacked dual polarized antenna system.**



## WHY DUAL POLARIZATION?

Many of the FM receivers on the market today are "economy type" with line cord antennas. Many transistor portables and most FM auto radios utilize vertically oriented whip antennas. FM transmitting stations radiate horizontally polarized energy. Thus, in spite of adequate ERP, adequate signals are not available at a significant number of receivers.

The answer to the problem of serving the total potential audience is dual polarization. Results of authoritative tests and measurements prove that dual polarization improves the signal level in the average FM receiver by at least 15 db. (The average receiver included AC-DC units with 30-inch pigtail antennas and combination AM-FM and hi-fi stereo consoles with built-in and line cord antennas.) For signal tests using auto radios and transistor portable FM sets equipped with vertical whip antennas, dual polarization produced increased levels of 16 to 17 db.

Thus, to reach more effectively the potential audience, an FM station, particularly in lower power class, should seriously consider the advantages of dual polarization.

## WHAT ABOUT COST?

Vertically polarized antennas may be installed in addition to the existing horizontal system, or in a completely revised antenna array. Costs would naturally vary with the complexity of the system; however, average cost of installing a 5-gain horizontal and vertical element antenna would be:

**\$ 3300** for horizontal elements with de-icers

**\$ 2800** for vertical elements

**\$1000** for shipping, installation and AC power to de-icers, for horizontal elements. (Verticals do not require de-icing.)

The average cost for a complete new 5-bay horizontal/5-bay vertical combination antenna, therefore is about \$7,000. It must be remembered that one cannot get something for nothing. This holds true when adding vertically polarized radiation to an antenna system. More horizontal elements are required to provide a given ERP value, since some of the power normally going to the horizontal elements is diverted to the vertical antenna. This factor makes the antenna system larger, and increases costs. The addition of vertically polarized radiation to an existing or contemplated FM antenna system is certainly a worthwhile project. Past experience has indicated that this addition should be at least 20 percent of the horizontally polarized ERP, to be worthwhile economically.

As noted previously, the maximum allowable ERP of vertical polarized radiation is limited to the licensed horizontal radiated ERP power. The power available to the antenna can be determined by multiplying the transmitter power output by the transmission line loss (efficiency). For example, the total available power of a 10-kw transmitter is equal to 10 kw (transmitter output) multiplied

is 9 kw and we want to operate with same horizontal and vertical power, using one transmission line, we must use a 50/50 power split to feed 4.5 kw to each antenna. A 6-bay horizontal polarized antenna with a power gain of 6.3 would be required to obtain the licensed ERP of 24 kw with a power input of 3.8 kw for each antenna feed line.

If a 6-bay horizontal polarized

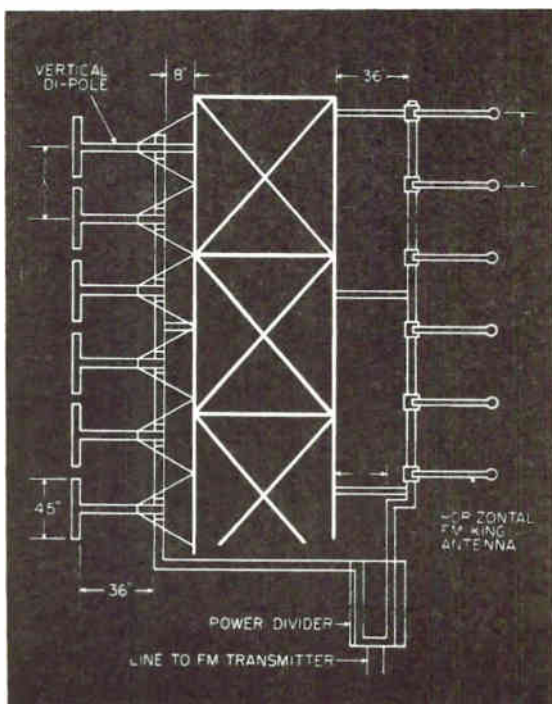


Fig. 6. "Back-to-back" dual polarized antenna system.

by the transmission line efficiency of 90%, the result is 9 kw of available power. If the horizontal polarized antenna is a 3-stacked array with a gain of 3.0, and the station's licensed ERP is 24 kw, then the transmitter will be operating at less than full power output of approximately 8.0 kw.

Since the total available power

antenna is used, a 5-bay vertical polarized antenna should be interlaced between the horizontal elements. One manufacturer's vertically polarized antenna has the same gain as their horizontally polarized elements; thus, an equal number of horizontal and vertical bays may be used. The vertical polarized ERP for this combina-

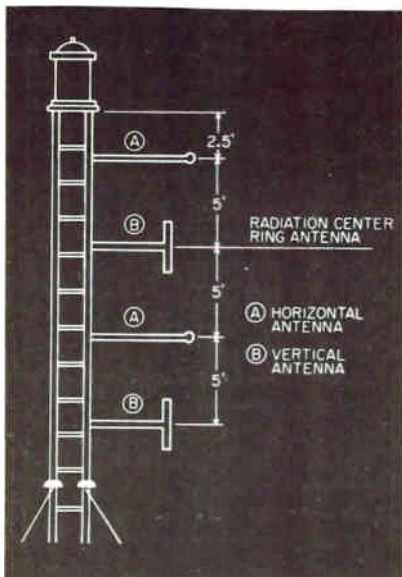


Fig. 7. Intermingled or interlaced dual polarized antenna system.

tion would be 20.2 kw. (5.31 power gain  $\times$  3.8 kw power input = 20.2 kw ERP). Thus the dual polarized FM antenna combination would therefore comply with the FCC regulations. The gain of the horizontal and vertical antennas increases with the number of stacked bays used; Table I contains the figures for determining the appropriate number of horizontal and vertical antenna elements.

#### Vertical Pattern

The vertical pattern shows how the radiated energy is distributed and its proper choice is an important factor in good coverage. The vertical pattern is a plot of the relative field strength versus the vertical angle transmitted in a given vertical plane. Fig. 9 illustrates typical patterns for low, medium, and high gain antennas.

#### Choice of System

In the examples given here, only

vertical and horizontal plane radiation has been discussed. Elliptically polarized radiation results from a dipole whose axis is 45 degrees to the earth. Unfortunately, this condition holds true in two general directions only. Circularly polarized radiation occurs from a combination of vertically and horizontally polarized radiators with the same center of radiation and with power 90 electrical degrees displaced. Circularly polarized FM antennas are practical in interposed arrays if the power to the vertical (or horizontal) elements are delayed 90 degrees. There appears to be no particular advantage of circular polarization over straight horizontal and vertical polarization.

Selecting the desired dual polarized antenna system can only

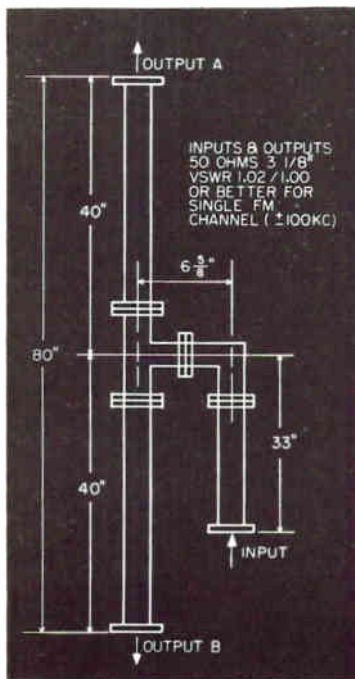
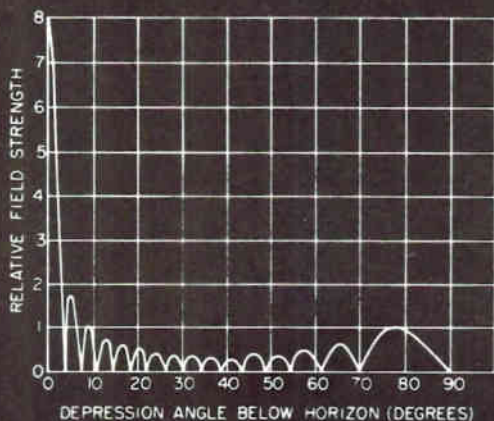
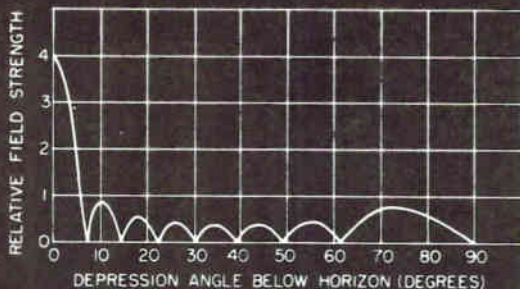
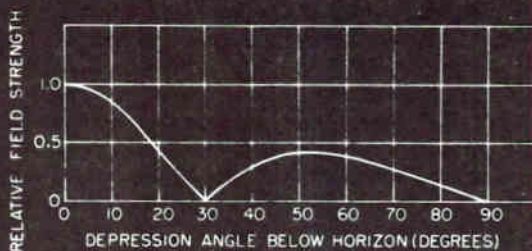


Fig. 8. A typical FM power dividing tee.

No. Of Dipoles	HORIZONTAL				No. Of Dipoles	VERTICAL			
	Gain		Input Power Rating			Gain		Input Power Rating	
	Power	DB.	KW	DBK		Power	DB.	KW	DBK
1	0.9	0.5	3	4.8	1	.95	.002	3	4.8
2	1.0	2.8	6	7.8	2	1.97	2.942	6	7.8
3	3.0	4.8	9	9.5	3	3.12	4.942	9	9.5
4	4.0	6.0	12	10.8	4	4.2	6.230	12	10.8
5	5.1	7.1	15	11.8	5	5.31	7.251	15	11.8
6	6.3	8.0	18	12.6	6	6.39	8.057	18	12.6
7	7.3	8.6	21	13.2	7	7.5	8.751	21	13.2
8	8.4	9.2	24	13.8	8	8.57	9.330	24	13.8
10	10.5	10.2	30	14.8	10	10.96	10.398	30	14.8
12	12.5	11.0	36	15.6	12	13.19	11.204	36	15.6
14	14.5	11.62	42	16.4	14	15.3	11.844	36	15.6
16	16.5	12.18	48	17.2	16	17.48	12.426	36	15.6



**Fig. 9. (top) 2-bay vertically polarized antenna. Power gain: 1.969, db gain: 2.942. (center) 8-bay vertically polarized antenna. Power gain: 8.571, db gain: 9.330. (bottom) 16-bay vertically polarized antenna. Power gain: 17.483, db gain: 12.426.**

be made by evaluating a particular station's requirements. Consideration must be made of the inter-effects of these factors:

1. Available transmitter power.
2. Transmission line losses.
3. Existing antenna and tower structure.
4. Terrain of area coverage.
5. FCC rules.

The proper choice will result in vastly improved service to an existing FM audience.

# DUAL POLARIZATION

## —A Boon to FM Broadcasters

During the past two years there has been a great deal of interest directed toward achieving more uniform coverage from FM broadcast stations through the use of dual polarized antennas. Tests conducted using facilities at WNHC-FM, New Haven, Conn. have been reported in CCIR Study Group X, Document USPC-BC 22, dated Dec. 15, 1964. The antenna feed system was modified to provide for radiation of horizontally polarized signals only, vertically polarized signals only, or a combination of the two. Extensive

measurements were made in both Hartford and New Haven to determine the effects of dual polarization on reception in the service area, and also upon the interference potential of dual polarized transmissions.

### Transmitting Equipment Used

The transmitting antenna consisted of a Jampro 8-bay horizontally polarized section mounted on one leg of a 100-meter self-supporting tower and an 8-bay vertically polarized section mounted on an adjacent leg. The two sections

**TABLE I—Vertically Polarized Component Transmitted From The Horizontally Polarized Antenna**

Measurement No.	Horizontal Field (mv/m)	Vertical Field (mv/m)	DB Difference
1	83.0	2.5	32.0
2	79.0	2.8	29.0
3	72.0	2.2	30.3
4	84.0	3.8	26.9
5	78.0	14.0	14.9
6	90.0	12.0	17.5
7	120.0	11.5	20.3
8	38.5	5.0	17.8
9	37.5	2.7	22.9
10	47.0	4.0	21.4
11	54.0	7.0	17.8

**TABLE II—Horizontally Polarized Component Transmitted From The Vertically Polarized Antenna**

Measurement No.	Horizontal Field (mv/m)	Vertical Field (mv/m)	DB Difference
1	4.3	60.0	32.1
2	3.5	59.0	36.6
3	7.4	53.0	17.2
4	3.5	54.0	34.6
5	8.6	43.0	14.0
6	4.0	38.0	19.6
7	2.3	43.0	38.8
8	6.2	52.0	18.4
9	3.0	39.0	29.6
10	5.8	40.0	16.8
11	7.2	34.0	13.8
12	8.8	48.0	14.6

were separated by approximately 4 meters, and fed through a 50/50 power splitter with individual feed lines originating from separate junction boxes. A coaxial switch was installed between the power splitter and the vertically polarized antenna junction box so that power could be switched into a dummy load. It was therefore possible to make field intensity measurements with horizontally polarized antenna excitation only or both horizontally and vertically polarized antenna excitation. The effective radiated power in the

horizontal plane was 10 kw, and in the vertical plane 9.5 kw. (The gain of the vertically polarized antenna was slightly lower, thus accounting for the difference.) The VSWR of the system was 1.15, and remained the same for all modes of operations.

During the latter portion of the tests, the coaxial switch was moved to permit power to be switched from the horizontally polarized antenna to a dummy load. Thus, it was possible to make measurements resulting from vertically polarized radiation alone.

**TABLE III—For Field Measurements**

Point No.	Distance (miles)	DUAL ANTENNA		HORIZONTAL ANT.		VERTICAL ANT.	
		Horizontal Field (mv/m)	Vertical Field (mv/m)	Horizontal Field (mv/m)	Vertical Field (mv/m)	Horizontal Field (mv/m)	Vertical Field (mv/m)
1	27.0	.980	.750	.940	.110	.120	.860
2	33.4	.850	.300	.820	.110	.045	.360
3	42.3	.320	.170	.350	.065	.032	.185
4	46.9	.260	.090	.270	.030	.024	.100
5	52.3	.310	.150	.280	.040	.018	.180
6	55.6	.070	.038	.080	.028	.007	.031
7	57.4	.080	.034	.080	.012	.010	.036
8	61.5	.070	.030	.070	.010	.008	.030

## Receiving Equipment Used

To assure accuracy of the measured fields, it was necessary to design a dual polarized receiving antenna that would measure the horizontal and vertical fields simultaneously. The design of this antenna consisted of a horizontal balanced dipole mounted on the bottom skirt of a coaxial vertical dipole. It was necessary to bring the coaxial cables from the dipole down through the bottom skirt of the vertical antenna to eliminate radiation from currents flowing in the coaxial sheath. Tests on this antenna indicated 37 db decoupling between the horizontal and vertical sections.

Simultaneous horizontal and vertical fields were recorded by using two VHF field intensity meters to feed two chart recorders. The antenna was raised to a height of 10 meters during all measurements. To assure a homogeneous field, measurements were recorded by making runs varying in length from 30 to 150 meters, depending upon available clearances.

Measurements of the service area field were made with the same equipment, except that four spot measurements were made at each location, instead of a continuous chart recording, because of limited clearances in populated areas.

## Close-in Measurements

A number of close-in measurements (2 to 5 miles) were made to determine the extent of vertical component radiation from the horizontally polarized antenna. Line-of-sight locations, which had Fresnel clearance, were chosen for these measurements. The vertically polarized component measured from 14.9 to 32.0 db below the horizontally polarized component.

The average of these locations showed the vertical field to be 22.2 db below the horizontal field. (See Table I).

A second set of measurements was made at these same points to determine the extent of horizontal component radiation from the vertically polarized antenna. It is interesting to note that the horizontally polarized component measured from 13.8 to 38.8 db below the vertically polarized component, and the average of these locations showed the horizontal field to be 23.0 db below the vertical field. (See Table II.)

## Far Field Measurements

Far field measurements were made starting at the 1-mv/m contour to determine the effect on the horizontal field when equal amounts of power were fed to the horizontally and vertically polarized sections. At each of the eight locations chosen, chart recordings were made of the horizontally and vertically polarized fields being radiated from the dually polarized antenna, from the horizontally polarized antenna only, and from the vertically polarized antenna only. The fields were recorded while the receiving vehicle was moved over a distance of from 50 to 150 meters with the receiving antenna at a height of 10 meters. The most distant recordings were made at a location where the horizontal field measured approximately 70 microvolts. (See Table III.)

## Service Field Measurements

To determine the effect of the addition of the vertically polarized field in the service areas of WNHC-FM, a number of measurements were made in the Hartford and New Haven areas. The



TABLE IV—Hartford Area Measurements

Point No.	DUAL ANTENNA		HORIZ. ANTENNA		VERT. ANTENNA	
	Horizontal Field (mv/m)	Vertical Field (mv/m)	Horizontal Field (mv/m)	Vertical Field (mv/m)	Horizontal Field (mv/m)	Vertical Field (mv/m)
A1	.360	.720	.330	.095	.079	.740
B1	.960	.995	.935	.140	.290	1.100
D1	.260	.245	.235	.038	.032	.235
F1	.370	.190	.280	.034	.070	.210
G1	.730	.360	.650	.090	.086	.340
B2	.580	.370	.510	.060	.130	.300
E2	.750	.890	.780	.190	.280	.770
A3	.280	.190	.240	.040	.064	.110
B3	.250	.240	.220	.050	.090	.180
C3	.960	.720	.900	.140	.130	.455
D3	.260	.089	.170	.038	.090	.120
E3	.740	.530	.670	.112	.180	.490
G3	.295	.215	.240	.029	.070	.250
A4	.560	.420	.560	.104	.057	.340
B4	.120	.160	.138	.036	.044	.120
C4	.160	.130	.150	.026	.032	.100
D4	.210	.190	.190	.022	.064	.160
E4	.500	.400	.490	.120	.150	.330
G4	.745	.320	.650	.093	.120	.230
A5	.350	.300	.300	.078	.045	.180
B5	.490	.590	.480	.080	.083	.525
F5	.360	.335	.330	.073	.045	.298
G5	.395	.420	.350	.047	.110	.370
C6	.350	.610	.370	.057	.095	.570
D6	.430	.390	.400	.065	.080	.355
A7	1.640	1.100	1.630	.050	.140	1.240
B7	.820	.510	.850	.150	.093	.360
F7	.380	.400	.420	.065	.100	.340
G7	.200	.205	.180	.018	.056	.210

Hartford area is approximately 25 miles from the transmitting site. The transmission path is over terrain which produces varying degrees of shadowing starting with practically line-of-sight in West Hartford to moderate shadowing in East Hartford. The dual polarized antenna is mounted on the north face of the tower, toward the city of Hartford.

A grid system was laid over a city map of the Hartford area so that most of the 49 grid points fell in the populated area shown

on Map No. 1. Measurements were recorded at 29 of these grid points, with the greatest concentration in the downtown area. The locations were chosen by going to the grid point and then finding the nearest site where the measuring antenna could be raised to 10 meters with sufficient clearance to move the vehicle approximately 20 meters. At each of these locations, four spot measurements were recorded with the vehicle being moved about 5 meters between spots. Measurements were

recorded while transmitting with the horizontal and vertical antenna, the horizontal antenna only, and vertical antenna only. The four spot measurements at each location were averaged and tabulated in Table IV.

Similar measurements were made in the New Haven area, approximately 9 miles from the transmitting site, as shown on Map No. 2. New Haven is located at the base of a number of mountains which end abruptly and almost immediately before entering Long Island Sound; thus, the transmission path from WNHC is over very rough terrain. Severe shadowing is evident in some areas, while in some parts of the city farther south, line-of-sight paths were obtained. The transmitting antenna, however, is mounted on the opposite side of

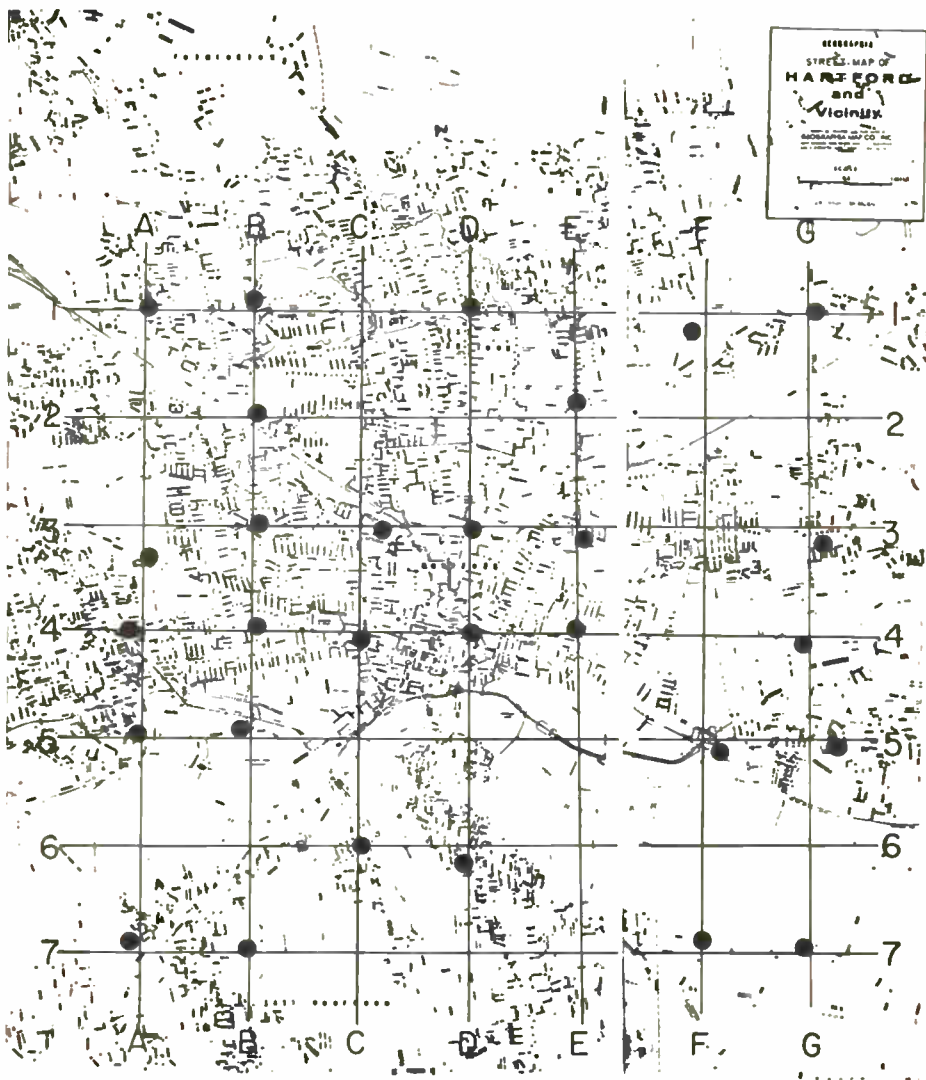
the tower from New Haven. A map system with 30 grid points was used. Measurements recorded at 20 points in populated areas appear in Table V.

### Summary of Results

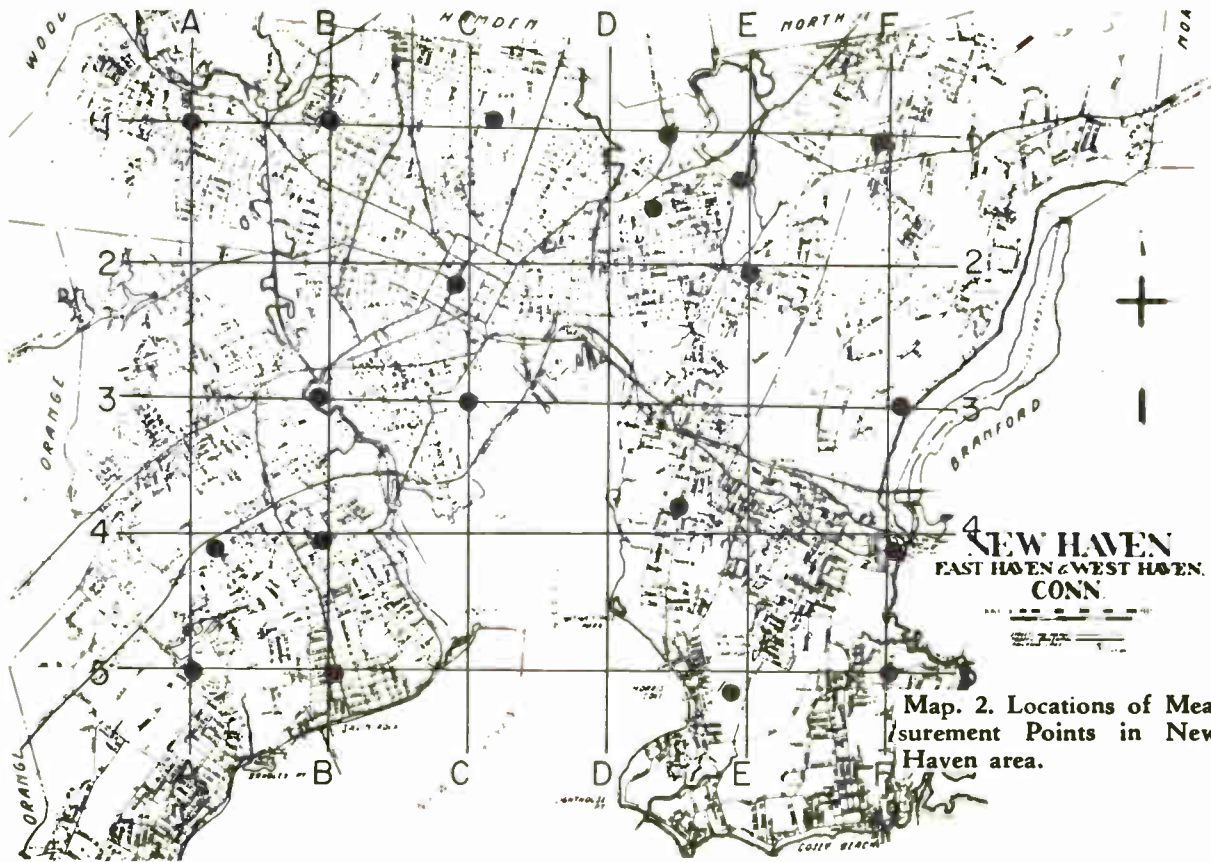
As shown in Table III, measurements made at distances from 27 to 61.5 miles from the transmitter, using alternately dual polarization and horizontal polarization, show very little improvement in the horizontally polarized component received at the eight monitoring points. At distances greater than 55 miles, very little change is observed. Up to 50 miles, on the other hand, a vertically polarized component on the order of 100 microvolts or better is established. This signal would be of considerable advantage to listeners employing automobile FM receivers with a whip antenna.

TABLE V—New Haven Area Measurements

Point No.	DUAL ANTENNA		HORIZ. ANTENNA		VERT. ANTENNA	
	Horizontal Field (mv/m)	Vertical Field (mv/m)	Horizontal Field (mv/m)	Vertical Field (mv/m)	Vertical Field (mv/m)	Horizontal Field (mv/m)
A1	1.950	3.100	2.500	0.210	1.360	2.900
B1	3.100	5.250	2.375	0.420	1.160	5.200
C1	2.650	10.900	1.900	0.450	1.310	8.400
D1	0.960	0.890	0.415	0.110	0.810	1.230
E1	6.600	20.250	6.100	0.460	5.600	20.750
F1	1.600	6.180	0.865	0.103	1.500	6.230
C2	3.100	11.300	1.640	0.320	2.180	10.750
D2	1.250	3.500	0.680	0.135	0.790	4.500
E2	2.560	8.750	1.425	0.265	1.850	10.200
B3	4.450	6.600	4.300	0.480	1.880	10.100
C3	1.650	4.480	0.850	0.131	0.990	5.730
F3	1.100	5.100	0.280	0.056	1.000	5.650
A4	1.950	1.950	1.900	0.150	0.360	2.350
B4	1.100	4.330	0.805	0.110	0.695	4.880
E4	6.150	13.500	5.500	0.580	0.800	15.100
F4	2.080	5.300	0.640	0.070	1.650	5.620
A5	6.430	4.280	4.850	0.370	1.230	3.730
B5	4.180	4.150	1.100	0.080	2.350	4.130
E5	1.060	7.930	1.710	0.130	0.980	7.930
F5	2.100	15.480	1.450	0.115	2.200	17.150



Map. 1. Locations of Measurement Points in Hartford area.



The measurements given in Table IV, while not made in areas which are line of sight from the transmitter, were not substantially affected by shadowing. Conse-

### Conclusions Drawn From Tests

1. In the absence of shadowing or diffraction effects, transmission of a vertically polarized component adds very little to the signal received on a horizontally polarized receiving antenna.
2. When receiving antennas having a substantial vertical component are employed, a correspondingly substantial improvement in overall service can be expected.
3. The vertical component appears to have substantial value for users of automobile FM radios, both in town and at distances up to 50 miles from the transmitter.
4. In the presence of shadowing or diffraction effects (see New Haven measurements), shadowed areas which have very low signal strength during horizontally polarized transmissions receive substantially improved horizontally polarized components when dual polarization is employed.

quently, the plane of polarization of the received signal should be substantially the same as transmitted. This, apparently, is the case. Although the relative magnitudes of the dually transmitted vertical and horizontal components appear to be about equal, there was little increase in the horizontally polarized field over that measured when the horizontal

antenna provides a horizontally polarized field measurably improved over that received when using the horizontal transmitting antenna alone. This improvement is most noticeable in those areas where the magnitude of the fields indicates substantial shadowing—for example, points D2, D1 and C2 on map No. 2.

Reference to the New Haven measurements shows that at 18 out of the 20 locations measured, the *horizontal* component of the field *increased* when vertical polarization was added. At 7 of the 20 locations, the *vertical* field *increased* with the addition of horizontally polarized radiation. It should also be noted that at 10 of the 20 locations, the horizontally polarized field measured with only the vertical transmitting antenna operating, was of higher intensity than the horizontally polarized field measured when only the horizontal antenna was excited. At 16 of the 20 locations, the vertical component of the measured field antenna alone was in use. This, of course, would be the case if no rotation of the plane of polarization were to occur. At the same time, there is a substantial vertically polarized field throughout the Hartford area, which would indicate that car radios employing whip antennas or home radios that employ so-called "rabbit ear" antennas, should receive a substantially better signal due to the presence of the vertical component.

Table III presents a different picture, however. The measurements, in general, were made in areas shaded to a greater or lesser degree by the rocky formations which lie between the transmitting antenna and New Haven.

In 90% of the locations the dual

was of higher intensity than the horizontal component when radiating with both vertical and horizontal antenna sections. In New Haven, as in Hartford, the presence of the strong vertically polarized field would substantially improve the service rendered to FM receivers with indoor, or "rabbit ear," antennas.

## DA Antenna Systems for FM

by John H. Battison

THE FCC has long permitted AM broadcasters to use directional antennas, but prior to the FM freeze a few years ago, very few FM stations were allowed this privilege. FM directional antennas were beginning to appear in applications for new FM stations and improved FM facilities just as the freeze was imposed. Today, there is a resurgence of interest in FM directional antennas.

As activities in FM construction become more settled, the FCC is stabilizing its outlook on directional FM antennas and spelling out their requirements more clearly. The major purpose of the directional system is to enable short-spaced FM stations to increase power to the maximum now allowed their classification under new FCC Rules. Directional antennas *may not* be used, however, as a means of reducing minimum mileage separation requirements in order to fit in a new station.

Before a station manager decides to use a directional antenna, he should become familiar with the pertinent parts of the FCC Rules. Two deal specifically with such antennas and their uses (see box). A typical application under the classification of improving service might be a situation where the proposed principal city is close to a mountain or similar shadowed area and there is no advantage in radiating toward the blank mountain side. The other approved application is for the purpose of using a specific antenna site. If an applicant owns an existing tower or high building, or even another class of broadcast station, and wishes to use this as the supporting structure, a directional antenna might be required in order to limit the combination of height and power in a specific direction to conform with the Rule regarding power and height combinations.

## Technical Requirements

Technical requirements are spelled out in detail in FCC Rule 73.316(c),(d) subparagraphs 1 through 3. Certain portions are particularly noteworthy.

In most cases where a directional FM antenna is used, the engineering portion of FCC Form 301 will be completed by the applicant's consulting engineer.

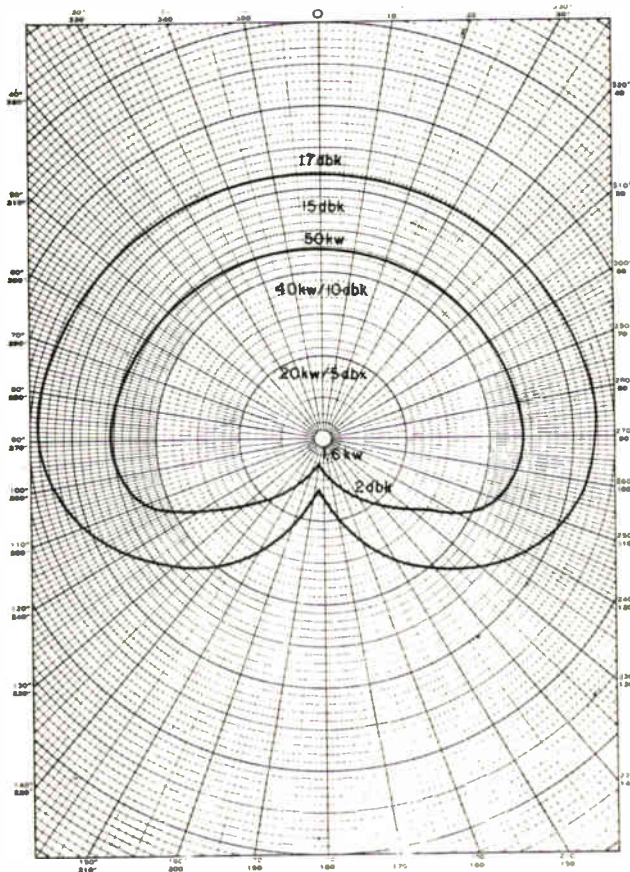


Fig. 1. An illustration of the relationship between power in kw and dbk for a given pattern.

However, sometimes a well qualified chief engineer can handle this work. (See BM/E-June, 1965.) If this is the case, these points should be observed. The application must completely describe the antenna and explain the method of obtaining directivity. You must provide a radiation pattern showing free space field intensity at one mile in mv/m for the horizontal plane<sup>1</sup> and data on vertical radiation between plus and minus 90 degrees. The FCC prefers to have all data in dbk, rather than kw. See Fig. 5.

and minus  $10^\circ$  above the horizontal plane. This data must not show any undesirable radiation in the vertical plane between these limits. Finally, the name, address and qualifications of the engineer making the calculations must be given. The antenna information required above may be computed or measured, but you must include a full description of your computations and methods of measurement.

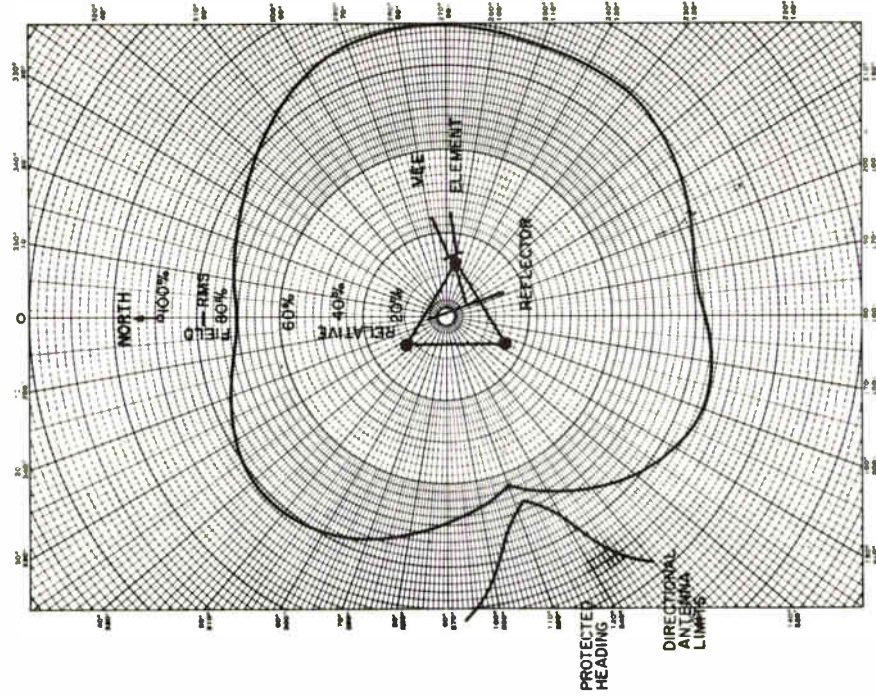


Fig. 2. Predicted antenna horizontal field plot for WJZZ, Bridgeport, Conn.

Station managers with experience in AM directional antennas will notice a big difference—a consulting engineer must provide the technical data supporting the directional antenna system. This is because there are so many variations in AM DA patterns that every installation is different. The limits of radiation are very rigid in FM DA systems; therefore, it is possible for a manufacturer to have FCC required



technical data for his whole line of FM antennas. There may be the exception, of course, where an exotic pattern is required—and can be justified—but this will be rare. The manufacturer will furnish complete engineering data for paragraph (d) of this Rule.

### Operating Directional Antennas Systems

The horizontal field patterns for three operating FM DA systems are shown in Figs. 2, 3, and 4.

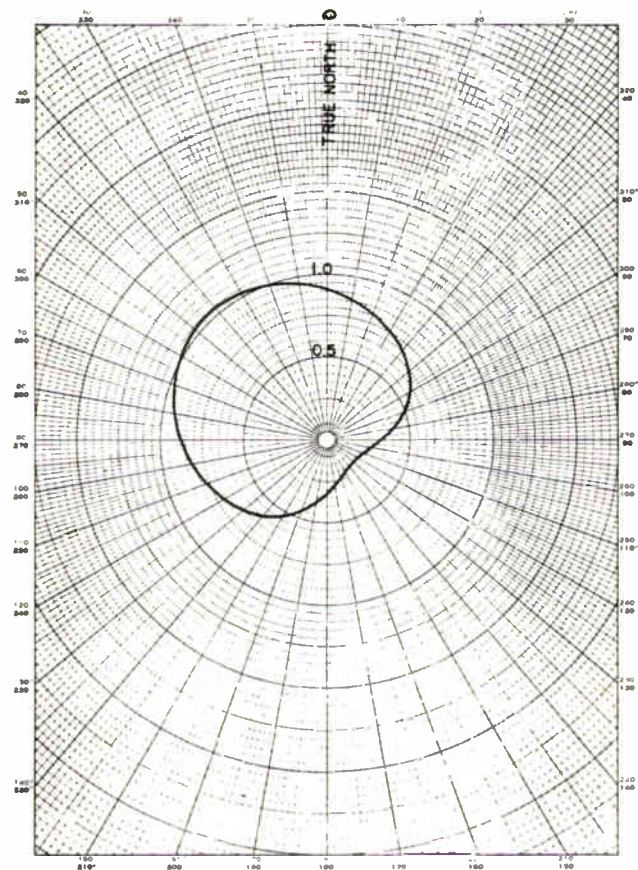


Fig. 3. DA horizontal pattern for WGIR-FM, Manchester.

WJZZ, Bridgeport, Conn., Fig. 2 uses a Jampro J 6b/6V/DA; WGIR-FM, Manchester, N. H., Fig. 3, plans to use a Collins 37M-DA and WTFM, Lake Success, N. Y., Fig. 4, will use an Alford 7615.

These DA's are shown because they represent a cross section of new stations: there are many older

operations, but they were installed before the present DA regulations went into effect, and as a result do not have to conform with the new Rules.

### Engineering Considerations

The application procedure for an FM directional antenna system is far simpler than that for an AM directional. This is due to the difference in physical

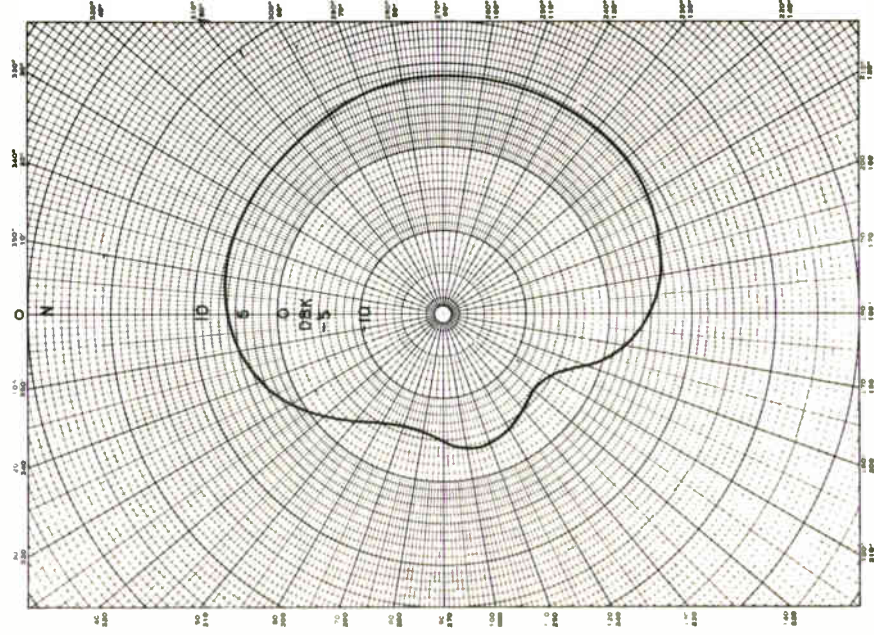


Fig. 4. DA horizontal pattern for WTFM, Lake Success. arrangement. Because of the small size and often one-piece construction of an FM antenna, it can be adjusted and tuned at the factory for its desired directional pattern, and installed in the field with reasonable certainty that the pattern will be correct—provided that the antenna is properly oriented.

The FCC has inserted into the Rules a provision that might go unnoticed by many readers. It says

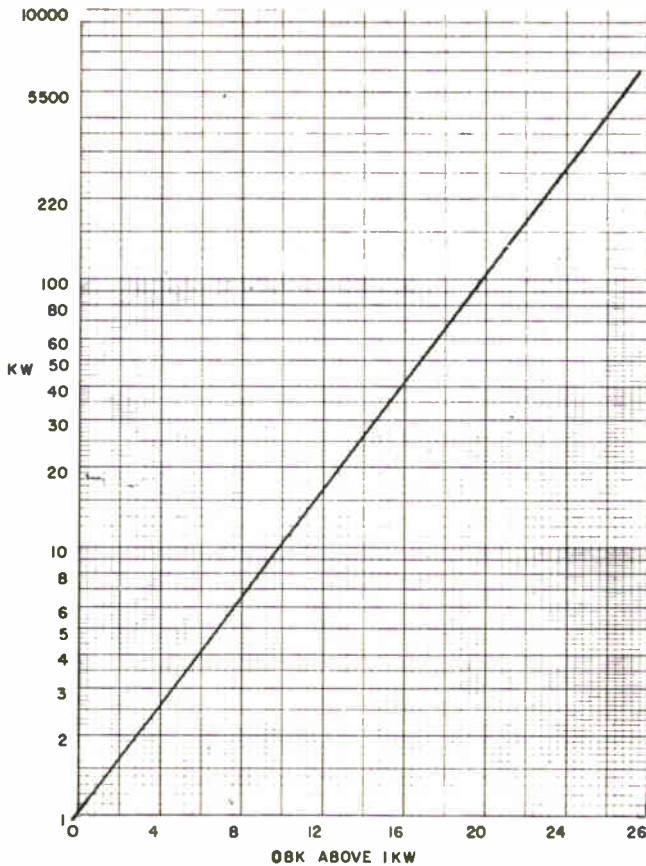


Fig. 5. Graph showing relationship between power and dbk above 1 kw.

### FM Antenna Manufacturers

Since almost any FM antenna can be converted into a directional antenna, most manufacturers are able to meet any requirement. It probably can be safely said that every antenna manufacturer is able to offer directional antennas.

Alford Mfg. Co., Boston, Mass.  
 Andrew Corp., Chicago, Ill.  
 Canadian GE, Toronto, Ont., Can.  
 Canadian Marconi, Montreal, Que., Can.  
 CO-EL, Westfield, N.J.  
 Collins Radio Co., Cedar Rapids, Ia.  
 Gates Radio Co., Quincy, Ill.  
 General Electric Co., Syracuse, N.Y.  
 Jampro Antenna Co., Sacramento, Cal.  
 Radio Corp. of America, Camden, N.J.

"a submission must be made by a qualified surveyor that the antenna has been properly oriented at the time of installation." This means that a surveyor must measure the azimuth of the antenna when it is installed, probably by means of a mark on the base of the antenna as it is being mounted on the tower, or in a manner which will assure the Commission that the antenna is properly oriented.

### Proof of Performance

Measurements are required in the horizontal as well as the vertical plane. The 360° horizontal radiation pattern must be shown. There is no formal way in which the FCC requires the proof to be measured or submitted, provided the material is there and is correct. Ed Hackman, current Head of the FM en-

#### Condensation of FCC Rules Governing FM DAs

**Rule 72.213 (c):** In the case of short-spaced stations, maximum radiation may be used—provided that the maximum power radiated in the short-spaced direction is not in excess of the amount allowed non-directionally. No more than the maximum permissible power for the class of station concerned may be radiated in any direction, and the power increase off the radial separating the two stations must not be greater than 2 db for every 10° of change in azimuth. (See Fig. 1.)

**Rule 73.316 (c):** A directional antenna is considered to be any antenna that obtains a deliberate non-circular pattern for the purpose of improving coverage or using a particular site. It may not be used to circumvent the minimum mileage separation requirements. A ratio of 15 db maximum to minimum radiation will not be accepted. The hypothetical patterns in Fig. 1 comply with this rule.

gineering group, is a reasonable man, and is always willing to explain things to an applicant's engineer.

The Rules call for a proof to be made in the field, or by the manufacturer. The latter is far easier and less expensive for the applicant, although such activities do tend to remove the bread from the mouths of consulting engineers. However, the Commission requires that the manufacturer make his measurements with the antenna mounted on the actual tower, or a replica thereof, together with all lines, ladders, lights, etc., that will be used in the final installation. The reasoning behind this is obvious. However, the word *tower* should not be taken to mean the 300-foot high mounting structure, but to a section of tower or pole on which the antenna is secured prior to mounting on the actual tall tower. The old rule which

required measurements along eight radials with a pen recorder is out! Today, directional antennas for FM use are as simple to specify and use as non-directional antennas.

### **Management Considerations**

FM directional antenna costs should not be more than 10% of general equipment costs. Their construction is simple and, in many cases, undetectable from non-directional antennas. DA arrays are as simple to install as non-directionals, except for proper orientation. Unlike AM DAs only one tower or supporting structure is needed.

The average FM station now operating at full power, will not have to consider directional operation. One application of the FM directional is in the case of a short-spaced station which wants to increase power. Then it may be necessary to use a directional antenna to control radiation in the short-spaced direction. Occasionally an operating FM station will discover that coverage in a given direction is not what it might be for various reasons such as terrain. In this case a directional antenna will achieve the desired coverage. FCC Rules governing the proposed operation must be adhered to. Often an existing FM antenna can be modified, depending on the design, to give a directional pattern by means of fairly simple phasing alternations. When this is done, field pattern measurements will have to be made with the antenna mounted on the station's tower, and this can run into several thousand dollars, depending on the complexity of the measurements. Generally, if the antenna in use has been amortized, and the station is about ready for a new one it would be better and cost less in the long run to install a new one that has been factory-tuned, adjusted, and furnished with a proof of performance.

# Preparing Engineering Data For FCC FORM 301

By Harry A. Etkin

The most significant factor in assuring a successful filing of Form 301 is to supply all the specific data in complete detail. Thus, in planning a new station or changes in an existing station, a broadcaster should be familiar with the engineering know-how required. Familiarity with the FCC Rules will aid in making the necessary decisions regarding site location, equipment requirements, and antenna location and construction. The engineering staff should therefore be acquainted with the following: Vol. 1, Nov. 1963: Part 1—Practice and Procedure; Part 17—Construction, Marking, and Lighting of Antenna Structures; Vol. III, Jan. 1964: Part 73—Radio Broadcast Services; NAB Engineering Handbook 5th Edition, Section 2—Antennas, Towers and Wave Propagation.

Section V-A of the form applies to standard broadcast (AM) engineering data, Section V-B to FM data, and Section V-C to TV engineering data. Section V-G of the application specifically pertains to antenna and site information.

## Application Considerations

Applications lacking complete answers, or supplementary documents and engineering data, may be returned for additional infor-

mation or corrections. While the application may be resubmitted, and no additional fee is required, approval for construction and operation will obviously be delayed, possibly resulting in unplanned financial loss. To minimize the possibility of such a delay, a cardinal rule is to become familiar with the instructions on the cover page of Form 301 and the applicable sections of Part 73 of the FCC Rules.

## Cost Considerations

One of the first points to be considered about costs is whether the chief engineer or a consulting engineer should make the calculations and perform the tests to obtain the necessary data. While many chief engineers may be capable of preparing much of the data required, it is generally advisable to use the services of an engineering consultant, especially if the antenna system is complex (such as a directional array). Also, present-day regulations make it almost mandatory to enlist the aid of a consultant in making an allocations study and report for proposed facilities. In an operating station, engineering time is too valuable to perform the technical determinations. For a new station, however, it is most

practical and economical for the chief engineer to work with a consulting engineer.

Engineering personnel assigned to the project should be advised of the necessity for keeping within

### Selecting a Frequency

Available frequencies for FM broadcasting are listed in Par. 73.201: Numerical Designation of FM Broadcast Channels, Subpart B—FM Broadcast Stations (Vol.

**Table I—Typical Horizontal FM Antenna Data**

NO. OF SECTIONS	G A I N		
	POWER KW	DB	FIELD
1	0.9	0.5	0.95
2	2.0	3.0	1.41
3	3.0	4.8	1.73
4	4.1	6.1	2.02
5	5.2	7.15	2.28
6	6.3	8.0	2.51
7	7.3	8.63	2.70
8	8.4	9.25	2.90
10	10.5	10.2	3.25
12	12.5	11.0	3.55
14	14.6	11.65	3.83
16	16.6	12.20	4.07
20	21.0	13.22	4.59

**Table II—Typical Vertical FM Antenna Data**

NO. OF SECTIONS	G A I N		
	POWER KW	DB	FIELD
1	.95	.22	.97
2	1.97	2.94	1.40
3	3.12	4.94	1.79
4	4.20	6.23	2.05
5	5.31	7.25	2.30
6	6.39	8.06	2.53
7	7.50	8.75	2.74
8	8.57	9.33	2.93
9	9.76	9.89	3.12
10	10.95	10.40	3.31
11	11.87	10.74	3.45
12	13.20	11.20	3.63
13	14.03	11.47	3.75
14	15.29	11.84	3.91
15	16.30	12.12	4.04
16	17.18	12.43	4.18

the budget. Total cost for the engineering data will vary widely from station to station and area to area. As required tower heights and power outputs increase, costs will increase proportionately.

III of the Rules). The channel you request must be one assigned to your community (Table of Assignments, Par. 73.202). If your community has no channel assigned, or is not within 25 miles of

the assignment, or if there are stations already on the channels in your area, a petition must be filed with the FCC to change the Table of Assignments as required by Par. 73.203.

### Antenna Site Considerations

Applicants who propose to operate an FM antenna in the immediate vicinity (200 ft. or less) of another FM antenna, or TV an-

approved, the AM license should apply for authority (informal application) to use the indirect method of measuring power. The FM application will not be considered until the new resistance measurements are filed for the AM station. If the FM antenna is to be mounted on an element of an AM directional array, or on a tower in the vicinity of a directional array, a full engineering

**Table III—Authorized Power and Antenna Requirements**

Minimum Effective Radiated Power		
CLASS A	100 watts (-10 dbk)	
CLASS B	5 kw ( 7 dbk)	
CLASS C	25 kw ( 14 dbk)	
Maximum Height		
CLASS	MAXIMUM POWER	MAXIMUM ANTENNA HEIGHT
(feet above average terrain)		
A	3 kw (4.8 dbk)	300
B	50 kw (17.0 dbk)	500
C	100 kw (20.0 dbk)	2000

**Table IV—Operational Formulas**

1. ERP in KW = Transmitter power in KW - Transmission Line loss in KW + Antenna Power Gain in KW. The transmission line loss includes the loss in harmonic filter and power divider when dual polarization is used.
2. ERP in DBK = Transmitter Power in DBK - Transmission line loss in db + Antenna power gain in db.
3. Power in dbk = $10 \log_{10} \frac{\text{Power in KW}}{1.0}$
4. Power in KW = $\text{Antilog}_{10} \frac{\text{Power in dbk}}{10}$

tenna with frequencies adjacent to the FM band, must describe the effect the two systems will have upon each other.<sup>1</sup>

If an FM antenna is to be mounted on a nondirectional standard broadcast antenna tower, new resistance measurements must be made after the FM antenna is installed and tested. During the installation, and until the new resistance measurements are

study of the effect on the performance of the AM array must be filed with application. In some cases, the FCC may require re-adjustment and certain field intensity measurements of the AM system when the FM antenna is in operation.

### Section V-B

If you plan to use a dual polarized antenna, Tables I and II list



data for horizontal and vertical polarization. Fig. 1 shows how data for dual polarization is entered on the form.

The mathematical expressions for antenna field gain and power gain are:

$$\text{Field gain} = \text{field intensity in mv/m for multielement antenna} / 137.6$$

$$\text{Power gain} = (\text{Antenna field gain})^2$$

Authorized power and antenna requirements are illustrated in Table III. No minimum antenna height above average terrain is specified. Heights exceeding those listed in Table III may be used if ERP is reduced by the amount in-

be used solely for the purpose of reducing minimum mileage separation requirements; it is permissible if it will improve service, or permit the use of a particular site, and is designed for a non-circular radiation pattern. Directional antennas with a ratio of 15 db maximum to minimum radiation in the horizontal plane are not allowed.

Applications proposing the use of a directional antenna must be accompanied by:

1. A complete description of the proposed antenna system.
  - (a). A description of how directivity will be obtained.

(b) Antenna data		
Make <b>Vert, Electronics</b> <b>Horiz: Gates</b>	Type No. or description <b>300</b> <b>FMA-6R</b>	No. of sections <b>6</b> <b>6</b>
Effective free space field intensity at one mile in mv/m for one kilowatt antenna input power <b>Vert. 359.3</b> <b>Horiz: 342.6</b>	Antenna field gain <b>Vert. 2.611</b> <b>Horiz. 2.49</b>	Antenna power gain <b>Vert. 6.817</b> <b>Horiz. 6.20</b>
Is horizontal polarization proposed? Yes <input checked="" type="checkbox"/> No <input type="checkbox"/>		
If "No", attach as Exhibit No. <b>Eng</b> complete engineering data on the antenna and the effective radiated power proposed. <b>Both horizontal &amp; vertical proposed.</b>		
Is directional antenna proposed? Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>		
If "Yes", attach as Exhibit No. complete engineering data thereon.		

Fig. 1. Sample antenna data entries on Form 301.

indicated by the appropriate curve in Fig. 2.

The height of the radiation center is the physical center of the radiating elements if uniform power distribution is used. If a split-feed or power divider system and nonuniform power distribution are employed, the height of the radiation center is not the same as the physical center (the manufacturer will furnish this data).

A directional antenna may not

(b). A means of determining the operational pattern and maintaining allowable tolerances, such as a rotatable reference antenna.

2. Horizontal and vertical plane radiation patterns showing the free space field strength in mv m at 1 mile and ERP in dbk for each direction; a complete description of how the measurements were

made, including the type equipment used and a tabulation of the measured data. If you compute directivity, methods used, formulae, sample calculations<sup>2</sup> and tabulations of the data must accompany the application.

3. Radiation characteristics above and below the horizon-

zenith of  $-10^\circ$  and the nadir, to conclusively demonstrate the absence of undesirable lobes in these areas.

4. The horizontal plane pattern must be plotted on polar coordinate paper with reference to true north. The vertical plane must be plotted on rectangular coordinate paper

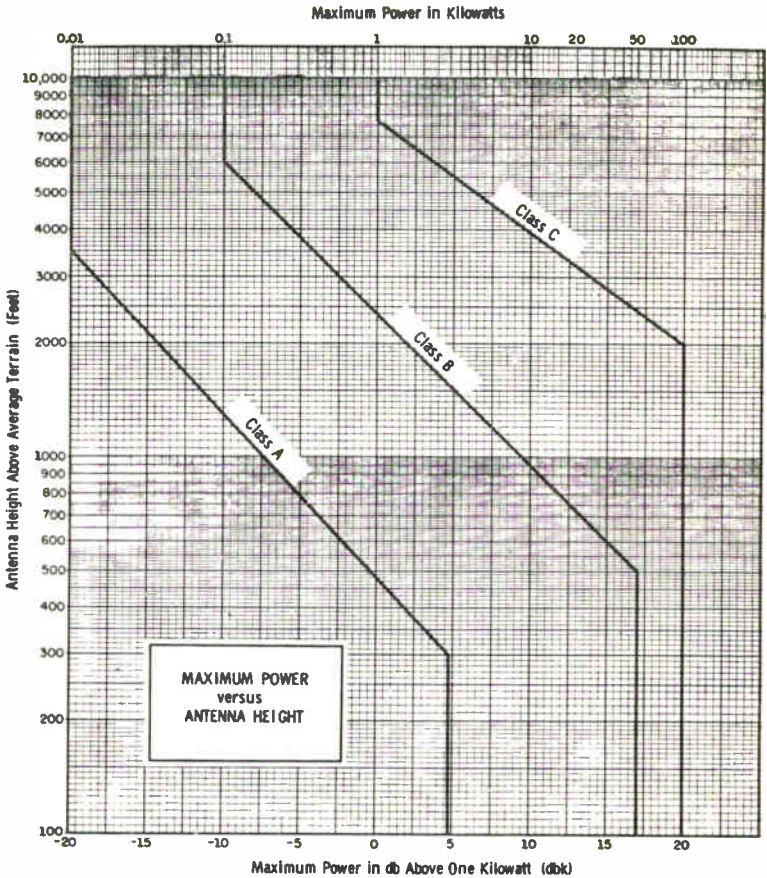


Fig. 2. Relationship between antenna height and power.

plane illustrated by vertical patterns. Complete information and patterns for angles of  $\pm 10^\circ$  from the horizontal plane, and the portion lying between  $+10^\circ$  and the

with reference to the horizontal plane.

### Transmission Lines

Fig. 3 shows entries for the required information on the trans-

mission line. These characteristics vary with frequency: size in inches, coaxial or waveguide, efficiency to produce the desired ERP and, of course, cost considerations. The total length in feet includes the horizontal run from the harmonic filter to the base of the antenna tower and the length up the tower to the antenna terminal point where the gain is rated. Power loss for this length may be determined from the manufacturer's specifications. (See Table IV.)

### Expected Coverage Information

Profile graphs of the terrain, from 2 to 10 miles for 8 or more

with the distances in miles as the abscissa, and the elevation in feet above the mean sea level as the ordinate. The elevation of the antenna radiation center and the source of the topographic data should be indicated on each graph.

The F(50,50) field strength chart, Fig. 4, is used to predict field strength of the contours (Fig. 1 of Par. 73.33 may also be used). The chart is based on an effective power of 1 kw radiated from a half-wave dipole in free space, which produces an attenuated field strength at 1 mile of 103-db above 1  $\mu\text{v}/\text{m}$  (137.6 mv m).

The chart may be used for other

11. Transmission line proposed to supply power to the antenna from the transmitter		
Make <b>Andrew</b>	Type No. <b>452 562</b>	Description <b>Coaxial</b>
Size (nominal transverse dimension) in inches <b>3-1/8 3-1/8</b>	Length in feet <b>280 320</b>	Rated efficiency in percent for this length <b>90.6 83.6 92.3</b>
12. Proposed operation		
Transmitter power output in kilowatts <b>7.36</b>	Power dissipation within transmission line in kilowatts <b>1.20</b>	
Antenna input power in kilowatts <b>Vert. 2.93 Horiz. 3.23</b>	Effective radiated power in kilowatts (must be same as shown in Para. 2) <b>Vert. 20 Horiz. 20</b>	

Fig. 3. Sample entries for transmission and proposed operation data.

radials from the transmitter location, must accompany the application. One or more radials must extend through the principal city. All radials should be plotted on a topographic map.<sup>3</sup>

The graph for each radial should be plotted by contour intervals of from 40 to 100 feet and, where the data permits, at least 50 points of elevation should be used for each radial. The graphs should indicate the topography accurately and should be plotted

powers; the sliding scale associated with the chart serves as the ordinate. Par. 73.313: Prediction of Coverage, explains its use.

If the terrain departs widely from the average elevation of the 2 to 10 mile sector, in one or more directions from the antenna site, the prediction method may indicate distances that are different from what may be expected in practice. For example, a mountain ridge may indicate the practical limit of service, while the

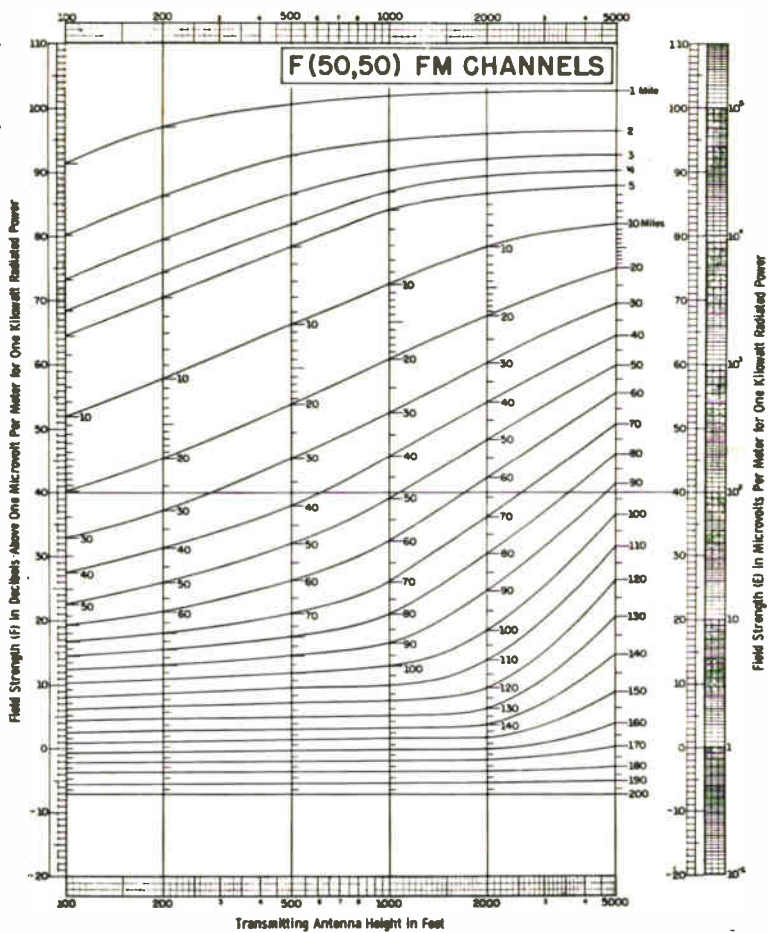


Fig. 4. Chart for predicting field strength.

prediction method indicates otherwise; the prediction method should be followed, accompanied by a supplemental exhibit concerning the contour distances as determined by a method based on actual conditions. The exhibit should describe the procedure employed and include sample calculations. Maps of predicted coverage should include both methods of prediction.

When measurements are required, these should include the area obtained by the regular method and area obtained by the supplemental method. In directions where the terrain is such that negative antenna heights or heights below 100 feet for the 2 to 10 mile sector are encountered, a supplemental showing of expected coverage must be included with a description of the method used

in predicting the coverage. The Commission may require additional information about terrain and coverage in such cases.

1. FCC Rules, Par. 73.316: Antenna Systems—Part e.

2. Ground level elevations may be obtained from the U. S. Geological Survey, Dept. of the Int., Wash., D. C. 20240. West of the Mississippi: U.S.G.S., Denver 15, Colo. Sectional aeronautical charts are available from the U. S. Coast and Geodetic Survey, Dept. of Commerce, Wash., D. C. 20235.

3. Topographical maps for most areas are available at a nominal cost from U.S.G.S. If none is published for your area, use the information in Par. 73.312, subparagraph (a) FCC R&R.

### Costs for FM Engineering Data

The average cost for engineering, design work, test and measurements, calculations, computations, compiling of data, and filing of Form 301 would be \$500 to \$1,000 for a nondirectional antenna. There is usually an additional charge of \$100 for personnel expenses and the cost of obtaining and entering the data for:

- a. Geographic coordinates
- b. Topographical maps
- c. Sectional aeronautical maps
- d. Profile graphs
- e. Aerial photography
- f. Predicted field strength patterns and contours
- g. Instrument approach or landing charts
- h. Other incidental materials

Charges for an existing FM station, such as addition of vertical polarization, transmitter power increase, and directional antenna, would cost about \$500.

### Facts About FM Antenna Structures

An antenna located at a height above the service area, such as a mountain top, may have a pattern null falling in the vicinity of a heavily populated section of the principal city.

If a populated section lies within the area, the broadcaster should have the antenna manufacturer apply electrical beam tilt or null fill or a combination of both.

Polarization patterns, standing wave ratio, and gain may be affected by side mounting an antenna. A performance check should be made before deciding on a final location.

### Additional Methods of Determining Topographical Data

Topographical data may be obtained on roads which are along radials from the transmitter site by using a sensitive altimeter.

The average elevation of each radial from 2 to 10 miles may be determined by averaging the mean values of mile or half mile segments.

The height of the antenna radiation center above the average elevation of the radial is: Height of radiation center above sea level minus the 2 to 10 mile average radial elevation.

The free space field intensity in mv/m at 1 mile is measured 1 mile from the antenna with 1-kw input in the half-wave dipole. At this 1-mile point, the field intensity for the half-wave dipole is equal to 137.6 mv/m. This measurement is made under conditions of free space field intensity; i.e., the signal is free from reflections from earth or other objects.

## Facts About Form 301

FCC Form 301 is an all-in-one application for authority to construct a new broadcast station, or to make changes in an existing broadcast facility. The various sections include:

- I. General, Facilities Requested
- II. Legal Qualifications
- III. Financial Qualifications
- IV. Statement of Program Service
- V-A. Standard Broadcast Engineering Data
- V-B. FM Broadcast Engineering Data
- V-C. TV Broadcast Engineering Data
- V-G. Antenna and Site Information

Each Section alone, although requesting a considerable amount of detailed information, is no more difficult to prepare than a Federal Income Tax form. Considered as a whole, however, a broadcaster may wonder if he has the tenacity to see an application through to its acceptance. Obviously, however, applications are continually being accepted, and approved. The reason is that much of the data is prepared by experts—a procedure known to be sound and economical. However, it is also a sound policy for every broadcaster to know what is involved, if for no other reason than to realize he should seek qualified help.

Sections II, III, and IV of the form are used to determine an applicant's qualifications for operating a broadcast station. Thus, assuming the other sections, which deal with engineering aspects, are in order, the information these three sections contain weigh heavily in the Commission's judgment of an application. Normally, the information requested in these sections is available, and although they should be completed with the aid of legal counsel, their preparation requires no undue expense. Section V, however, is another matter, especially if a new station is being sought. Depending on the facilities requested, a great deal of time and expense may be involved in making tests, measurements, and calculations for the necessary supporting data. In fact, because of the complications involved in preparing this information, it is the rule, rather than the exception, to enlist the services of a consulting engineer.

# *Considerations for Automated Radio Programming*

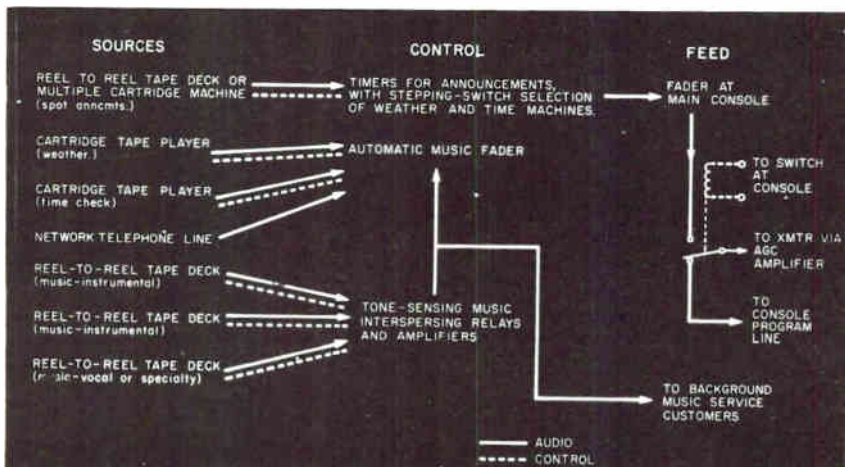
by Joseph D Coons

**E**VEN IF ONLY because of imaginative mailing pieces portraying sophisticated equipment, every manager and chief engineer has at least casually considered automation. Those with actual experience express either unequivocal acceptance or outright rejection of totally automated programming.

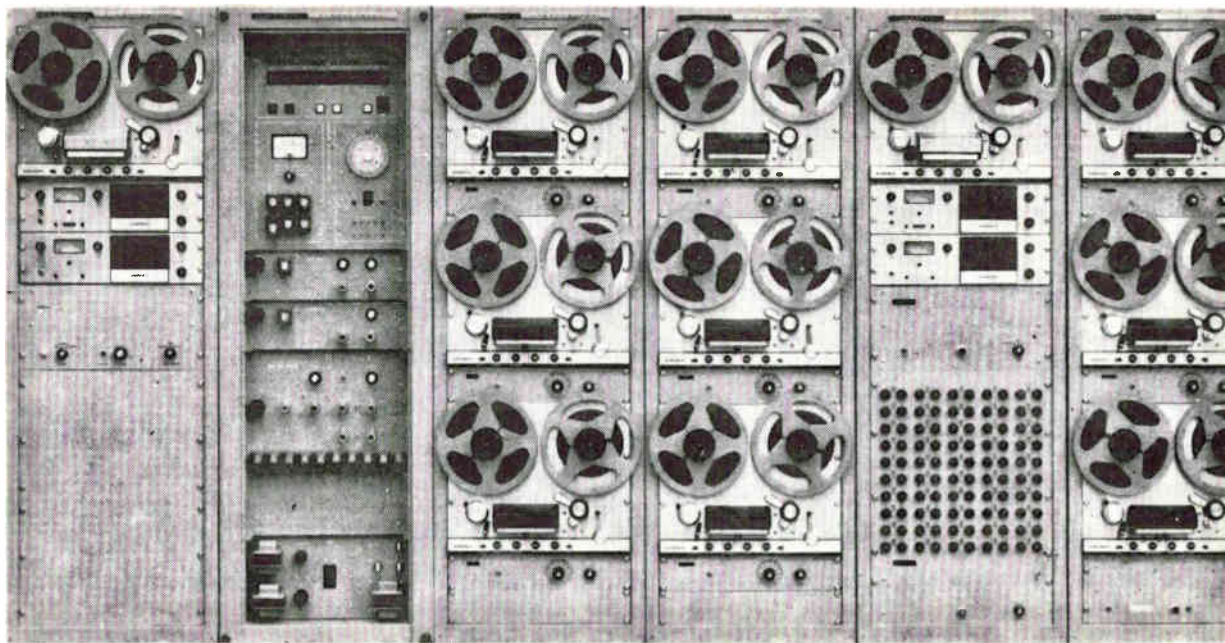
In a broad sense automation means any function performed by equipment. In addition to an entirely automated format, equip-

ment may be used to accomplish simple sequential functions where, for example, a cartridge tape machine automatically starts another tape machine or turntable.

Program automation generally will conjure up a vision of a combination of reel-to-reel and cartridge tapes and/or record changers, time clocks, etc. There are many stations operating with such systems, particularly FMs. However, there are instances where *partial* automation will fit into any format.



Block diagram illustrating some of the functions possible with a fully automated system.



Schafer systems are adaptable to FM stereo and virtually any type AM operation. Basically, the system employs Ampex tape recorders, but cart machines may also be used if desired. "Random Access Spot Locator" allows commercial or any other material to be played in any order desired; it's possible to set up on a "memory unit" the order in which any of the items on the "Spot Locator" are to be played. If a particular song or commercial must be played several times a day, it need appear only once on the "spotter" tape. Time signals

may be aired as frequently as desired on the audio clock. Network switching is accomplished by using a digital clock to anticipate joining the net; dead-rolling pre-timed music fill, arranging for the system to finish whatever program is being aired, then cross fade to the fill in progress which has been timed to end at the proper time to allow for identification and network adjacency commercial. The digital clock then switches from net to local and restarts the system for the desired sequence.

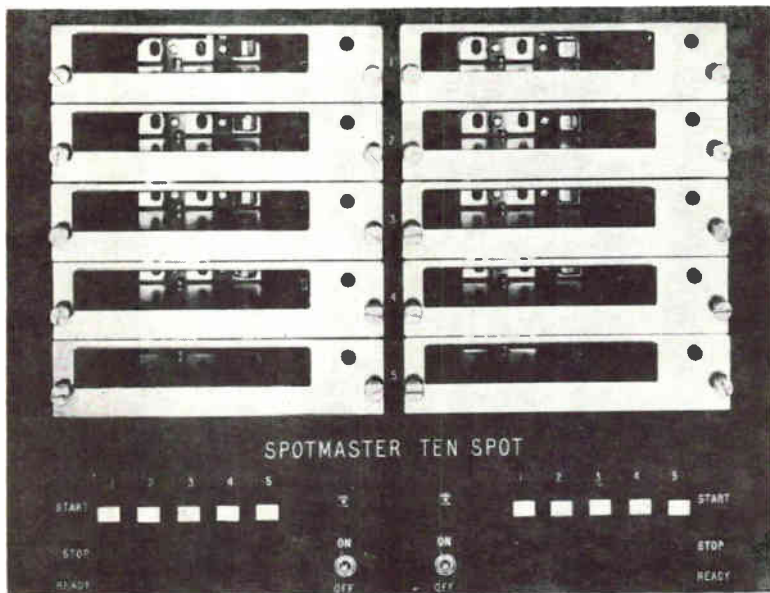


## Why automate?

Complete automation of *any* station must obviously either eliminate some personnel or improve operational efficiency. However, some formats will require complicated equipment to produce a multiplicity of program elements, such as frequent time and weather announcements, record introductions, in addition to spot announcements and promotionals. Equipment is available to do this,

keep a tighter rein on program content. A live announcer frequently faces situations where he must "ad lib" his way out, and this can be disastrous at times.

Many AMs, particularly "personality" and "Top 40" format stations, are finding that partial automation is serving them better. Multi-cartridge tape machines and "trip cue" cartridge tape machines which, by means of a tone, start another tape or turntable, or any



Spotmaster "Tenspot" comprises two 5-bank decks which can be preprogrammed for sequential operation, yet retain full manual control.

but it's expensive. On the other hand, if the cost is justifiable, the same number of people can do more, or fewer people can do just as much as before. Tighter and more reliable production will likely result from automation. Mistakes, inherent in live programming, should not be present in prerecorded material, and since tape doesn't become scratchy after repeated use, overall sound should be improved. Management can also

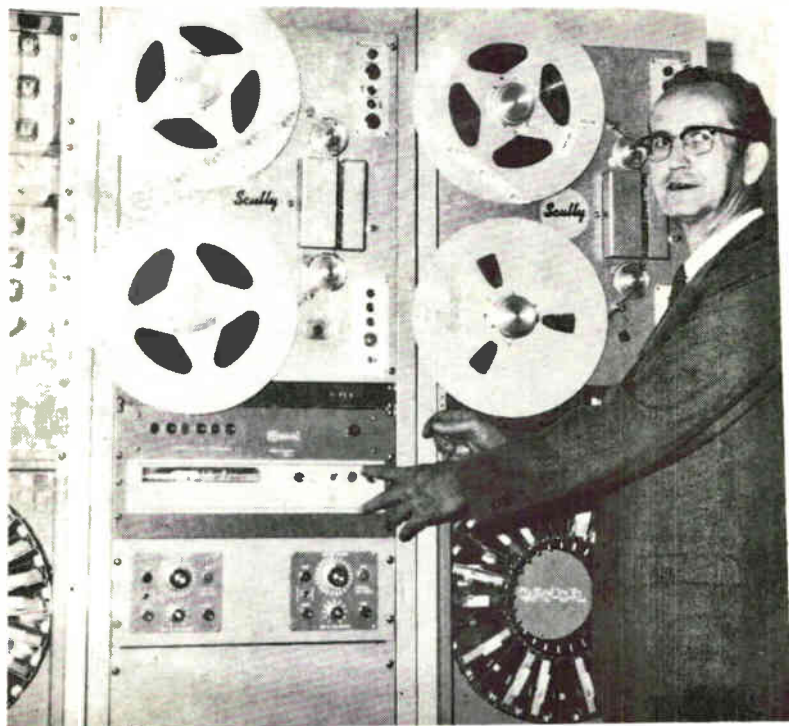
desired unit. Usually, just as many employees are required, but station sound and efficiency are better. New devices "in the works" may eliminate the more laborious tasks and as a result, allow an announcer to attend to more detail, enhancing tighter production and a proportionately improved image.

## Format Adaptation

Uncomplicated music-news-an-

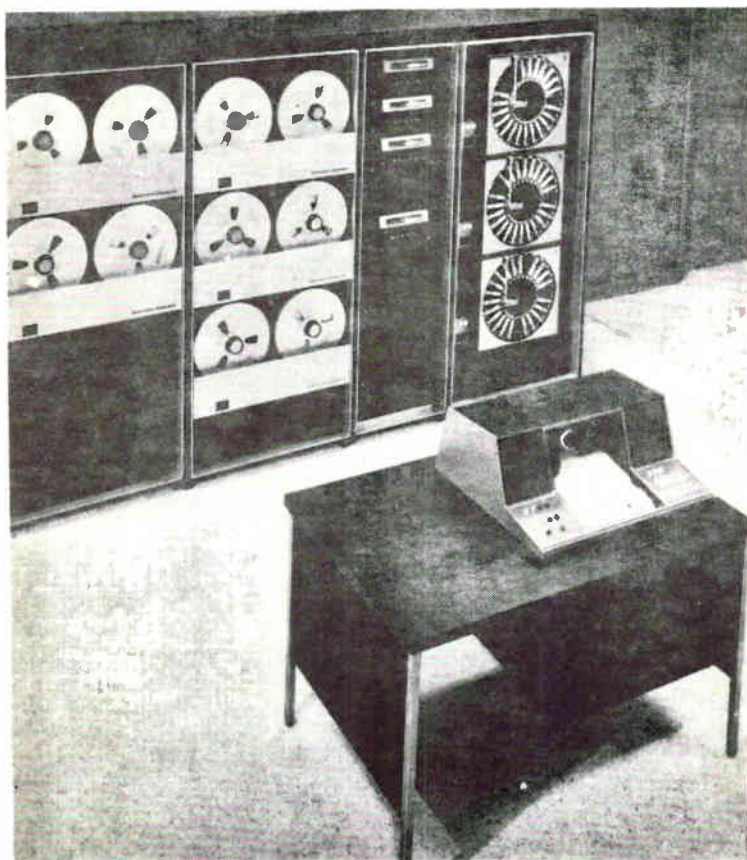
nouncement programming is the simplest to adapt. Pre-taped music, on 14" reels, with announcements recorded on a separate reel-to-reel tape or on cartridges in a multi-cartridge machine, is the most frequently used system of complete automation. The music tape starts

news, can also be inserted by fading the music tape or stopping it, whichever is compatible with timing. If frequent copy changes are necessary, the multi-cartridge tape machines work better, simply because a single or specific spot may be re-recorded without

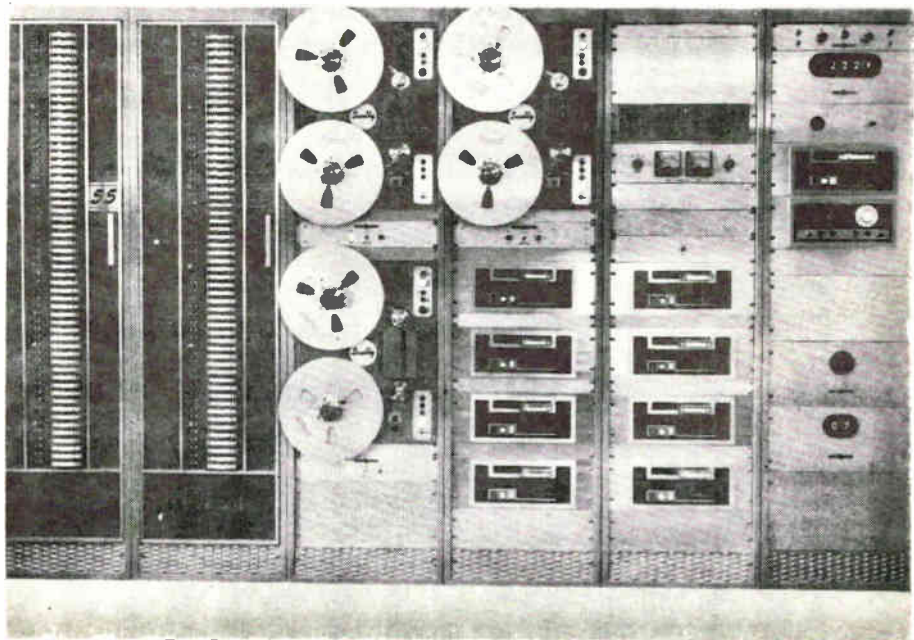


Wilbur Fattig, Chief Engineer at WSB Radio, shows custom automation equipment used for multiplex stereo programming. System consists of modified Garrison control system, customized IBM type switching system, RCA Model RT-7 cartridge unit, MaCarTa Model 248RS Mark II Carousels, MaCarTa Model RS-10 Random Select control, and Scully Model 270 stereo tape reproducers. System was customized to provide complete flexibility.

the talk tape by means of a tone inserted at the appropriate time, providing insertion of commercial or promotional announcements. At the conclusion of these precisely-timed talk breaks, the music tape restarts. News, including network disturbing an entire reel. Emergency news or announcements of immediate importance can also be inserted merely by fading the music tape. System timing will not be interrupted unless the music tape is stopped off schedule.



LTV-Continental's **Prolog** utilizes the station log to accomplish any degree of automatic programming and logging. It assembles any program element from any one of 253 sources and mixes it into a tightly integrated on-the-air format. **Prolog** can operate completely unattended for 24 hours or more, mono or stereo. Unattended or live, it automatically prints on the log the year, date, and time of every element aired. A basic system can begin with a background music, sequential programming, or voice injection capability, and grow to meet demands of "personality" or "top 40" programming. **Traffaccounting**, combined with **Prolog**, offers a complete traffic and accounting system, using IBM tabulating equipment to automatically perform almost all station operations.



Automatic Tape Control system provides two basic control concepts—tape memory and sequence/time. The basic system consists of a system programmer, three tape machines as program sources (cartridge or reel), master switcher, logging decoder, printer, digital clock, program time control, AGC amplifier. Program sequence is dialed on telephone-type dial, causing clusters of control tones to be recorded. An entire day's programming sequence can be recorded on a single cartridge. Automatic program logging provides start time and 5-digit code printed on the program log. A manual system control unit provides for remote operation of all tape sources, and makes available start and stop functions on the system programmer and the fade on the program control device. Manual control can be achieved at any time. System shown was recently installed at KPOL-FM, Los Angeles.

In so-called one-man operations, where the announcer operates the board and writes both program and transmitter logs, complete automation seems to be of little value, since unattended operation would doubtfully gain FCC approval. However, partial automation would permit the announcer to direct his attention to other details, such as news gathering and providing a much needed voice change in a one-man operation, not to mention better production. But, if another staff member (the traffic girl, chief engineer) could monitor, one announcer could tape the talk portion of an entire day's programming. Logging would have to be automatic in this case.

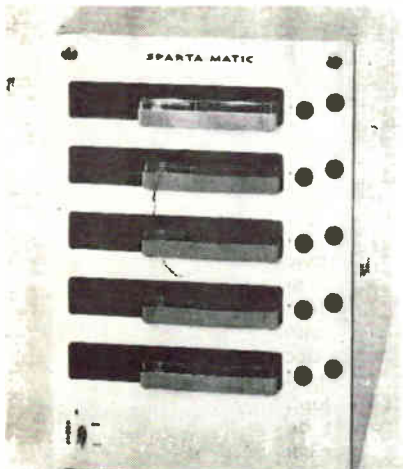
A larger staffed station with control engineers can undoubtedly economize by eliminating an-

### How Do Automation Users Feel?

"Our system is doing a fine, dependable job on FM," reports Elmo Ellis, WSB Atlanta. Automation is not used for WSB-AM because they do a great deal of audience participation programming.

"Automation will eventually take over because of economic pressure," reports P. H. Cunningham, WGET-FM Gettysburg. "We are happy with the job our system is doing for us." Mr. Cunningham says automation eliminates his need for three additional people and offers better quality and control.

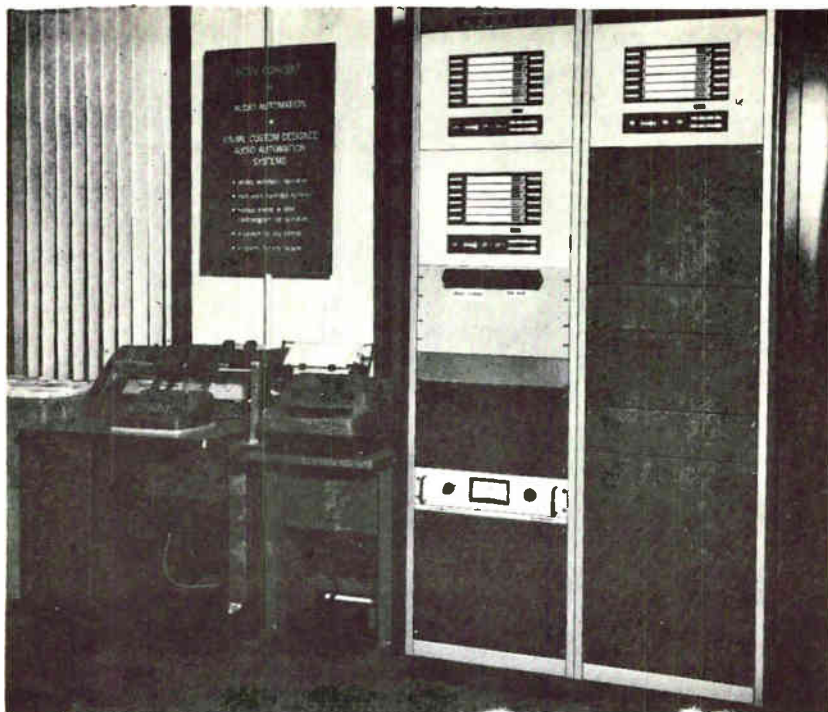
WITH-FM manager R. C. Embry says, "Our equipment is performing quite capably and keeping sponsors happy." Automation was used for a period on WITH-AM, but abandoned due to a lack of compatibility with the format.



Sparta MC-105 multiple-tape cartridge deck has capstan drive common to all decks. Each deck incorporates transistorized playback and tone-burst cue amplifier, operates independently through manual control, or when coupled to sequential electronics using multiple cue tones, may be operated in a pre-set automated sequence. If rack-mounted, the width allows two units to be mounted side by side in 19" space.

nouncer air time. Logging and monitoring functions would be the engineer's tasks, as they may already be. Announcers not required to prepare the talk tape can be reassigned.

A more involved format presents a different breed of problems. A strong personality format, with many program elements, will work, but not nearly so simply. Talk portions without the music take far less time to record in actual man hours. Records (which are not on the talk tape) are played by an automatic changer on cue from the talk tape. Since music represents at least half of the time, only one half as much announcer time would be necessary to prepare a program. Time checks and weather forecasts may be inserted at any predetermined time by clocks.



Visual 12000 IBM card-controlled system typically utilizes Spot-master "Tenspot" and KRS 6-Stack units, operates any reel-to-reel, automatic cartridge, or other remote-controlled equipment. Program material is coded on IBM cards, and preliminary log printout is provided by automatic typewriter. As programs are aired, station log is automatically typed and verified by pulse coding from tape cue track. On-air time is automatically stamped on log. Provision is made for manual take-over, to enable last-minute corrections as well as continued operation in case of component failure. Silent sensing of both audio console and transmitter gives proof of program play. Loss of audio or RF is indicated by failure code, which initiates restart of cartridge. Next program event is aired in case of restart failure. IBM cards can also be used for printout of billing, sales records, etc. System components can be integrated into existing setups on building-block approach, enabling flexibility and custom design to suit individual station requirements.

Stations who feel vitally obligated to continue with live informal, down-to-earth programming will be wise to adopt some automation techniques. Even the "push" operations, with the gain-riding control engineer and the disc jockey who plays cartridge tapes and records, multi-cartridge and trip cue machines, can lessen

menial chores and allow more devotion to air work. Generally, more mechanical operations mean fewer human errors.

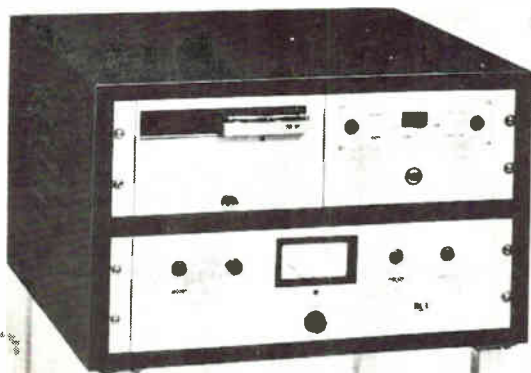
### Engineering Considerations

Your engineering department must bear the brunt of any new equipment installation and they

must maintain it; therefore, they should have a part in selecting equipment. New units must be integrated with old, unless you plan to replace all gear. It will be engineering's responsibility to train personnel to operate new equipment, too, and if changes are extensive this will be no slight endeavor.

If you install total automation, provision must be made to assure station breaks at required times. Automatic clocks will accomplish this, but all must be considered

continuity can be used as a selling point. Most broadcasters have found, though, that advertisers insist mainly on performance—automated or not—and haphazard practices will not be obscured solely by automation. Announcement *length* assumes new importance with automation. Many times, not too much attention is given the actual length of a spot. This practice will throw a system completely out of time; consequently, advertisers who like to run "overtime" must be dealt with.



RCA's "trip cue" cartridge tape units can be automatically started in a predetermined sequence. The system actually produces two cue signals—one recorded on the cue track to indicate the beginning of a tape, the second recorded on a different frequency at the end of the recording to start another unit.

initially. Accurate logs are required and unless automatic logging is a part of your plans, engineering must have a guarantee that this obligation will not be slighted or ignored. In most cases of complete automation, automatic logging is a wise investment. A reliable EBS system is required and it must alert a responsible person who can take necessary action.

### Sales Considerations

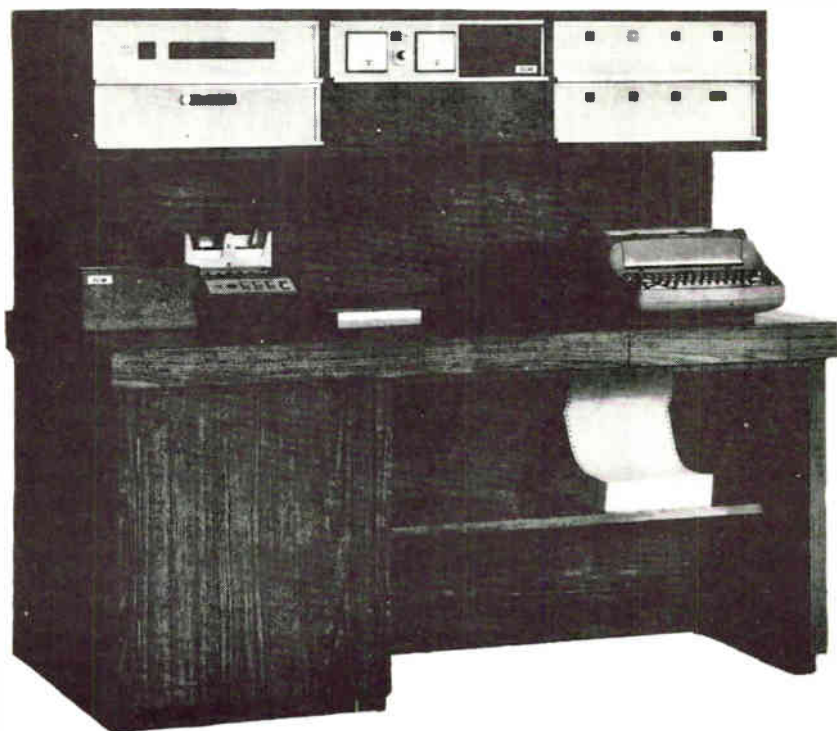
The reliability of automation's

If a reel-to-reel tape is used for announcements, advertisers who demand frequent and short-notice copy changes will create many problems. Of course, cartridge machines help ease this situation.

### Costs

Complete automation equipment for simple program formats (such as FM) may cost up to \$4,000. Most manufacturers offer lease-amortization plans. Pre-taped music averages \$200 a month. This does not include any record-

IGM Model 600 automates both programming and logging. The "random select" type control unit works from punched cards, automatically controls programming for a full day or more, types the log complete with time and all required FCC data. Modular, roll-out units include digital clock read-out and "next event" indicator (upper left); automatic network switcher (lower left); monitor unit (center); first four tape channel modules (upper right); three more channel modules and playback control (lower right). Interphase and clock controls are housed behind panel at lower left. Punched card reader is high-speed NCR unit. Typewriter is IBM automatic. Unit illustrated will soon be placed in operation by Storer station WJW-AM-FM Cleveland, using IGM's "Heritage" taped music series. Equipment also readily lends itself to efficient billing and accounting procedures. IGM Model 500 insertion-type control unit permits starting on smaller scale, with as few as one voice and two music channels, building up to any desired system.







Magnecord Model 1048 used as a component in some automated systems is adaptable to semi-automated programming. The 1048 is a 2-channel unit which can operate for three hours at  $3\frac{3}{4}$  ips. The second channel can be used for cue tones, or

subsonic tones can be used in a stereo system. It has  $\frac{2}{10}$  sec. start— $\frac{1}{10}$  sec. stop response at  $3\frac{3}{4}$ , and  $\frac{1}{4}$  sec. start— $\frac{1}{10}$  sec. stop at 7.5 ips. Since it is solenoid operated, only a s.p. switch is required for remote start/stop operations.

ing facilities or audio equipment.

Total automation equipment for modern programming (top 40, etc.) in an AM-FM operation can cost as much as \$35,000.

Individual equipment costs vary, depending on function and degree of automation. Playback cartridge machines start at \$400; trip-cue machines with record-reproduce functions are \$1300 (\$1800 for stereo). Timing machines vary—from as little as \$100 to as much as \$1200 and more in highly complex systems.

## Conclusion

Will you automate? It's a tough decision, involving not only costs, but the entire image of your station. Currently, automation's biggest success stories come from FM operations, where automatic equipment is easily adapted to a desired format. FM automation will continue as economics require tighter reins on operating costs and as stations are required to program separately from AM.

# *Is Automated Transmitter Logging Paying Off?*

by Charlie Buffington

**F**OR YEARS, broadcasters have been faced with the FCC "bugaboo" of logging semi-hourly transmitter readings. Everyone knows what a pain in the neck it is to have to make these readings by the clock. In this day and age, and especially where modern and reliable transmitter gear is used, tedious meter reading and logging often seem a waste of time. Yet, one cannot deny the validity of the Rules, nor the value of properly logged data in preventive maintenance. Thus, it is only natural that more and more stations are resorting to automatic logging equipment as the logical solution.

From a survey of many users of such equipment, logging accuracy is immeasurably better, and a constant, continuous, permanent log of transmitter parameters is provided. It is very easy for a busy operator to overlook regular half-hour reading times. When a chief engineer inspects a manual log, he can't be positive of its accuracy. An automatic log chart, on the other hand, gives him truer and continuous operational readings. Slight changes in operating constants, indicative of impending trouble, can easily go unnoticed in half-hour readings, whereas a

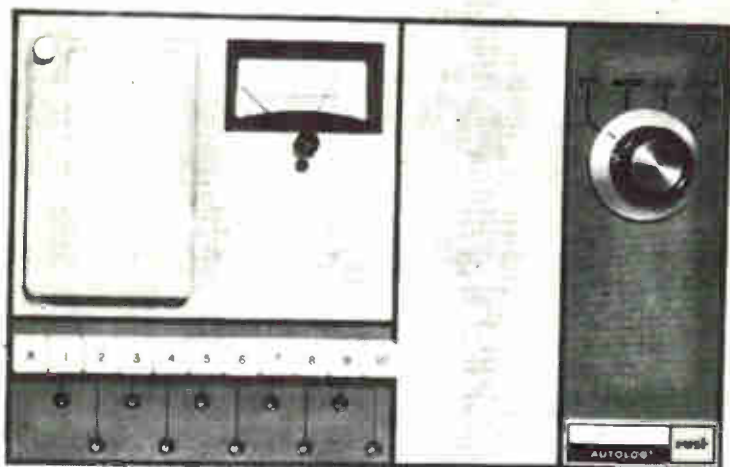
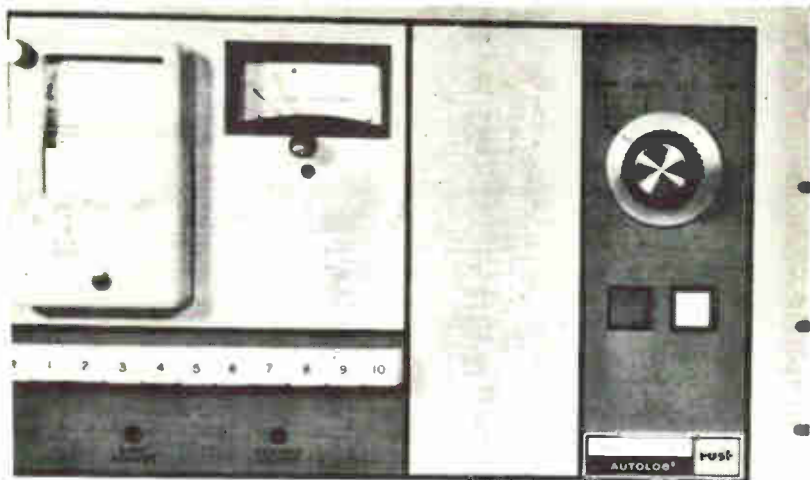
continuous recording will readily show intermittent momentary variations.

## **Effects on Manpower**

Aside from the engineering values of having an automatic "watchdog," and a continuous record of transmitter performance, are there any other advantages to be gained? Very definitely! Numerous stations using automatic logging equipment are unanimous on this point.

Automatic logging has freed transmitter engineers and operators from long, boring transmitter watches to handle other important jobs in the control room, in production work and in maintenance. A multitude of financial gains have been derived from more useful deployment of personnel in various phases of operation. Some stations have reported cutting transmitter staffs in half, thereby providing much needed manpower for maintenance and production.

One station reduced its transmitter staff from four to two men. Two were reassigned to studio work and the remaining two maintain the equipment and manually log entries during nighttime operation. Another station reas-



Rust AUTOLOG equipment is designed for local or remote logging. Requiring a single pair of metallic phone lines, the AL-100R is compatible with DC remote control systems and will use the same pair of phone lines. Sampling voltages are fed through one of the remote metering positions. Sampling voltages of 10mv to 10v, usually derived by sharing remote control samples, may be fed into any of the 10 inputs. Readings displayed on the chart recorder appear as continuous lines which vary in direct proportion to any parameter variation. Each parameter is also displayed on the panel meter beside the chart. The system provides continuous alarming of desired parameters, and when a pre-set upper or lower limit is exceeded, it stops sequencing on the defective position and indicates which parameter has varied. Contacts for aural alarms are incorporated for instant alerting. Rust Model AL-100, designed for local logging, has identical basic features.

signed three of four men to studio control, leaving transmitter supervision to a resident operator. At still another station, one man has enough time to maintain visual and aural transmitters, two microwave receiving stations, an FM transmitter with two SCA operations, and an FM standby transmitter. Previously, a large part of his time was spent merely logging transmitter readings. Although it's not required (as long as licensed operators are available in emergencies), many stations keep one man at the transmitter, charged with maintenance responsibilities and an occasional check on overall operation.

### **Equipment Performance**

Automatic loggers are meeting and exceeding the expectations of the chief engineers we talked to. Initially, though, some didn't find everything so rosy. Some problems were encountered in matching sampling voltages to logger requirements, and a bit of experimentation was necessary to produce the required levels. While most logging equipment will accept a fairly wide range (10v or so) of input sampling voltage, high plate voltages and currents are tricky to reduce to acceptable levels. Engineers who have worked with remote control gear will find their experience quite useful. If you are installing a remote logger, the sampling voltage problem may not be so complicated since you already have data coming in from the transmitter at levels suitable to most loggers (if yours is a DC system). However, in a few cases, line noises interfering with logger accuracy were reported. This presents a particularly knotty problem since phone company line quality is involved, and the only solution is to improve line quality.

Transmitter RF on phone or sampling lines, especially if it's intermittent, gives erroneous readings until it's tracked down and eliminated.

Components used in sampling and alarm circuits, and in the logger itself, must be of the highest quality; at least comparable to broadcast equipment standards. To sacrifice quality is to invite all sorts of problems: repeated failure, difficult calibration maintenance, and the risk of inaccurate readings.

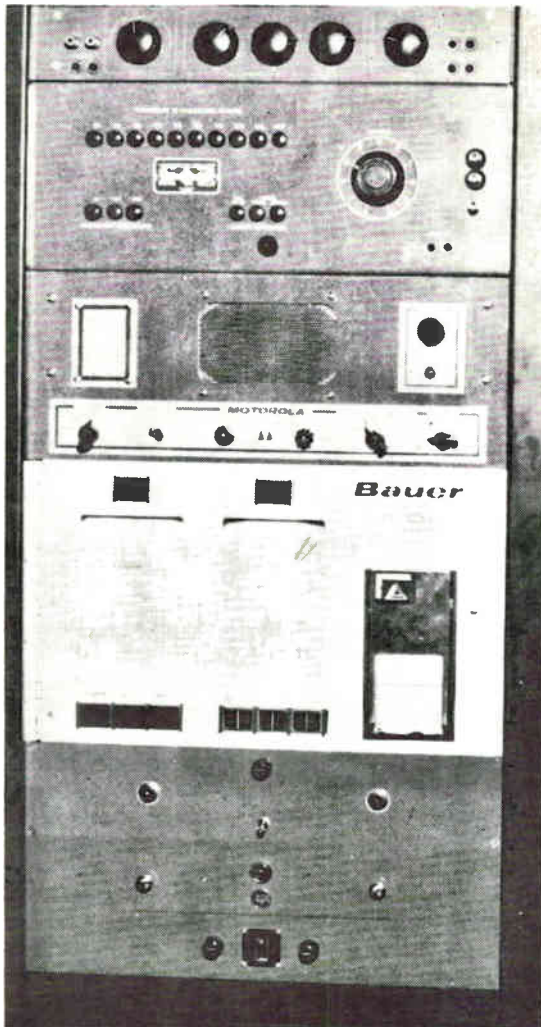
Also, personnel must become familiar with the equipment, which is unlike most other broadcast gear. Adequate installation time serves as a "get acquainted" period and allows for accuracy and stability checks, and "debugging." One chief expressed, as his only regret, allowing insufficient installation time.

### **Importance of Maintenance**

An automatic logger without a properly moving recorder chart is less than useless. When a new roll of paper is installed, special care must be taken to insure that it is inserted properly and moving at its proper pace. If carelessness in setting up the recorder is permitted you may discover later that you have no operating log for an entire day! Chart paper quality is of utmost importance; use of cheap, off-brand paper may result in sprocket hole tearing, as it did in one station, which wound up with no operating log for several hours.

### **Logging Procedures**

Some stations remove the length of chart at the end of each broadcast day and attach it to a daily log sheet containing carrier on and off times, tower light records,

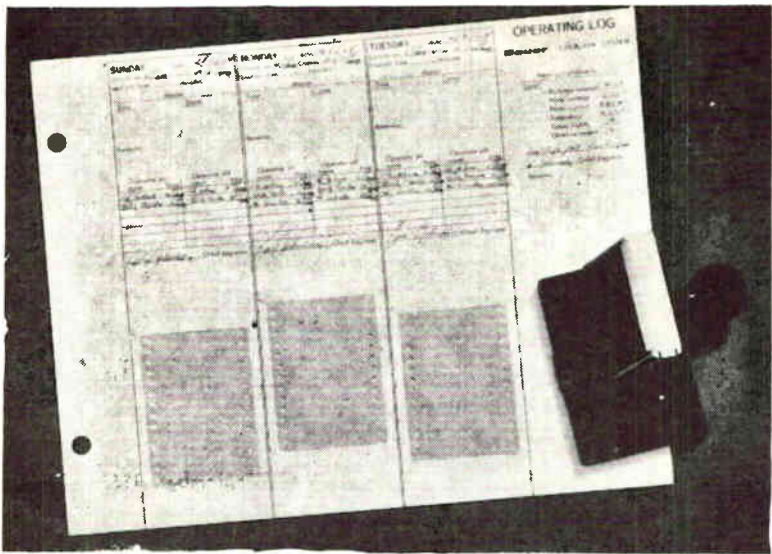


Bauer Log-Alarm equipment records necessary parameters 7 times each hour on a 1" per hour strip chart. If transmitter frequency or power output varies beyond preset limits, the unit sounds an internal alarm, plus external alarms at any desired location, until the condition is corrected.

DA phase readings, etc. Others leave the roll chart in place until used up before filing it in the records. In the latter case, the date is stamped on the chart at the beginning of each day.

### What About Costs?

Surprisingly, automatic logging equipment is fairly reasonable, ranging from a minimum of \$2,000 to as high as \$5,000 where



Automatic logging charts become a part of the daily permanent record of transmitter operation. This form

a more complex installation is involved. TV and AM-FM stations will need two loggers to accommodate both transmitters.

Automated logging installations in remotely controlled stations require phone lines capable of carrying DC. If existing lines fulfill the requirements, without disrupting remote control and fail-safe functions, installation costs will be that much lower. If transmitter sampling circuits do not exist, they will have to be installed. If the transmitter was designed for remote control, at least some of these sampling circuits can be adapted to feed the logger. Manufacturers' recommendations should obviously be closely followed. Sampling voltage levels are critical; if they are not at recommended values, logger calibration will be difficult to adjust and maintain.

Most logging equipment uses internal relays to operate external parameter tolerance alarms, but

it's up to the station to devise necessary alarm apparatus. Bells, buzzers, flashing lights, or any combination of devices which will attract attention will do the job. Intermittently ringing bells and buzzers and flashing lights have been found to attract attention more readily than a steady ringing or buzzing, or a constantly glowing light.

### Is Automatic Logging For You?

While it may be possible to do so, it usually isn't practical to discharge transmitter staff personnel whose jobs are eliminated because of automated logging equipment. Most stations have found that they have a need for technical personnel in other phases of their operations. On the other hand, after a period of stabilization, an employee who resigns may not always be replaced.

From a manager's viewpoint, automated logging makes it pos-

sible to accomplish more with the same number of people, and to enhance better technical operation. There are many ways to use an engineering staff's additional time to advantage — more thorough maintenance, for example. Better

maintenance is almost like money in the bank!

Your situation must, of course, dictate whether or not automatic logging will be advantageous to you. Stations using it say it's a wise investment.

# ***Planning to Go Remote? Here's Help!***

by Leo G. Sands

**S**HOULD YOU lease wire circuits or install your own radio link? Or, is it wise to even consider going remote at all. Much depends upon economics, and the quality and reliability of available leased circuits. Where circuits of adequate quality are available or can be made available without paying excessive construction costs, leased circuits are usually less costly.

A radio link installation, on the other hand, requires a substantial initial investment, but recurring costs are generally lower. It provides considerable flexibility; it can reach into areas where link services are not available; and it enables expansion of remote control facilities without increasing the cost of the transmission medium.

## **Circuit Requirements**

Four or five circuits are usually required from the transmitter site to the remote control point. As shown in Fig. 1, these include (1) a control channel, (2) a telemetering channel, (3) an order wire, (4) a program circuit, and, if

stereo facilities are required, (5) a second program circuit.

The program circuits already exist if the studio and transmitter are at different locations. Don't forget to include the present cost of leasing one or more program circuits when you consider the total cost of a radio link against the total cost of leasing all of the required circuits.

## **Control Channel**

The control channel may be a so-called 0-15 cycle circuit which may be a true metallic hookup capable of passing DC, or a derived circuit which does not pass DC but provides a relay at the transmitter site with control contacts at the remote point. These two types of circuits are illustrated in Fig. 2.

Or, a *voice grade* telephone circuit may be used to provide the equivalent of up to 32 circuits of the type shown in Fig. 3, by employing *tone multiplexing*.

## **Telemetering Channel**

The true metallic circuit in Fig.

2 can be used for direct analog measurement. A derived 0-15 cycle circuit, which does not provide a DC path, can be used for remote measurements of transmitter currents and voltages by converting them into coded pulses. A single circuit of either type can be used

to provide up to 32 telemetering channels by employing tone multiplexing.

### Order Wire

The order wire may simply be a common carrier telephone hookup

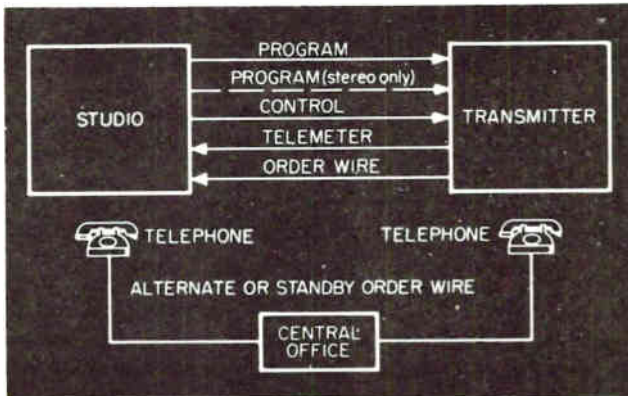


Fig. 1. Remote Control Circuit Requirements.

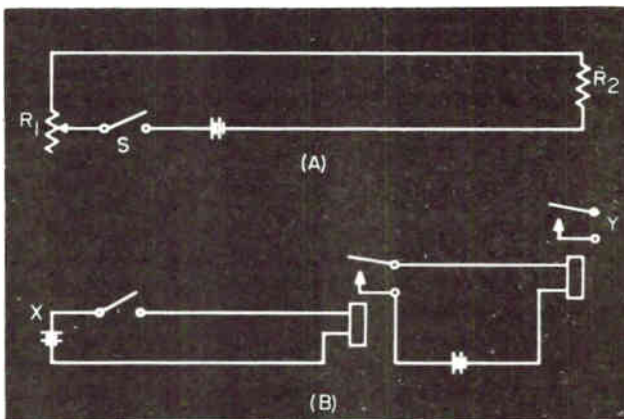


Fig. 2. Two Types of Metallic Circuits. (a) Metallic DC Circuit can be used for transmission of quantitative information. (b) A signaling circuit may not necessarily provide a direct DC path from X to Y.

for both control and telemetering. The cost of leasing such a line is usually around \$1.50 per mile per month. A voice grade telephone circuit, costing around \$3 to \$5 per mile per month, can be used

between the transmitter site and studio. Or, a separate voice grade telephone circuit may be leased, terminated at each end in a local battery, magneto telephone, or intercom unit of the type ordinarily



used for remote control of mobile radio system base stations, as illustrated in Fig. 4. On the other hand, the order wire may consist

Broadcasters are eligible for station licenses in the Business Radio Service and Citizens Radio Service for other than program

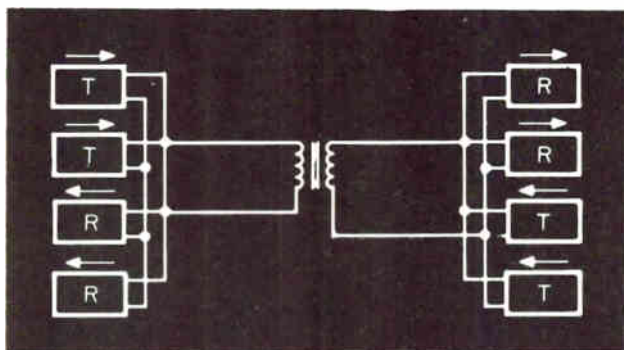


Fig. 3. Up to 32 tone channels can be accommodated by a voice grade circuit. Transformer illustrates that DC path is not required.

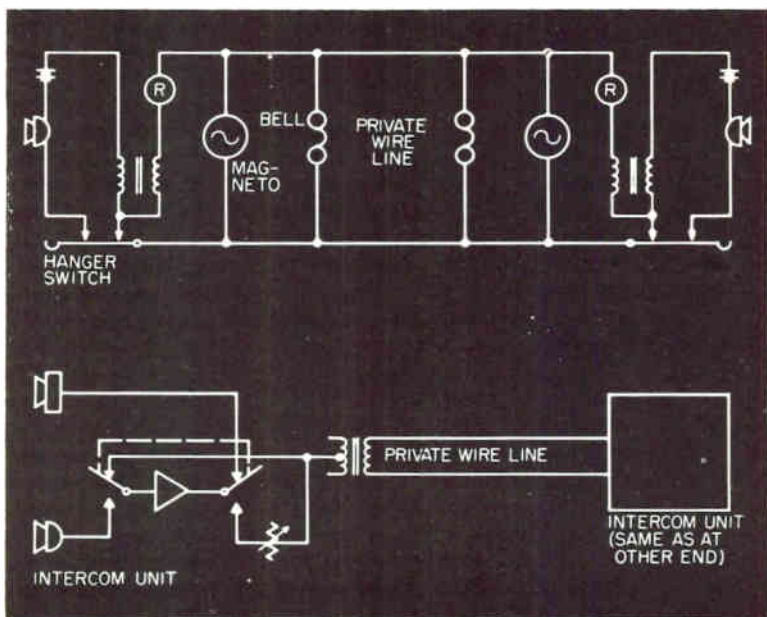


Fig. 4. Private Line Order Wire Circuit.

of a single-channel, reversible two-way radio link, as illustrated in Fig. 5, preferably equipped with tone squelch to mute the receivers except for desired signals.

transmission. Thus, the radio transmitter-receiver at each location may be a Class-D Citizens radio unit, or a 5-30 watt AM unit operated on one of the 27-mc busi-

ness channels. A 3-watt (or lower power) unit may be operated on one of the low-power business channels in the 5-50 mc, 150-173 mc, or 450-470 mc mobile radio bands, on which fixed communications are permitted. Or, a UHF/FM unit may be operated on any one of the 48 Class-A Citizens channels in the 450-470 mc band with input power up to 60 watts.

### Program Channel

The program channel (two for stereo) must meet the frequency range requirements stipulated by

quate frequency bandwidth to accommodate all of the channels, as provided under telpak tariffs.

When the broadcaster has a right of way where he can install a suspended or buried coaxial cable, all of the channels can be accommodated by a single cable, as shown in Fig. 6.

If such a transmission medium is not available, the program channel(s) may be independent and one voice grade telephone circuit may be employed for control, telemetering, and order wire purposes.

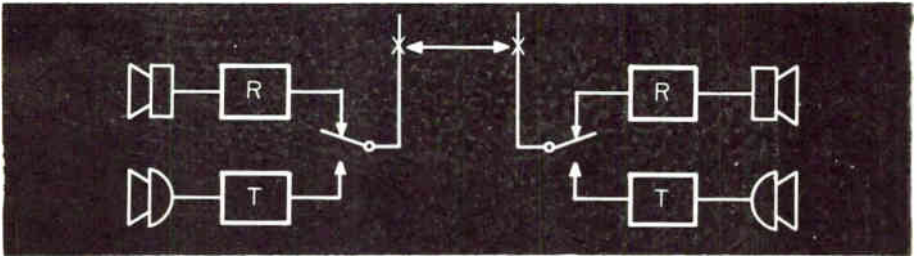


Fig. 5. Radio Link Order Wire.

the FCC for the type of broadcast station. A leased program circuit generally consists of an *equalized* telephone circuit. Rates are higher than for voice grade circuits, even if it's simply an ordinary telephone circuit with one or more equalizers.

An 890-960 mc band radio link, licensed under Part 4 of the Rules, may be used to provide one or more program channels.

### Combined Circuits

A single broadband circuit, if available, can be used to provide one or two program channels plus the control, telemeter, and order wire circuits by employing frequency division multiplexing. The broadband circuit must have ade-

### DC or 15-Cycle Circuits

When a DC or 0-15 cycle circuit is used, remote control is achieved by dialing specific numbers to perform various control functions, such as turning on transmitter filaments and transmitter plate voltages, reducing power, increasing or decreasing plate and filament voltages in discrete steps, switching over from the main transmitter to standby, etc.

The same circuit can also be used to observe power line, filament, and plate voltages, plate and antenna current, frequency and modulation monitor readings, and for determining if the tower lights and flashers are functioning properly. Each circuit to be monitored is dialed. Selectors at the transmitter site connect the remote

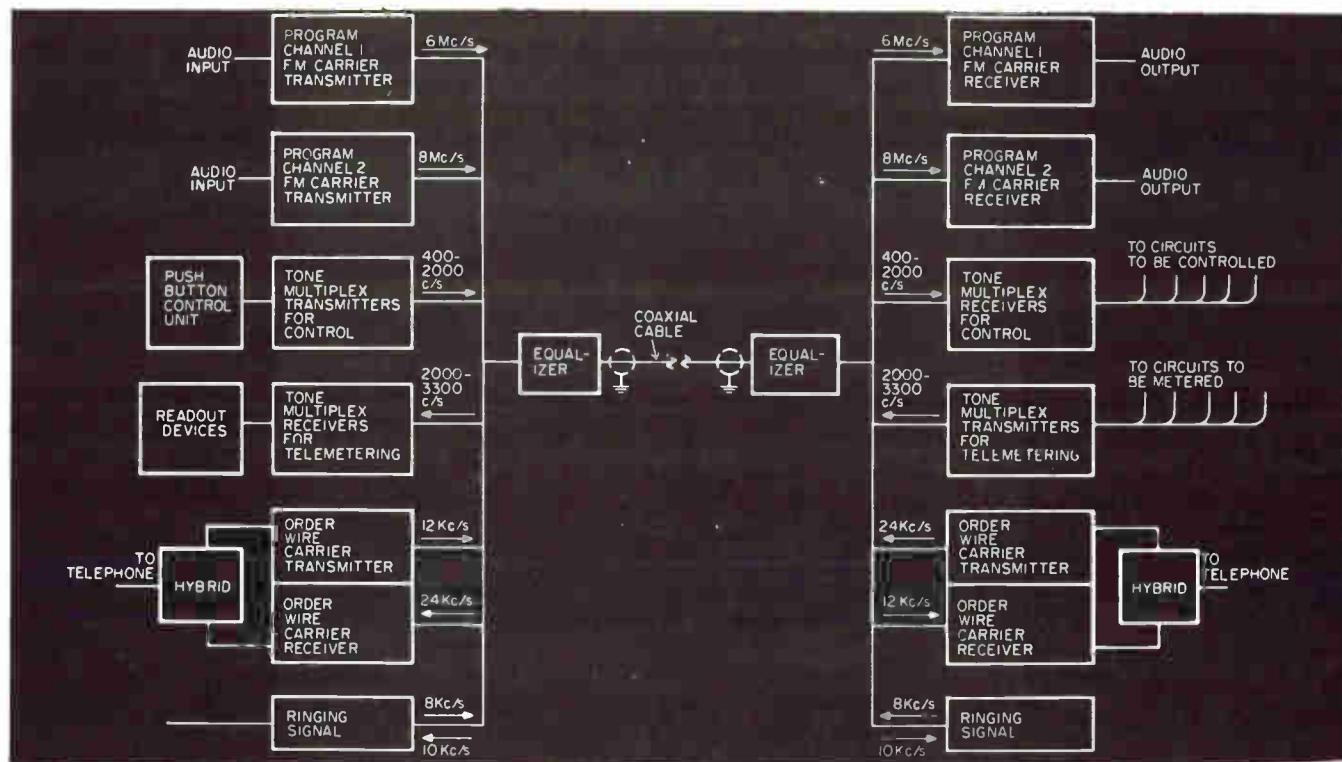


Fig. 6. Short-haul coaxial cable system for programs, order wire and simultaneous remote control and telemetering.

metering circuit to the various circuits in response to dialed commands. Fig. 7 is a functional block diagram of a remote control and telemetering system using a metallic circuit.

### Voice Grade Circuits

A single voice grade telephone circuit may be employed for simultaneous remote control and telemetering of several circuits by

erating at a frequency in the audio range and a tone receiver tuned to the same frequency. As shown in Fig. 8A, closing switch S causes a tone to be transmitted. When rectified by the distant tone receiver, output relay (K) pulls in. In the absence of tone, the relay is de-energized.

A two-state FSK (frequency shift keyed) or FM tone channel is illustrated in Fig. 8B. When S is

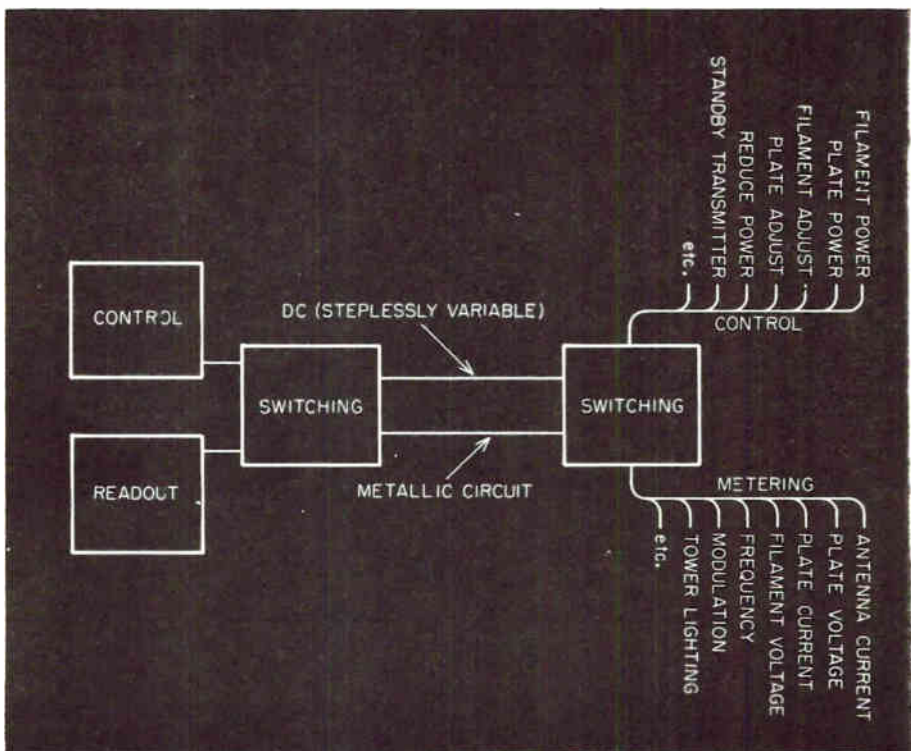


Fig. 7. Remote Control and Telemetering System.

tone multiplexing. By using tones and sequential control and telemetering circuits, the same line can also be used as an order wire.

### Tone Multiplex

An on-off (AM) tone channel consists of a tone transmitter op-

closed, the frequency of the transmitted tone is shifted, causing relay K to pull in. The relay drops out again when the tone shifts back to its normal frequency. One tone or the other is always present.

In a three-state FSK tone channel (Fig. 8C), a tone at the chan-

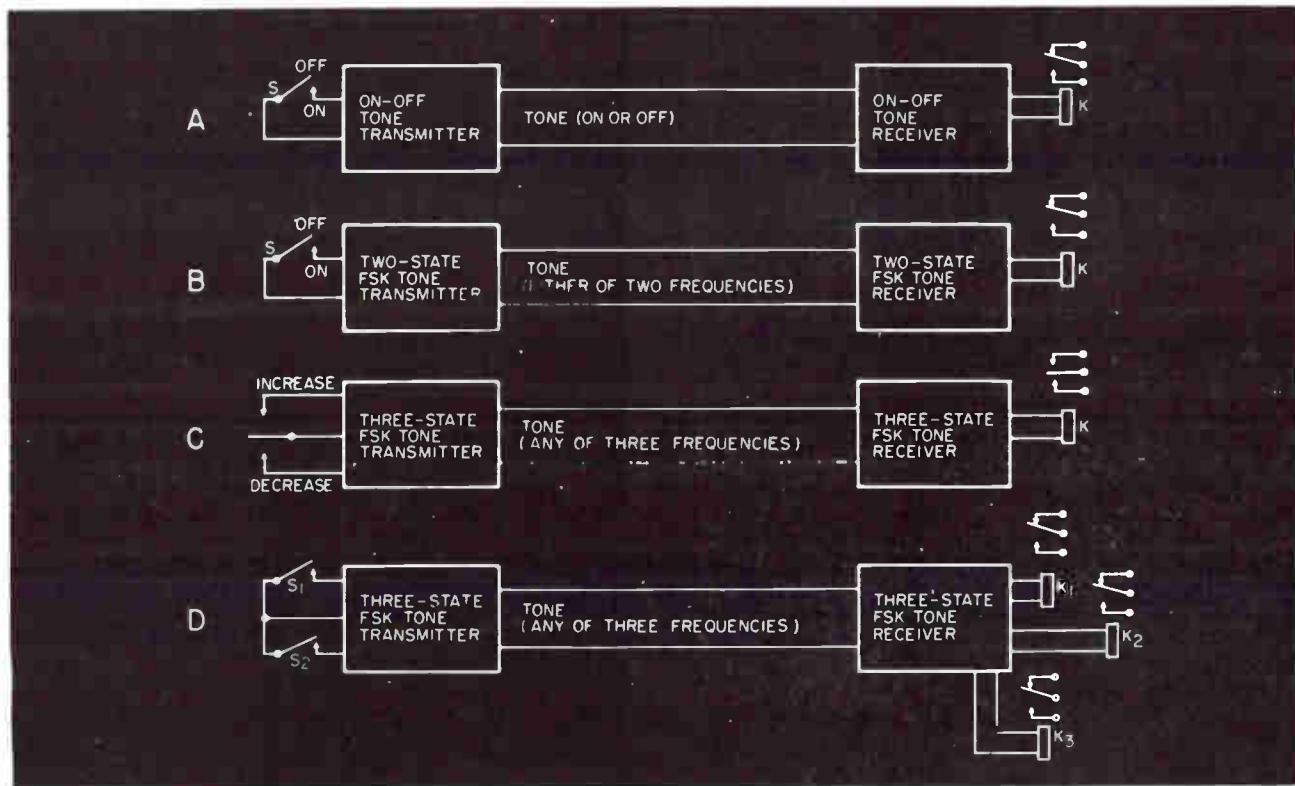


Fig. 8. Types of Tone Channels.

nel frequency is transmitted when S is in its center position. When S closes one contact pair, the tone is shifted up; when in the opposite position, tone decreases in frequency.

The output relay (K) may be a three-position differential or polar relay, which is normally in its center position and is pulled one direction or the other, depending on whether the frequency shifts up or down.

Or, separate output relays may be provided for all three tone frequencies, as shown in Fig. 8D. When S1 is closed, relay K1 pulls in; K2 pulls in when S2 is closed. Both switches should not be closed at the same time. Relay K3 operates whenever the tone frequency is shifted.

Since each tone channel operates on a different frequency, several tone channels may operate simultaneously on the same circuit. Up to 32 tones can be transmitted, in either or both directions, over a voice grade circuit.

### Speech Plus Tones

Three or more tones may be transmitted along with speech over a voice grade circuit without mutual interference by using filters as shown in Fig. 9. The filters may cut a slot in the voice band at around 2000 cps or attenuate frequencies above 2600 cps or higher, allowing room for tones at the top of the voice band.

ON-OFF and FSK tone equipment is available from several manufacturers. Any combination of ON-OFF and FSK tone transmitters and receivers and common power supply may be stacked in a 19-inch relay rack to accommodate the desired number of modules. In lieu of the power supply module, or as its standby, a

12-volt battery may be used as the power source.

An ON-OFF or two-state FSK tone channel can be used to transmit GO-NO/GO intelligence (mark and space signals). A three-state FSK tone channel can be used to transmit such commands as forward-reverse, up-down, fast-slow, increase-decrease, etc. A combination of these systems can be used to transmit more complex intelligence, including quantitative information, by coding the tone pulses or varying their duration, repetition rate or relationship.

In addition to keyed tones, there are tone systems which convey quantitative information by stepless variation of the tone frequency. As shown in Fig. 10, the tone frequency is varied by changing the voltage applied to the tone transmitter. The output of the tone receiver is a DC voltage which is proportional to frequency. For telemetering, the DC voltage to be measured (reduced if necessary) is applied to the tone transmitter and the value of the voltage is read on a meter connected to the output of the tone receiver.

Current is measured in the same manner by connecting the tone transmitter input to a series resistance in the circuit being monitored. RF and AC can be measured by rectifying it.

A variable frequency tone channel occupies more space than a keyed tone, and thus fewer can be accommodated within the same transmission band.

### Radio Links

An 890-960 mc band radio link can accommodate all of the required circuits. An FM radio link licensed under Part 4 of the Rules may employ up to  $\pm 200$  kc FM

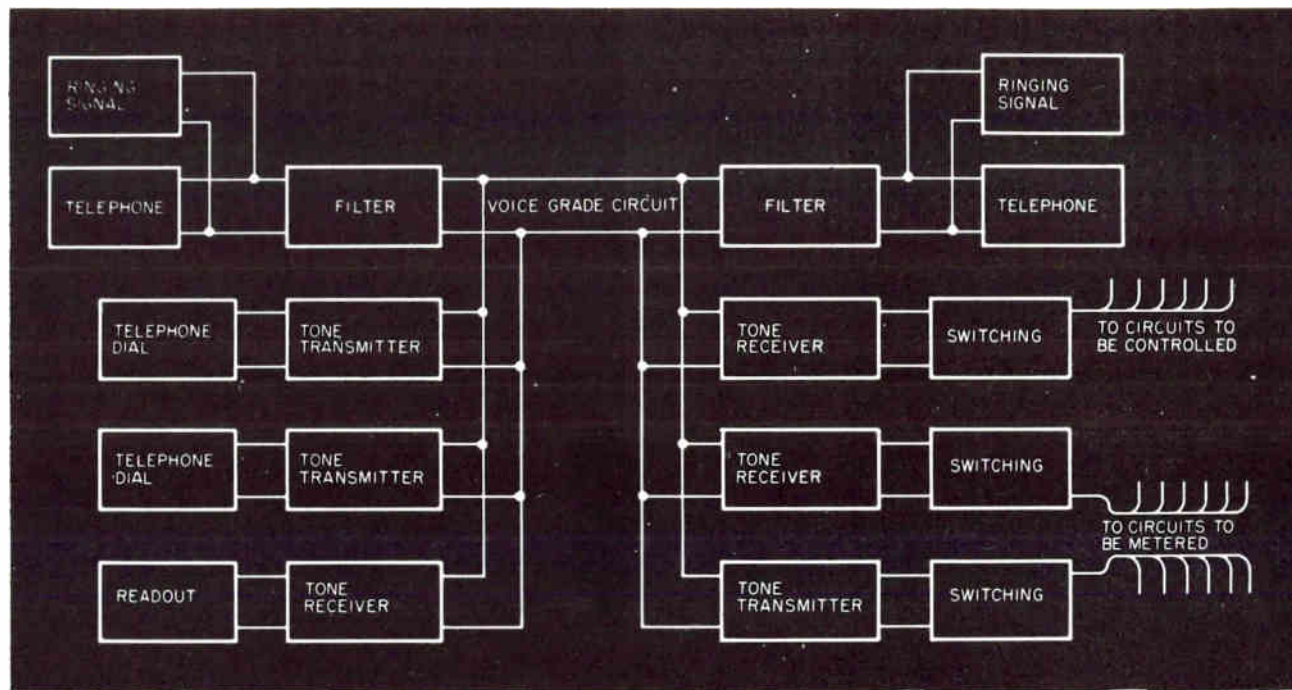


Fig. 9. Combined order wire and sequential remote control and telemetering system.

frequency deviation and, when employing a 4:1 deviation ratio, can accommodate up to 50 kc of intelligence.

A two-way link (Fig. 11) provides the same amount of band space in both directions. When broadband transmission is required in only one direction, the transmitter-to-studio artery may be a DC, 15-cycle, or voice grade wire line, or a narrow band radio link.

The narrow band radio link could operate in the 72-76 mc band, except when close to a TV station operating on TV channel 4 or 5. Or, it could operate on one

input. Class-A stations may be remotely controlled. For example, a tone could be transmitted from the studio via the broadband link, which would turn on the narrow band transmitter when a meter reading is made or control function is verified.

Ordinarily, Class-A stations are authorized for AM or FM radio-telephoning only, but the FCC may authorize use of other emissions upon adequate showing of need. While the point being made is that the operation of the return radio link on business or Citizens channels is technically feasible, such use, from

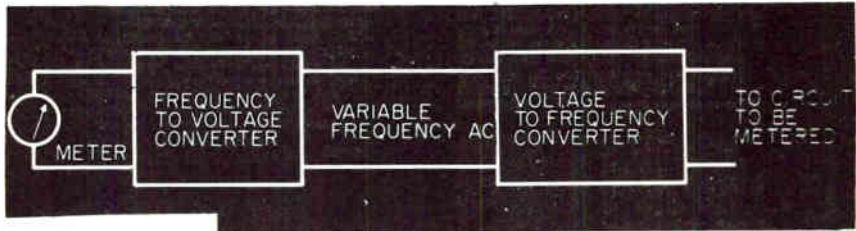


Fig. 10. Analog telemetering system.

of the 26-mc channels on which 30 watts input power and any kind of emission can be employed as long as band occupancy does not exceed 8 kc. The transmitters may be remotely actuated. Licensing would be in the Business Radio Service on a shared basis with other services, with no guarantees against interference.

Special narrow bands of frequencies are also available in the 25-50 mc and 150-174 mc bands to business radio applicants on a developmental basis. Any kind of intelligence may be transmitted within the specified frequency limits.

Or, the return link could operate on one of the 48 Class-A Citizens channels in the 450-470 mc band using up to 60 watts

of the standpoint of acceptability for broadcast transmitter telemetering, must be approved by the FCC.

While more expensive, a 12,000-mc band microwave link could be used to transmit telemetering signals from the transmitter to the studio. There is ample bandwidth for transmitting video signals from a closed circuit TV camera to a monitor at the remote control point. One or more remotely selected TV cameras could be used for direct viewing of the transmitter's meters as well as the tower lights.

### Telemetering

The simplest method of transmitter telemetering employs direct selective connection to the



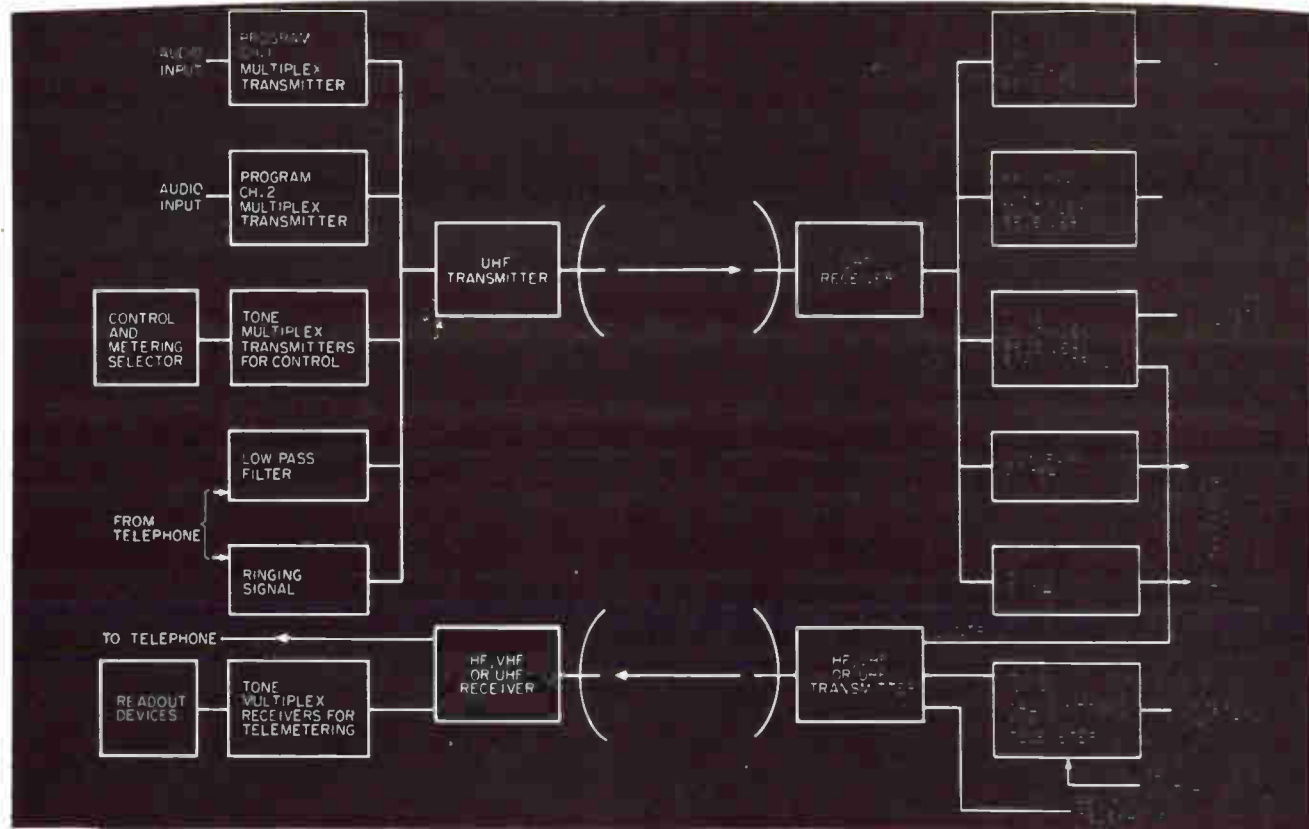


Fig. 11. Radio link block diagram.

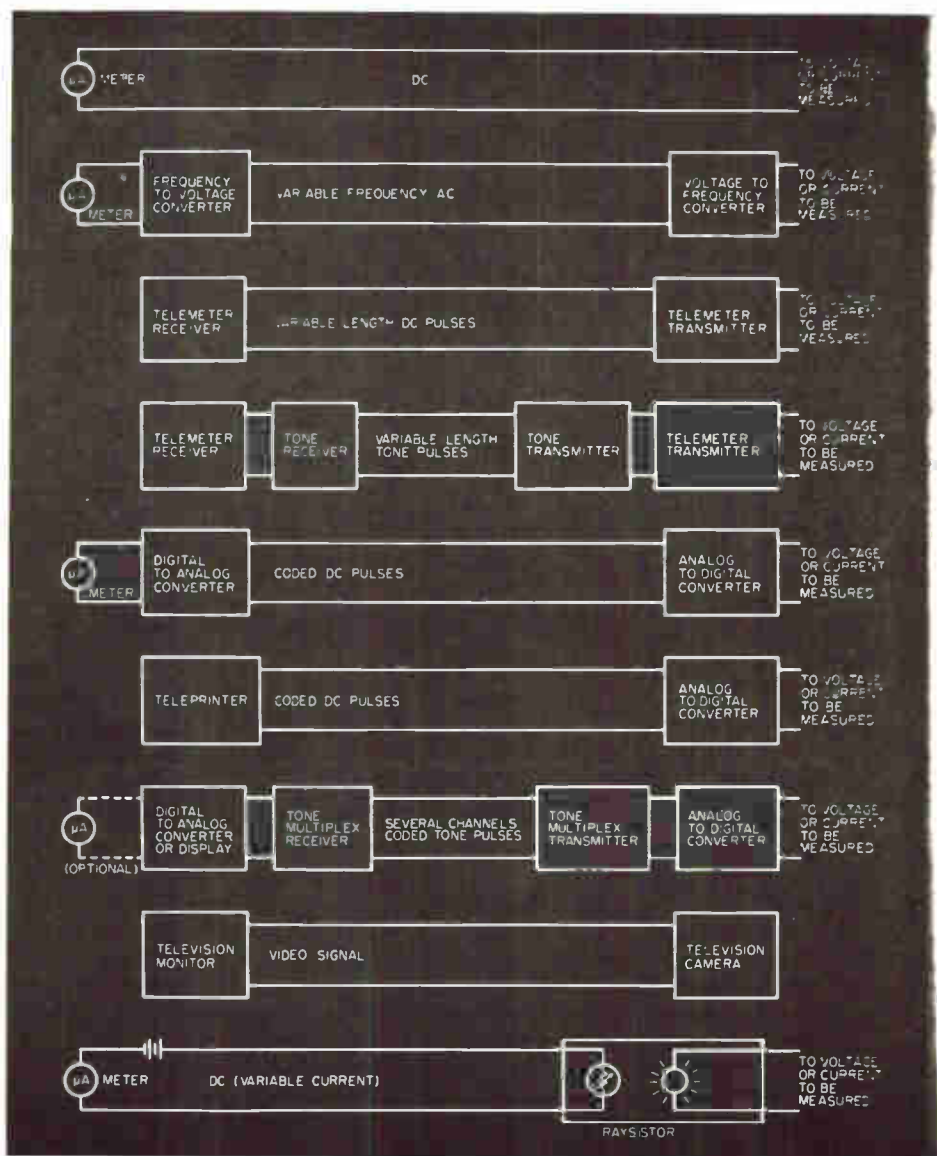


Fig. 12. Block diagrams of various telemetering circuits.

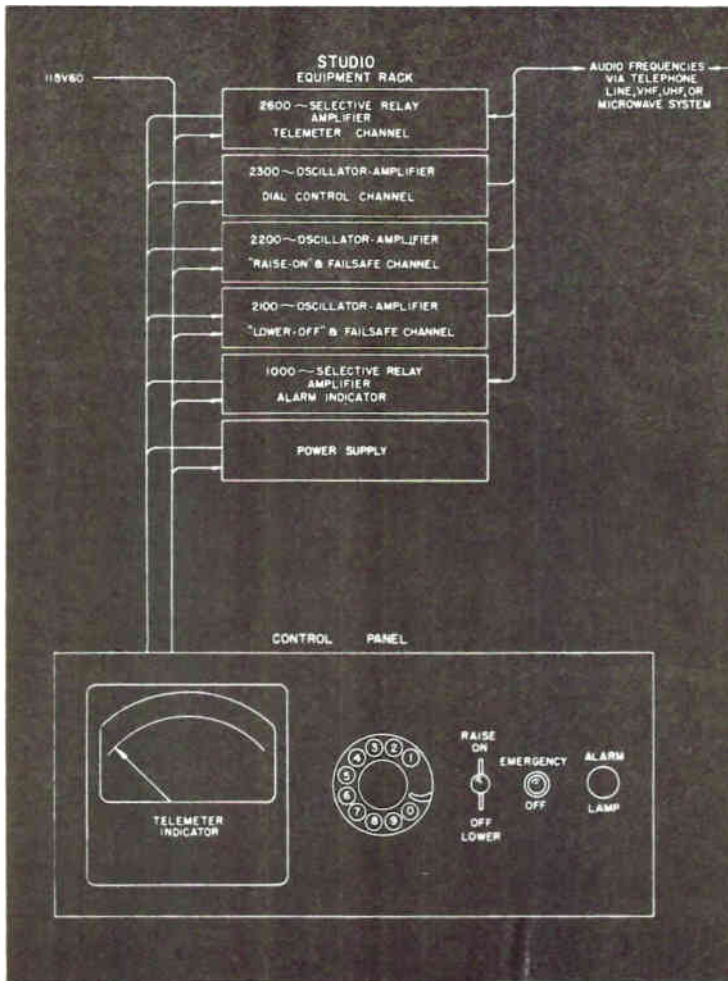
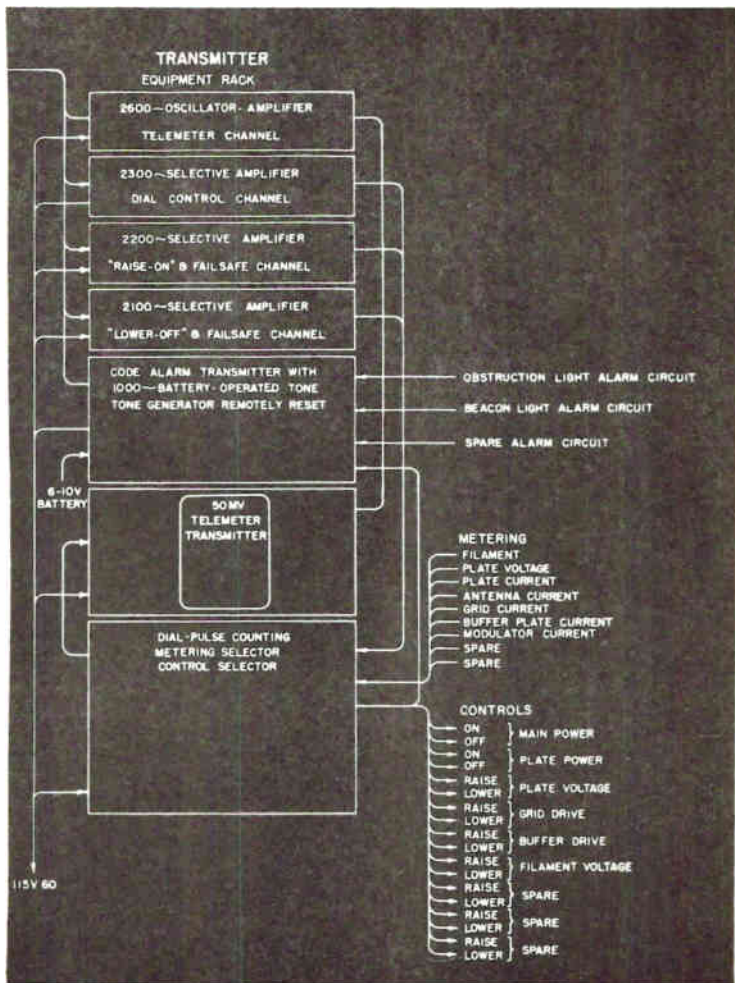


Fig. 13. Block diagram of control and telemetering system



compatible with wire line or radio link.

## Manufacturers and Suppliers of Remote Control Systems

Company	DC Wire	Tone Wire	STL/Radio
<b>Bauer Electronics</b> San Carlos, Cal.	X		
<b>Budelman Electronics Corp.</b> Stamford, Conn.			X
<b>Collins Radio</b> Dallas, Tex.		X	X
<b>Gates Radio</b> Quincy, Ill.	X	X	X
<b>Marti Electronics</b> Cleburne, Tex.			X
<b>McMartin Industries</b> Omaha, Nebr.			X
<b>Metro-Tel Corp.</b> Westbury, N.Y.			X
<b>Microwave Associates</b> Burlington, Mass.			X
<b>Moseley Associates</b> Santa Barbara, Cal.	X	X	X
<b>Radio Corp. of America</b> Camden, N.J.	X	X	X
<b>Rust Corp.</b> Everett, Mass.	X		
<b>Schafer Electronics</b> Burbank, Cal.	X		
<b>Trepac Corp. of America</b> Englewood, N.J.	X	X	X

transmitter metering circuits and the frequency and modulation monitors, and a meter at the other end.

Many telemetering techniques, developed to meet the requirements of water works, process machines, aerospace and the military, can be used for broadcast station telemetering.

A pulse duration telemeter transmitter, for example, can be connected to the circuit to be measured through a voltage divider and/or rectifier. The telemeter transmitter keys a DC or 15-cycle circuit, or a tone transmitter. The duration of the key

closure time with respect to the total metering cycle time causes the remote telemeter receiver to indicate volts or amperes in values related to pulse duration.

More direct is a voltage-to-frequency conversion/frequency-to-voltage reconversion system, in which the measured voltage or current (DC, AC, or RF) is applied as a small DC voltage to the variable frequency tone transmitter, and measured at the other end with a meter connected to the output of the frequency-to-voltage converter.

Another possible technique is the use of Raysistors to convert

voltage or current (DC, AC, or RF) directly into resistance.

Other techniques include the use of magnetic amplifiers and transistors for sensing voltage or current and providing a DC or AC output signal that can be measured at the remote central point.

### Digital Systems

Voltage and current can be converted into digital data by an analog-to-digital converter which transmits quantitative information as DC or tone pulses. At the remote control point the digital data may be fed to a numerical display or a teletypewriter for printout. Or the data may be fed into a digital-to-analog converter for readout on a meter or electronic counter. The digital data may be transmitted serially over a single tone channel, or several tone channels may be

employed for parallel transmission of data. Digital techniques, using push buttons or a teletypewriter, can be used.

### Choice of Systems

Complete broadcast station remote control systems are available. A block diagram of a commercial system is shown in Fig. 12. This one can be used over any two-way voice grade transmission path. Since it employs audio tones, a metallic DC path is not required.

A broadcast station's engineering staff can design its own remote control system employing available components. Using modern technology, it is possible to design automated broadcast station remote control systems which require no human commands, but which can be monitored by the operator in charge, who can take over control when and if necessary.

## Mobile News Units on a Shoestring

By Clarence E. Jones

“A CAR HAS STALLED in the left lane at the traffic light in downtown St. George. Traffic moving north through the city should use the right lane in the downtown area and proceed with caution to avoid unnecessary delay. This is Clarence Jones in Mobile Unit One returning you to QUIZ action central news.”

The news flash you just read came from a live broadcast on WQIZ, a small 500w daytimer lo-

cated in St. George, S. C. St. George is a town of only 1800 people, but WQIZ radio is known all over the low country of South Carolina as “The little station with a big voice.” It is not located within any large metropolitan area; the town has only one traffic light! Yet, it is the crossroad of two principal highways—a 4-laner winds through the town for about a mile.

Last September, we became in-

## FCC Rules on RPB Operation

Part 74 of the Rules, subpart D, contains all pertinent information for licensing RPB units.

Part 74.402 lists frequencies available for 26-mc use, from 25,870 through 26,470 mc—seven groups—26 channels.

A 5w or lower power mobile station operating below 30 mc must maintain a frequency tolerance of .02%.

There is no limit to the number of RPB stations authorized in a single area.

RPB units may not be used to relay programs from any established studio equipped for regular broadcasting, except for periods of emergency in the case of a remote transmitter.

Stadiums, convention hall booths, churches, and other similar facilities are not considered as established broadcast studios.

### Filing an Application

Use FCC Form 313 to apply simultaneously for both CP and license. You will need eight copies for each unit—four copies for the CP and four for the license. Three copies of each go to the FCC and one is for your files. Several extra copies are helpful as work sheets.

Fill in the base station CP application as follows:

1. (a) Remote pickup; (b) New station; (c) Station I.D.

2. Frequency (specify); Power: 5 watts; Emission: A3; Bandwidth: 20 kc.

3. Give your station coordinates (shown on license).

4. Antenna system: We specified the make and model, using separate 50-ft. TV antenna. (Using your broadcast tower will mean new resistance measurements and the use of isolating coax.)

7. E. F. Johnson Type 242-163, 5 watts. Crystal oscillator circuit: E. F. Johnson standard tube, one type 7054. Last RF Stage: E. F. Johnson standard tube, one type 7061, 2-ma, 360vdc, AM modulation.

8. 100% modulation—.005% or better as measured. Crystal oscillator with .005% accuracy (used to maintain tolerance). Annual measurement interested in adding remote broadcast and mobile news service. Mobile operation, of course, meant 2-way radio equipment. But when a price of over \$3,000 was quoted for two transmitters and a base antenna system, the project was dropped.

Then we got the bright idea of using Citizens band equipment. After all, most of our remote broadcasts would originate within 4 or 5 miles of the station. With 5w CB power, we should be able to achieve reliable RPB operation at distances up to 20 miles. We have since learned that this is a

practical and inexpensive way to expand news facilities while eliminating low-quality phone lines on longer remote broadcasting from stores, schools, churches, etc.

This article explains how we modified inexpensive readily-available units and got our mobile news/remote-broadcast equipment for under \$400!

### Choice of Equipment

For our purposes, we chose the Johnson "Messenger Two," although several other makes and models are suitable for this service. The cost of each unit is ap-

by qualified engineer.

The license form for the base station is exactly the same, except you check "license" under 1a. The CP and license applications for mobile and portable units are the same with these exceptions: In the blank space above Item 3, write: "This transmitter will be used both in a vehicle and as a portable unit." Under 3a, specify your coordinates and write: "Within 25 miles of these coordinates." Under 3c, write: "Within 25 miles of (your city). Under 4a, write "Vertical whip antenna when in vehicle; XXX Model ——— vertical when outside." (Specify make and model antenna.) Check "License" on the form for license. Send these forms with \$30.00 for each base and mobile unit (2 units—\$60.00) to the FCC. You may request the Secretary of the Commission to telegraph you, collect, when the licenses are granted.

### Finding a Frequency

Phone the FCC in Washington (202/EX 3-3620) person-to-person. Ask the operator for: "The person who can tell me what frequency is available for my city in the 26-mc remote pickup broadcast band." Be sure the operator places your call exactly that way to avoid excessive phone charges.

Tell the FCC employee that you are applying for a 26-mc RPB operation and want to know what frequencies are not being used in your area—starting at the 26-mc end of the band and working down. He will ask you if you are near certain towns, so it will help if you have a map of your state handy to check distances.

### Crystal Information

Third overtone *transmit* and *receive* crystals may be ordered from any reputable crystal manufacturer. The receiver oscillator operates at 455 kc below your specified frequency. When ordering, simply order crystals for your assigned frequency and specify the make and model of the transceiver. It's a good idea to send along a copy of the schematic, too.

proximately \$133. It can be powered from either 110v AC or 12v DC. Faced with a choice of fixed frequency and continuously-tuned models, we chose the latter. Variable tuning is of no value in the 26-mc RPB band, but this model has two additional IF transformers, providing greater selectivity and less adjacent channel interference.

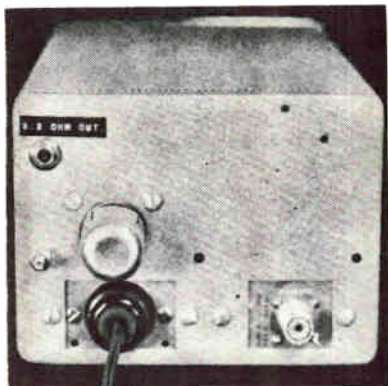
### Modification of the Units

The only modification of the base station unit, in addition to tuning, is the installation of a 3.2-ohm output jack on the rear of

the cabinet. To match the output to our console, we used a transformer of the proper ratio with cables of suitable length attached to each winding. The cable from the 3.2-ohm winding terminates in a phone plug to match the jack installed on the base station unit. The cable from the other winding can be terminated in a plug to suit any console input. Direct tape recordings for delayed use may also be made if a multi-tap matching transformer is used.

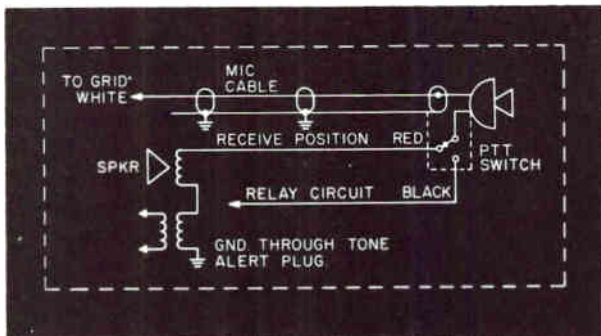
So that we could use a regular phone plug input on the mobile unit, rather than the PTT mic,





### 3.2-Ohm Output Jack

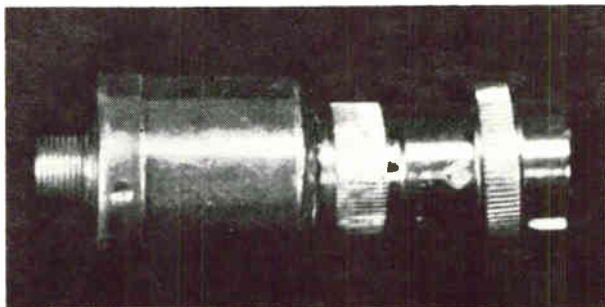
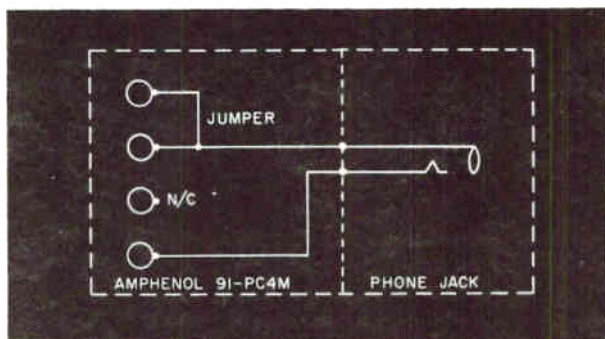
We used a two-color twisted pair to wire a 3.2-ohm output extension from the audio output transformer. We found that connecting this output across the speaker terminals results in the unit acting like a PA system. (Editor's note: Although WQIZ did not report problems with hum, a shielded audio cable connection would seem advisable for the 3.2-ohm output extension.)



Author Jones in news room, which is separate from main control room and has facilities for taping of news and editing, or direct on-air feeds. Remote news transceiver is at upper right.

## Mic Plug and Phone Jack Adapter

With this adapter we can use a phone plug input on the mobile unit rather than the PTT mic. We used a Switchcraft adapter (phone-jack input to phono-plug output) with the phono-plug soldered to the end of an Amphenol connector (91-PC4M). In making this piece the wires in the Switchcraft unit must not be damaged; and by leaving the ring on the Amphenol plug, the mic will be well grounded to the chassis jack. A jumper between pins two and four is necessary so the defeat switch will operate.



three changes were made: (1) modification of a phone jack phono-plug adapter and mic plug; (2) addition of a 4-conductor mic jack; and (3) addition of a carrier defeat switch.

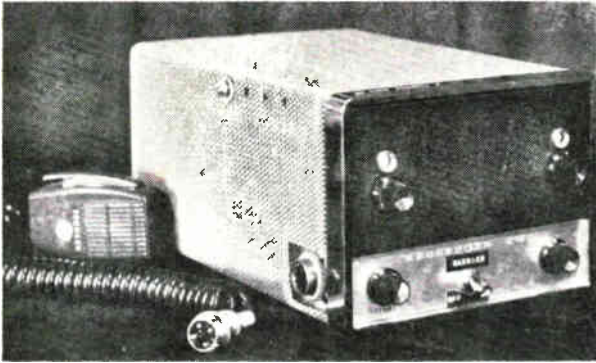
### Tuning

In achieving optimum operation on your RPB frequency, the transmitter and receiver sections will have to be tuned and adjusted.

The transmitter oscillator coil,

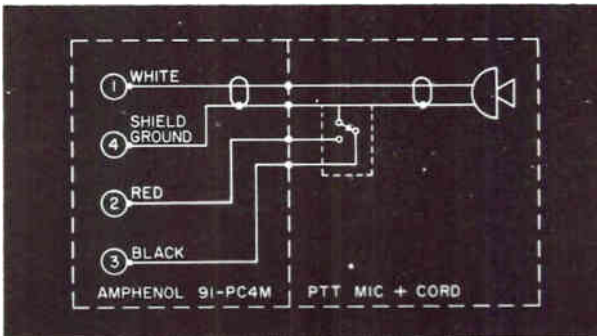
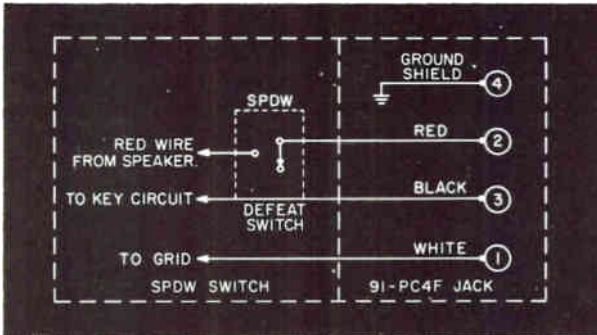
which is in series with the crystal, may require adjustment. (Ours did not.) It should be tuned for maximum oscillator grid voltage. To prevent circuit loading, use an RF choke in series with the VTVM probe.

The oscillator output and power amplifier circuits will require peaking at your specified frequency. The oscillator plate coil, power amplifier plate, and antenna coupling trimmer should be tuned for



### Defeat Switch and New Connections

A SPDT switch is mounted on the front panel of the mobile unit and wired as shown. An Amphenol mic jack (91-PC4F) is mounted in a convenient location and wired as shown. The original plug on the PTT mic is replaced by an Amphenol plug (91-PC4M).



maximum power output (about 3w). An RF wattmeter (the type normally used for CB units is sufficient) connected to the antenna output, should be used as the adjustment indicator. Tune the oscillator plate coil under modulation. A simple procedure is to whistle into the mic while tuning for maximum output.

Remember that all tuning and adjustment should be made while operating into a dummy load. A 50-ohm 10w resistor will serve quite well. The load should be connected across the antenna coax connector when the transmitter is keyed. Frequency and modulation must be checked by a technician holding at least a 2nd-Class Radiotelephone license.

The receiving antenna coil and RF circuit should be tuned to your specific RPB frequency. The best way to do this is to feed the output of a suitable frequency generator directly into the receiver, via the antenna coax connector, while monitoring the AVC voltage. Use an unmodulated signal and adjust the generator for the lowest usable output; too much output will cause overloading.

If an accurate signal generator is not available, simply peak the antenna and RF circuits for maximum noise output. Then trans-

mit a test signal from the other unit at a remote location, or operate it from another room, using a dummy load to produce a very weak signal. Retune the receiver for maximum signal volume. Nothing else needs to be retuned. We found that optimum operation of our units required only these adjustments.

### **Increasing Power Output and Modulation**

We were able to increase modulation by using a .25-mfd capacitor across the series resistor in the output winding of the modulation transformer. Power output can be raised by shorting out this same resistor. We increased ours to approximately 7w. In our case, we found modulation and power increases to be of no real advantage since most of our operation is within close range of the station. Our units could not be operated with both increased modulation and power, but they operated with no problem at all on continuous duty at 3-5w.

The main thing is that our units work, and they work well. Our dream of a remote pickup and mobile news unit has come true because we put wheels on our dream . . . mobile news for under \$400!

# *Tips & Techniques For Handling Live Audio*

By Philip Erhorn

ONE OF the most important technical aspects of live studio operations is the technique of audio mixing. While the technique naturally varies from one engineer to another, the man who combines musical knowledge with a good memory and keeps calm under pressure, is the type who eventually gets his name in the credit lines for a number of important network shows.

Our first consideration is the method used in setting up the mixer board. There seems to be an inherent urge on the part of most audio engineers to set up their mixer readings from left to right—that is, with the most important mics tied to the left-hand mixing pots. This tendency has probably been carried over from the early days, when it was prudent to connect the announce mic to the number 1 pot, so that it could be grabbed in an emergency without looking.

In most instances this mic doubled as the vocal mic for an orchestra setup, and the rest of the board was arranged about like

Fig. 1A. This simple arrangement could handle many shows involving a house band and vocalist, but when expanded to meet the modern demands of a complex show, the board tends to be off balance to the left. Such an arrangement is shown in Fig. 1B. Because only two pots of the large-knob rotary type can be simultaneously controlled with one hand, the most important pots, requiring the most gain riding, are not conveniently placed. This, of course, makes the mixing job more difficult.

Fig. 1C illustrates a more sensible method of setting up the mixer suitable for a large musical TV show, with the addition of two submixers to accommodate the relatively large number of microphones more easily on a conventional console. The submixers (which may be outboard portable units) feed into two pots on the main mixer panel for a more compact two-hand layout within a reasonable span. Note that the left hand may normally control the string mic and Boom 1, while the

right hand controls Boom 2 and the chorus mic. The most important mics are comfortably centered and under complete control, and a hand occasionally can be released to touch up the woodwind,

and the choice of microphone used on the stage booms. Even casual examination of the comparative curves of the older ribbon cardioids and dynamic/ribbon combination cardioids shows con-

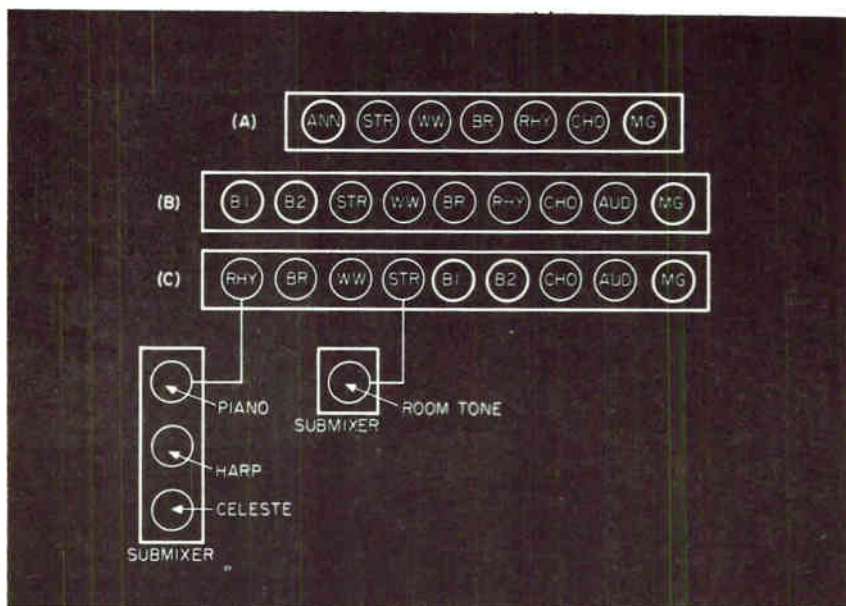


Fig. 1. Comparative Board Arrangements. a. Standard method. b. With more pots, board becomes unbalanced. c. Sensible method of balancing mixer pot arrangement.

-muted brass, audience reaction mics, etc.

A room tone or echo mic is shown submixed with the string mic. This idea works well in a large, but typically deadened studio. Even in a theater studio it will help to augment the sound of a small string section. As the string mic is opened, room tone tends to counteract the "rosiny" sound of a close-miked string section.

### The Importance of Microphone Choice

The second important consideration for improvement of TV au-

considerable leakage at both ends of the spectrum (Fig. 2). The front-to-back ratio is quite poor except at mid frequencies. Obviously leakage into the stage booms from a pit or off-stage orchestra is always severe. It is a psychological fact that musicians always play twice as loudly on air as in rehearsal, ruining a carefully set balance via pickup on the booms. In addition, ambient set noise is aggravated by spacious acoustics, particularly so in theater studios.

The newer dynamic cardioid and line microphones make a tremendous difference in handling these problems. Front/back ratio has

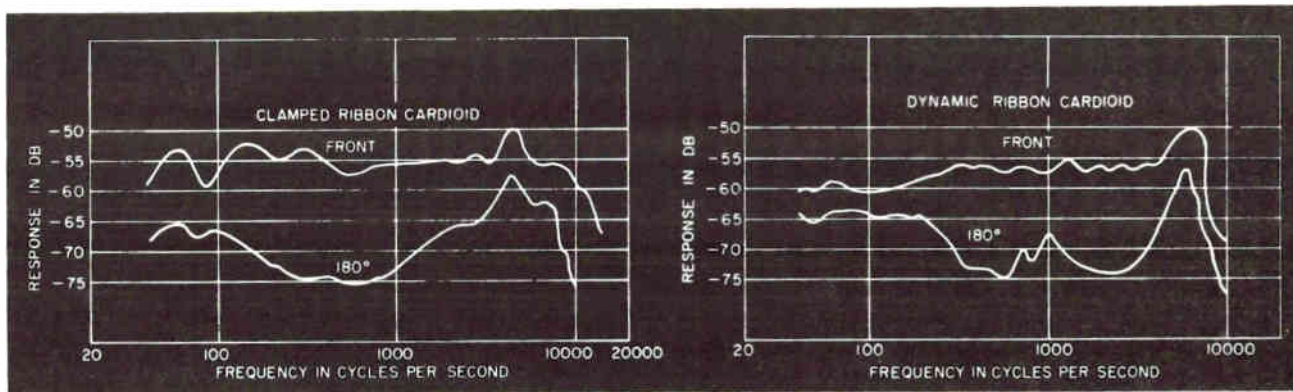


Fig. 2. Response curves of typical ribbon-type microphones showing severe leakage at both ends of the spectrum.

been increased and made quite uniform over a wide frequency range. Leakage in the old sense of the word is minimized, and working distances may be substantially increased. Of course, the boom operator must be more alert in positioning the mic, because of the increased directivity. Not the least of the advantages gained are mechanical ruggedness and freedom from shock, plus reduction of proximity effect.

### Control Engineer's Cue Sheet

With the physical setup of the board arranged so that the most important mics are centered among the pots, and the possible boom microphone problem alleviated, the next important consideration is some means of "prodding" the engineer's memory during the course of a long show.

Memory serves an important function because levels must be constantly adjusted on cue throughout the show, and critically changed to adapt to vocal entrances, dynamic orchestra levels, and commercials. For live shows, the audio control man has only one chance to do the mixing job correctly.

Because the average popular musical number runs only 3 to 4 minutes, memory is hardly overtaxed with regard to vocal cues or relative mixing levels. However, memory certainly needs regular jogging during the course of a long show involving many numbers, several commercials, and much repositioning of the booms, not to mention prerecorded sections, film spots, etc. Cue sheets and notes on the script are very necessary. The most important level changes and cues are in the transition from one musical num-

ber to another. As the announcer or performer takes over the boom at the conclusion of a number, the orchestra mics and other important mic pots must be reset for the start of the next number. They may need closing down (but not off) during announcements in order to hold down set noise, but must be quickly and accurately reset for most effective levels at the start of the next number.

Fig. 3 illustrates a simple shorthand method of marking a script or musical cue sheet so as to leave no doubt about proper pot settings. A rectangle with arrows represents the important mixer pots concerned with orchestra accompaniment. The circles represent the two boom mics. While this notation is correct for rotary pots only, a variant will easily suggest itself for those studios fortunate enough to employ vertical, slide-type mixing pots in their consoles.

Relative settings of all the important pots are shown at a glance by the arrow positions. If the engineer is supplied with song word sheets, important level changes can be shown throughout by quickly sketching in the rectangle and arrows during rehearsals. The arrows are best interpreted as set at the hours of the clock; the actual engraved dial setting is unimportant. If the boom pots need critical adjustment at the same time as orchestra pot changes, simply add the circles to the right of the rectangle, and write in the name of the person the boom is on at the time.

With the hands so busy with mixing, a foot-switch of the type used with certain home appliances can be an asset to a busy engineer. This switch should be tied in par-



allel with the talk-back or boom-cue key on the console, so that the boom operators can be cued in at important transitional points during the show, and without having to release a hand to operate the key. The addition of the foot-switch can do wonders for the smoothness of boom positioning, since communications with the operators is instantly available without fear of jeopardizing other mixing chores.

### Familiarity with Music Helps

While a good memory is an im-

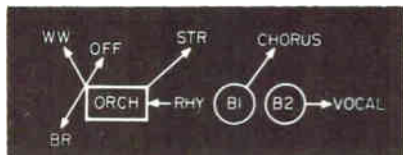


Fig. 3. Typical Script or Cue Sheet Shorthand.

portant factor in mixing of any kind, let us stress that an understanding of music is the most valuable asset an engineer can have, since so much of today's mixing is directly concerned with broadcasting music. There is nothing to be gained by assigning an engineer who normally spends his scheduled hours handling dramatic shows, telecine cut-ins, or news shows to a big musical extravaganza, unless he is musically competent. A man who knows music will have a feeling for what is coming next, even if he is not familiar with a particular number, and he can automatically anticipate dynamic level changes and vocal entrances.

In the pickup of a symphony orchestra on TV, the word mixing is almost a misnomer, since fewer mics are used in an ideal setup. The less the manipulation of the

mic pots, the more natural the dynamic realism, assuming room acoustics are a help and not a hindrance. Touching up accent mics to go with changes in camera shots may be necessary and should not be ignored. There is nothing worse to a classical music lover than to see a close-up of the woodwind section and to hear the incongruous sound of an overall, distant pickup. If the audio engineer cannot follow a score, the production personnel should see that he is cued in ahead of the camera switch.

By contrast, popular music mixing techniques continually call for compression of the dynamic range, and the general musical balance is, to a considerable extent, taken

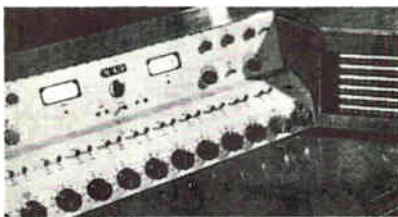


Fig. 4. Typical 2-Channel Console with Rotary Mixing Pots.

out of the hands of the musical conductor and placed in the hands of the studio engineer. If he is astute, the relative levels between accompaniment, vocalists, and announcers are kept uniform, without obliteration of one by the other, and as a bonus, the radiated power at the transmitter is commercially efficient. A second method of dynamic range compression involves the well-known but improperly understood compression amplifier. Since the use of such a device brings up certain other system philosophies and problems, however, suffice it to say that the newer, slow-attack, medium-re-

covery compressors are best suited for regular studio use. Fast-attack, shelving-curve compressors belong in the transmitter, serving as peak compression units.

### A Comparison of Two Board Layouts

A brief look at two radically different formats in mixing consoles will serve to provide both engineering and management with food for thought. While stereophonic audio is at present limited to FM, multi-channel mixing consoles for TV have real merit when tied in with cut-in studios, telecine, and VTR feeds, etc. Provisions for other flexible

illustrates a typical custom facility of two channels, utilizing rotary mixing pots and conventional lever keys for channels and hi-level input switching. By contrast, the console of Fig. 5 includes a much more comfortable, virtually horizontal control panel with vertical slide-type mixing pots; "glass-arm" effects are definitely minimized on a long show. The vertical pots afford both stepless mixing and instant visualization of relative settings. Three to four pots can be mixed simultaneously with each hand, since the knobs are finger wells and slide very smoothly. The technique of mixing with these pots is as easily learned as "Chopsticks" on a piano!

This console contains 12 microphone inputs, and a total of fifteen hi-level inputs connected to three separate mixing pots. All inputs can be switched via illuminated, color-coded push buttons to the three mixing busses. Compression is available on each output channel and is metered, as are the three isolated echo send facilities. Modular, in-line spacing of all important controls on  $1\frac{1}{2}$ " centers allows these fairly extensive facilities to be encompassed in a main control panel only 32" wide by 20" high. Every control on the console is within easy reach of the engineer. The possibilities for operational errors have been reduced to a minimum.



Fig. 5. Horizontal Control Panel with Slide-type Mixing Pots.

features such as individual microphone equalizers, echo feed pots, and bus switching should and must be considered for enlarged and flexible operations.

The console pictured in Fig. 4

# ***FM Overmodulation: Cause & Cure***

By Harry A. Etkin

**W**ITH THE continued improvement in recording and FM broadcasting equipment, the increased use of special equalization effects by recording artists and studios, the differences in microphone equalization and response, and the use of close microphone techniques, the high frequencies fed into FM broadcast transmitters are often of sufficient amplitude (after pre-emphasis) to cause serious overmodulation problems. The increasing number of incidents of FM overmodulation, and the resultant FCC citations, indicate a real need for corrective actions.

## **Why Does the Problem Exist?**

Normally the lower frequency component of an audio signal is amplified more than the higher frequencies. This occurs at every step between the input equipment and the transmitter, unavoidably adding a high frequency noise to the desired audio signal. As a result, the signal-to-noise ratio is low at the high frequencies. Where the audio spectrum from 50 to 15,000 cps is utilized, a situation such as this cannot be tolerated.

To improve signal-to-noise ratios, various methods of equalization and pre-emphasis are employed. Pre-emphasis—increasing the amplitude of high frequency

audio signals before they are fed to the transmitter—reduces the unfavorable relationship between high frequency audio and high frequency noise. High frequency program signal is increased, while the high frequency noise level remains the same, improving the high frequency signal-to-noise ratio.

However, as signal-to-noise ratios increase, equalization or pre-emphasis can actually result in signal degradation due to distortion brought about by the excessive high frequency signal levels that are forced through the various amplifiers. The main reason for the equalization and pre-emphasis network is to make sure that high frequencies are not blocked out by the inherent noise characteristics.

Since there is less energy in the upper section of the 50 to 15,000 cps region than there is in the portion below 1,000 cps, a 75-microsecond pre-emphasis curve was adopted by the FCC to take advantage of this distribution. Fig. 1 illustrates the standard pre-emphasis characteristic curve. The solid curve shows a flat response below 200 cps; at 1,000 cps the gain rises to +0.9 db, to +8.3 db at 5,000 cps, to +13.8 db at 10,000 cps, and at 15,000 cps the gain increases to +17 db. In gen-

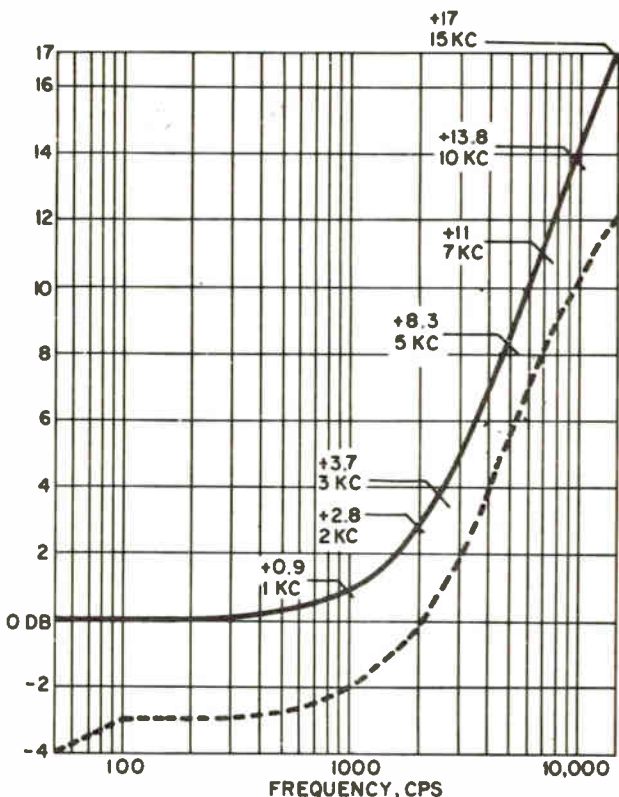


Fig. 1. Standard pre-emphasis curve. Frequency response limits are shown by solid and dashed lines.

eral, a 75-microsecond pre-emphasis curve means that amplifiers all along the audio line will be handling a 15,000 cycle signal 17 db higher than the 1,000 cps signal. If the transmission at 1,000 cycles is to be maintained at an adequate level, there is a definite probability of overloading the amplifiers at 15,000 cycles when using the 75-microsecond pre-emphasis.

### What are the Causes?

The FCC standard pre-emphasis curve is quite severe. When this curve was adopted, FM programming was not too competitive and the FM broadcaster usually oper-

ated the transmitter with low values of modulation to allow the transmission of the full dynamic range of recordings. The standard practice for FM broadcasters was to operate at a low modulation level without the use of peak limiting amplifiers. Although limiters are being used today, more FM stations are still being given citations for overmodulation. This has led many engineers to the conclusion that limiters were not operating correctly. However, tests showed that they were operating on a flat response curve, and the high frequency signal fell below the threshold of limiting. Overmodulation is caused by pre-em-

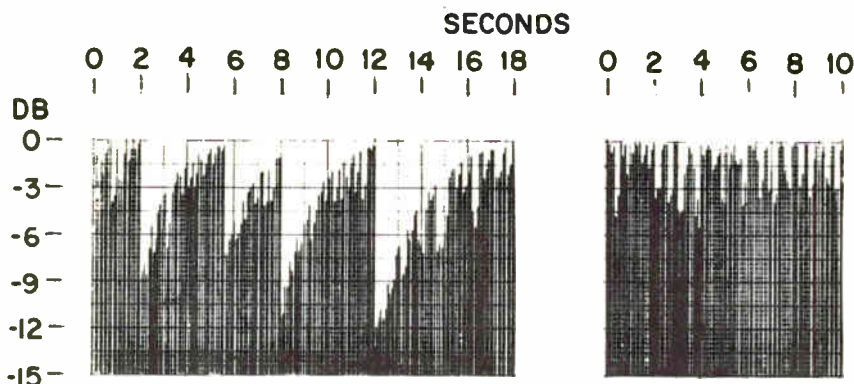


Fig. 2. Typical limiter operation with pre-emphasis ahead of the limiter. The same signal without pre-emphasis is on the right.

phasis of the audio signal *after* it passes through the limiter.

A limiter cannot always handle the complete job of loudness and level control. High-amplitude, high-frequency signals can trigger the limiter and cause a drop in overall program level, balance, and loudness. Where the limiter is inserted *after* pre-emphasis, it will be particularly susceptible to this triggering with a reduction instead of an increase in signal strength. This method of operation can limit the high frequencies as well as the mid-range and low frequencies. If the program level is maintained well below the threshold of limiting, acceptable program levels will be produced. However, some programs will cause unnatural effects, as shown in Fig. 2. The results shown are for a limiter with an attack time of approximately one millisecond and a 90% recovery time of about two seconds. When the pre-emphasized high-frequency peaks exceed the threshold of limiting, gain at mid-frequencies is reduced. Thus, the de-emphasized signal sounds like the limiter is undergoing a blocking-type of oscillation; the gain suddenly drops,

then recovers on the normal RC slope. This type of programming will produce a large group of complaining listeners. The right side of Fig. 2 shows the same signal without pre-emphasis.

If the limiter is placed before pre-emphasis, and if it is not triggered by high frequency peaks, the pre-emphasis can cause transmitter overmodulation with all its distortion and problems. Live studio programs, music, and other recorded sounds containing applause, percussion noises, finger-snapping, clinking and tinkling of glasses and keys, tap dancing, and other peaked high frequency sounds (when combined with program music or speech) will cause transients that will trigger the limiter and actually cause an attendant gain reduction. If the high-frequency content of music and other recorded sounds never exceeded the curve in Fig. 3, the limiter signal could be fed into the FM transmitter pre-emphasis network without causing overmodulation. However, present day microphone techniques and orchestration, combined with RIAA treble pre-emphasis, often create quite impossible levels at the high-

est audio frequencies. Fig 3 is complementary to the standard pre-emphasis curve and can be used in the FM receiver to de-emphasize the signal to restore the original frequency response. It can be seen that overmodulation will result if the high frequencies exceed the limits of the curve shown by the shaded area in Fig. 3.

FM transmitters are designed to tolerate extensive overmodulation with a minimum of distortion. However, considerable overloads can swing the carrier beyond the maximum  $\pm 75$  kc limit. A 6 db

peak power measured from many types of programs broadcast from a typical FM station. During these measurements, the limiter was set up for a constant mid-range level. The very high and very low frequency peaks occurred much less frequently than the intermediate high and low frequency peaks. Yet, these peaks show why broadcast stations are being given citations for overmodulation. From this study the broadcaster can assume that every FM broadcast station, without preventive overmodulation systems, will produce a peak power distribution

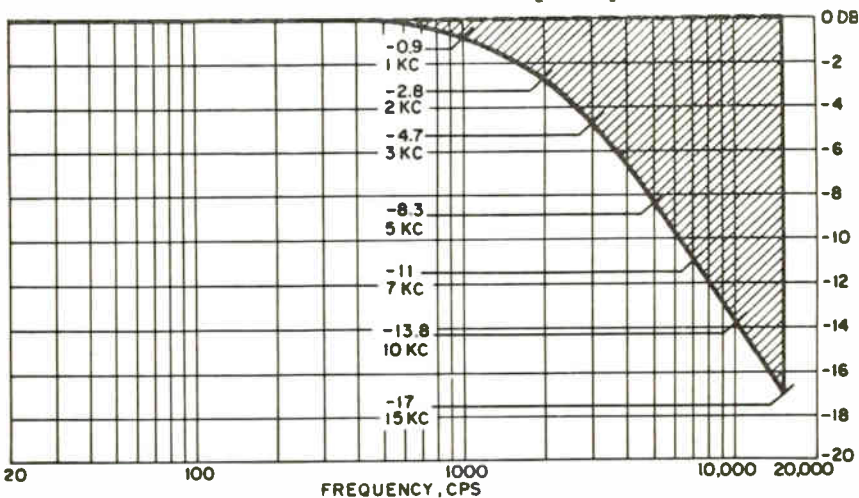


Fig. 3. Standard FM receiver de-emphasis curve.

program peak with low percentages of modulation will produce a carrier swing to  $\pm 150$  kc, which is well beyond the allowable limit. Numerous measurement studies, using spectrum and wave analyzers, have been made.\* The data provides a typical peak power distribution curve, as shown in Fig. 4. This is a composite curve of the

curve that will equal or exceed Fig. 4.

To reduce the excessive accelerations which occur at high frequencies, many FM stations simply reduce the modulation level to an average of 50%. This practice reduces the average program power output to one-quarter of the maximum allowed (Fig. 5.) The curve indicates that no overmodulation occurs below 5,000 cycles, but it is possible to overmodulate the transmitter as high

\*Study measurement data developed and compiled by Gates Radio Co., Advanced Development Engineering Dept., Quincy, Illinois.

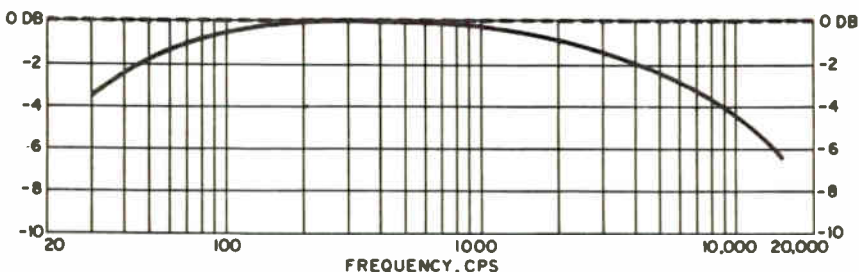


Fig. 4. Typical peak power distribution curve at limiter output.

as 70% at 15 kc. The 10-kc portion of the curve shows that overmodulation can exist up to 150%. Thus, even though the mid-frequencies are controlled by the limiter, the transmitter should be operated at a lower level of mid-frequency modulation to prevent high frequency overmodulation.

Even with 30% modulation, signals containing sharp transients could still cause more than 100% modulation at high frequencies. With 30% average modulation, the program power output of the FM station is approximately one-tenth of the maximum power allowed. In general, operation with very low modulation levels is not very practical because many of the peaks which cause the reduction in modulation are so great that

many FM receivers will not pass the signal and listeners are usually incapable of hearing it.

### What Are the Cures?

The most logical approach would be to eliminate the necessity of pre-emphasizing FM signals in the transmitter. The great hardship in achieving this objective is to have the set manufacturers modify receiver circuitry.

Since this isn't immediately practical, corrective measures must be employed. One method is to install a low pass filter which will cut off all signals that fall on the slope of the filter curve (Fig. 6). This actually results in signal degradation just to protect the station from a relatively few in modulation are so great that overmodulation peaks. Thus, the

### FCC Pre-emphasis Regulations

Paragraph 73.317 of Vol. III of the Rules states:

1. The transmitter shall operate satisfactorily in the operating power range with a frequency swing of  $\pm 75$  kc at 100% modulation.
2. The system shall be capable of transmitting a band of frequencies from 50 to 15,000 cps. Pre-emphasis shall be employed in accordance with the impedance-frequency characteristic of a series inductance resistance network having a time constant of 75 microseconds. The deviation of the system response from the standard pre-emphasis curve shall lie between the two limits as shown in Fig. 1. The upper of these limits shall be uniform (no deviation) from 50 to 15,000 cps. The lower limits shall be uniform from 100 to 7500 cps, 3 db below the upper limit; from 100 to 50 cps the lower limit shall fall from the 3 db limit at a uniform rate of 1 db per octave (4 db at 50 cps); from 7,500 to 15,000 cps, the lower limit shall fall from the 3 db limit at a uniform rate of 2 db per octave (5 db at 15,000 cps).

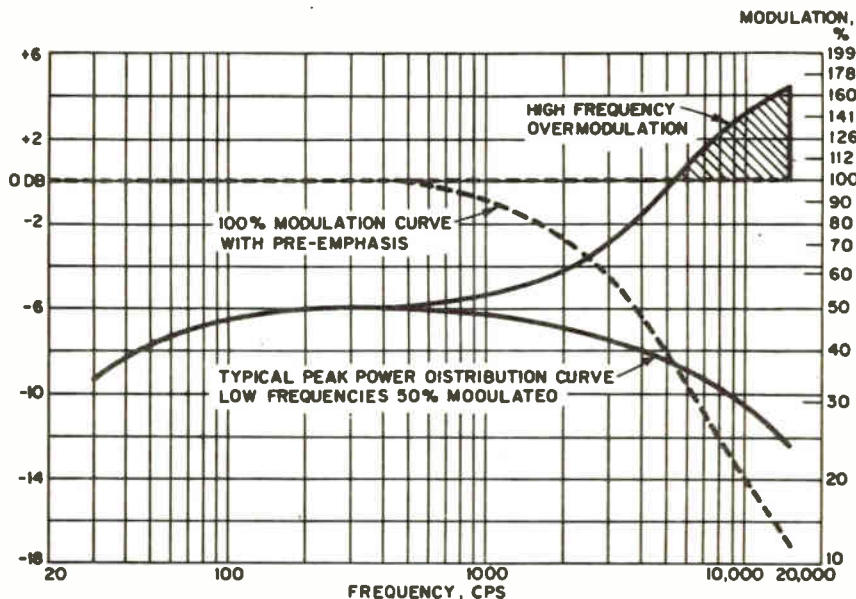


Fig. 5. Typical peak power distribution curve at 50% modulation.

low pass filter is not the cure for the overload problems.

Another method of controlling the high frequency peaks, developed primarily for the disc recording industry, pre-emphasizes the program material, acts upon the troublesome high frequency

signals, and de-emphasizes in a complementary manner to give an overall flat output. Although this type of operation can eliminate overmodulation in most cases, it can cause gain reduction at all frequencies above 600 to 900 cycles with some resultant signal degradation.

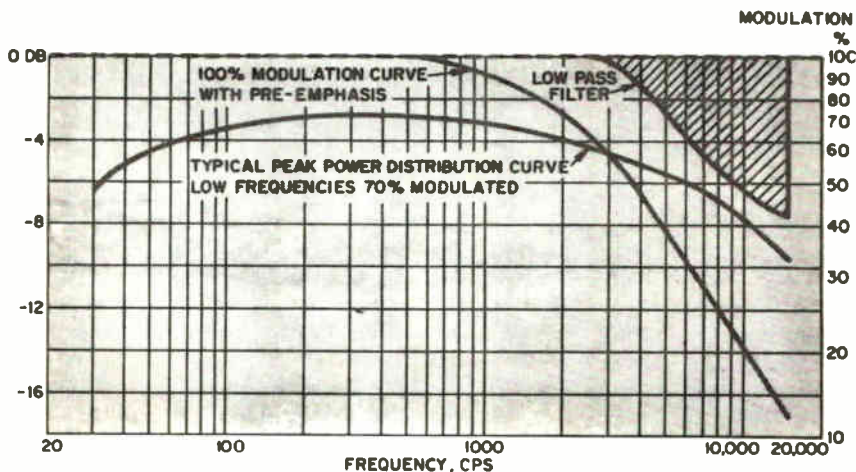


Fig. 6. Performance of low-pass filter.



When a limiter is installed in the system ahead of this unit (with low frequencies controlled to approximately 90% modulation), the resultant signal will contain a small amount of overmodulation in the 1100 to 1200 cycle area. There will also be

one another ideally, permitting a higher average level of program material and preventing overmodulation on sudden program peaks (Fig. 8).

The program material fed from the limiter into the automatic level control unit is pre-empha-

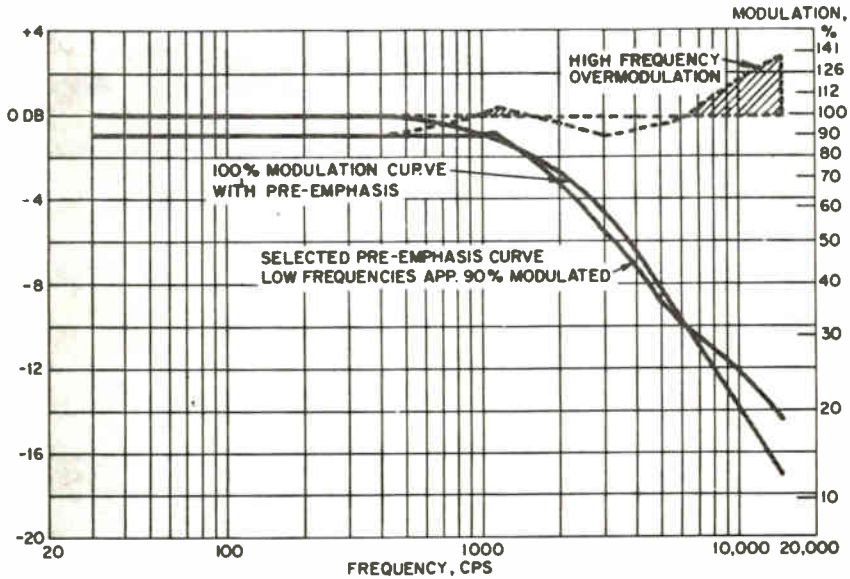


Fig. 7. Results of a typical selected pre-emphasis curve.

overmodulation peaks above 6500 cycles which may rise to 130% at 15 kc. Peaks are also produced in the 2 to 5 kc region (Fig. 7).

The most economical approach is to use a device that is most advantageous from a coverage standpoint—a unit which automatically controls the audio levels. The automatic level control is intended for use between the limiter and the FM transmitter. It is designed for both stereo and monaural service and can maintain a relatively constant output, much in the same manner that an operator might, by carefully and constantly riding gain on the program. The automatic level control unit and the limiter supplement

sized with a standard 75-microsecond curve; the sudden program peaks that exceed this curve are clipped off. The signal is then fed through a standard 75-microsecond de-emphasis curve to give an overall flat response. The overall response, shown in Fig. 8, is +0.2 db at 10 kc, -0.2 db at 15 kc, and essentially flat below these frequencies. Average modulation as high as 98% can be obtained without overmodulation. In operation, only those peaks which would cause overmodulation are affected, and they are generally the higher audio frequencies. The attack and release time is instantaneous for immediate and continuous protection,

and there is no deterioration of the dynamic range in program material.

### Costs

Since stereo is becoming a

costs, and boost power output at least eight times. More importantly, better control of program quality is maintained. By expanding effective range and improv-

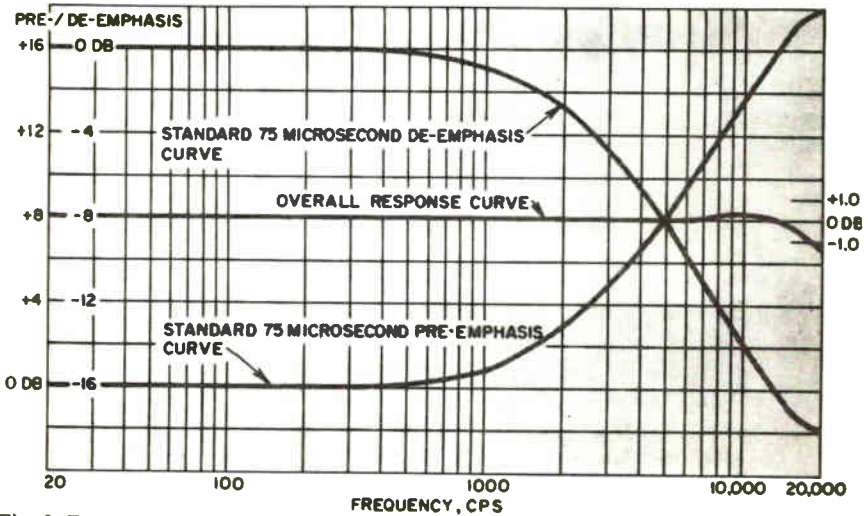


Fig. 8. Test data curves from an automatic level control unit.

standard practice with FM broad- casters, limiter and automatic level control units should serve both purposes. A dual peak limiting amplifier costs from \$900 to \$1,000 and the automatic level control unit runs between \$500 and \$600 (not including installation costs). The combined use of these units will improve program and commercial production, cut

ing reception, it should bring in extra advertising revenue.

The use of a peak limiting amplifier and automatic level control unit inserted between the audio system and the FM transmitter is the ideal approach for putting a ceiling on the high frequency peaks. Whether used for stereo or monaural, FM listeners will enjoy full range reproduction at a pleasant level.

# Making Use Of Limiters & Compressors

By Philip C. Erhorn

ARE YOU interested in improving your market coverage, perhaps at low cost? Are levels of your TV film features either too loud or too soft? Are line feed levels apt to be most unpredictable? Do you still get some of those complaints about loud commercials? Do you know the main differences between compressors and peak limiters, and how to use them to best advantage?

There are undisputably many useful applications for audio compression, but there is also a great

deal of confusion. To learn how audio compressors and limiters can be best applied to your own operations, read on.

## Limiters vs. Compressors

Certainly in any discussion of this sort, the first consideration is to point up the basic differences between compressors and limiters. This one area has been the cause for many cases of misapplication, to the detriment of the broadcast signal, with accompanying disappointment to both

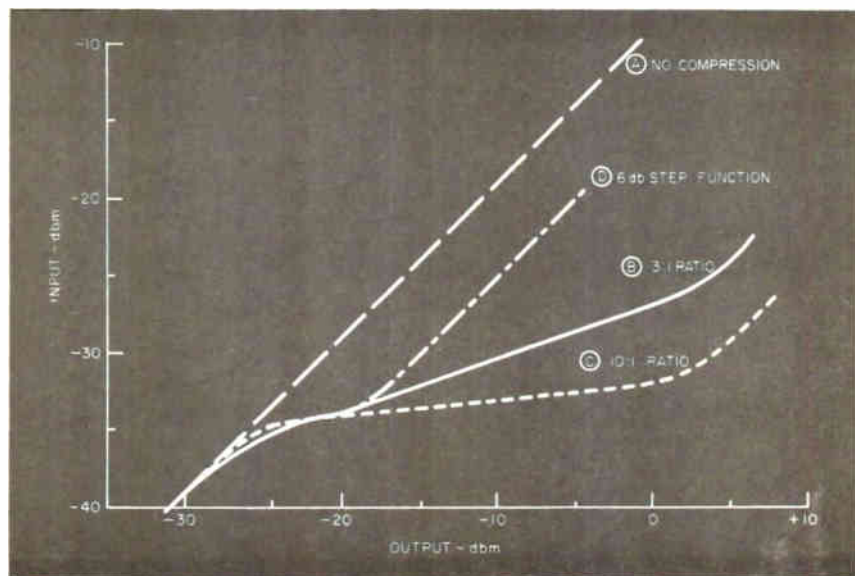


Fig. 1. Gain curves illustrating typical compression characteristics.

engineering and management. In Fig. 1 Curve A illustrates a linear input/output relationship, or no compression, whereas Curve C shows the shelving-type compression achieved with typical peak limiting devices. While the compression ratio shown is 10:1, which means that for a 10 db increase in input signal the output increases but 1 db, compression ratios of 30:1 are not unusual for peak limiters.

Peak limiters offer a very fast attack time, typically on the order of a few hundred *microseconds*, some even faster. Abrupt loud program passages and steep wave-front transients of high amplitude will be caught quite effectively by the peak limiter, and held to a level which, while perhaps briefly audible, does prevent overmodulation and splatter. Thus, there is no doubt about the value of the peak limiter at the transmitter site.

However, the use of such a fast attack, severely-shelved compression characteristic, as a method for increasing modulation density, would be highly objectionable to the listener. The dynamic volume range of music would sound squelched to an unnatural degree. A brass or tympani forte would be completely frustrated by the shelving action of the limiter curve.

Curve B of Fig. 1 illustrates a compression curve which, from a listening standpoint, is much less objectionable than Curve C. Note that the knee is less abrupt, and the compression ratio of 3:1 is more gentle in action. As a matter of practical fact, 20 db or more of compression of this type can be used without the listener being aware that considerable compression is in use. Moreover, average modulation level would be increased considerably, with an accompanying increase in effec-

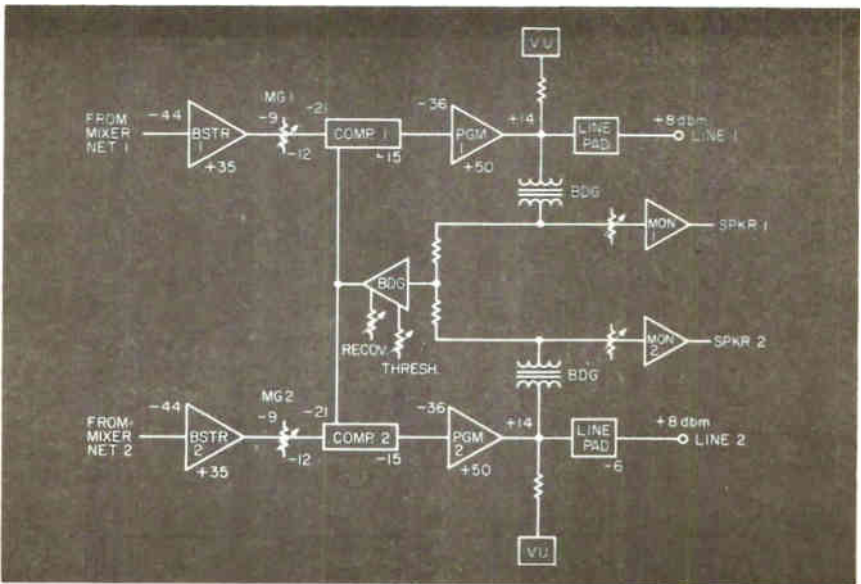


Fig. 2. Typical stereo mixing console detail showing insertion of LDR compressor with single control amplifier.

tive radiated power on AM and chart. These units are all designed for rack mounting at the trans-

mitter. The two solid-state designs use quite sophisticated circuitry for at least two logical reasons. The first involves elimination of conventional audio rectification to control the gain of a variable-mu tube. There are no variable-mu transistors as yet! The second is based upon other advances in circuit technology of be inadequate. Let us continue a bit further in this vein.

There is another aspect of compressors and peak limiters which is quite important, and this is the release time, or the finite time it takes for the device to recover from a considerable degree of compression. If the device recovers too rapidly, the abrupt up-and-down variations in program level produce the familiar "pumping effect," quite objectionable to the ear. When coupled with a fast attack time and adjusted for plenty of compression, a slow release time will chop distinct holes in the audio if triggered by severe level changes such as pistol shots, audience reaction, or an excited announcer. The recovery time of either a peak limiter or a compressor should be adjusted to the nature of the program. But remember that despite fancy names, the recovery circuit is basically a capacitor discharge curve, and the charging voltage is a direct function of program level and degree of compression used. While this obviously offers some degree of program-controlled recovery, there is no optimum release time setting for all program types.

### **Transmitter Applications**

Most of the peak limiters currently available, or in current use, are listed in the accompanying

ed for rack mounting at the transmitter. The two solid-state designs use quite sophisticated circuitry for at least two logical reasons. The first involves elimination of conventional audio rectification to control the gain of a variable-mu tube. There are no variable-mu transistors as yet! The second is based upon other advances in circuit technology of be inadequate. Let us continue a bit further in this vein.

All of the units except one provide considerable gain, which must be taken into account. The studio line is delivering +8 dbm, and the transmitter audio circuits require nominally about zero dbm for full modulation. Therefore, much of the gain supplied by the peak limiter must be dumped, or it will adversely affect signal/noise ratio and overall distortion. Because physical size is not a very significant factor in rack-mounted gear, the choice of tube-type or solid-state design is a matter of weighing circuit features and convenience controls vs. price. While we are all familiar with the reliability of well-made tube equipment, solid-state devices have a definite edge in freedom from annoying maintenance problems, and their stated characteristics do not change as easily as tube equipment.

Only two of the listed units are supplied for FM stereo in one integrated package. Where two independent units must be purchased, they must be connected so that the degree of compression and the time constants are identical. Otherwise, the stereo effect will be degraded.

### **Compressors—Basic Considerations**

The compressor section of the

chart shows that many compressors, unlike peak limiters, have a slow attack time. "Slow" may be catalogued in the range of a few milliseconds to 30 milliseconds or so. There is no denying that a fast attack time is desirable, to catch virtually any kind of level peaks, whereas a slow attack time will let the initial part of the peak through before the compressor takes over. However, the point to remember is that once into compression, attack time is relatively immaterial. Indeed, a slow attack time at this point prevents the device from instantly responding to a greater transient peak which would obviously drive it into further compression. Thus, the slow attack provides a "gain platform," and avoids rapid response to instantaneous large program peaks once a reasonable degree of compression is achieved.

It can be stated with some authority that a fast attack time is generally accomplished with sophisticated circuitry, which will cost more than a lesser complicated slow-attack circuit. The so-

called "zero return" feature is basically a function of the R/C time constant in the release, or recovery, circuit. Depending on the setting of the release time control, partial recovery can be rapid, with complete recovery to full gain dependent upon the degree of compression used and the nature of the program material, as well as the time constant.

### Compressor Amplifiers

Of the various compressors listed in the chart, all but two include an amplifier in the package. Thus, in addition to method of mounting and power supply requirements, you must also consider how to cope with the amplifier gain. Two of the peak limiters listed also appear in the compressor section. They are optionally designed to do a dual job, accomplished by adjusting the several controls as directed in the instruction manuals.

Several of the units are designed for rack mounting and are self-powered from a 117v source. If they are wired to fol-

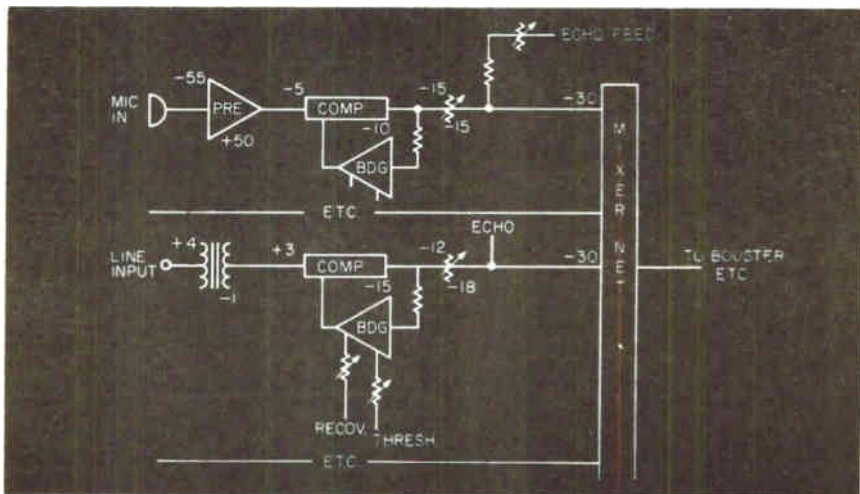


Fig. 3. Abbreviated system showing LDR compressors inserted in input circuits.

low the usual console output, gain must be dumped, except to make up for compression losses. The maximum output capability of a few is borderline if used in place of the regular console program amplifier.

Some of the compressor units are designed for plug-in console or rack-shelf mounting, and require an external power source, such as the console supply. Obviously, these units can be readily substituted for the console program amplifier with little problem. If they do not already match the mounting system of the console amplifiers, it is not difficult to accommodate them within the confines of the console shell. Their gain and input level requirements have been made compatible for direct substitution with regular program amplifiers, and they do an adequate job of compression at reasonably low cost. Unfortunately, these units do not lend themselves to stereo use, as they are not normally supplied with a means for ganging compression and time constant characteristics. If identical but isolated units are placed in each stereo program channel, the one which is driven hardest by a program peak will compress more than the other (and will take longer to recover). This tends to degrade the stereo effect at the listening end.

### **LDR Compression Devices**

It is difficult to state the case for the new LDR (light-dependent resistor) compressors without sounding prejudiced in their favor. They have many practical advantages over more conventional compressor amplifiers, and only one significant disadvantage. An LDR is a type of cadmium sulfide or cadmium selenide photo-

cell that greatly varies in resistance depending upon the amount of light which reaches it. This simple component therefore lends itself admirably to applications for controlling gain in an amplifier or in a system. It is easily adapted for remote control.

The LDR cell, if properly manufactured, contributes no noise to the circuit in which it is inserted, assuming that its net output level after compression is not so low as to be below the system input noise. Distortion is a function of the nonlinear resistance characteristics of the cells. Typical measurements show 0.5% THD or less at +4 dbm output after 20 db of compression. The distortion is below 0.1% THD when the LDR is inserted at typical internal system points, such as those shown in the block diagram of Fig. 2. Insertion loss is no more than 3 db when looking into a 600-ohm load, and less than 1 db when looking into the non-loading input of some amplifiers.

The single fault with LDR's lies primarily in the light source. An incandescent light has a very definite thermal characteristic which delays activation of the cell. This means that for compression (gain reduction) use it must be classed as a slow-attack device when driven by a conventional lamp. If the lamp is powered by AC, ripple voltages will be superimposed on the audio circuit which the LDR is controlling.

Of course, the answer to thermal delay caused by the lamp is to use an electroluminescent source, and this has been done successfully in the Teletronix Model LA-2A. This rack-mounted unit utilizes an LDR ahead of a conventional amplifier, and although it is available adapted for

stereo, its gain must be taken into account as mentioned earlier. Although called a leveling amplifier, this unit can also be used as a peak compressor because of its fast attack time.

Two other units, the Melcor Model C-20 and the Fairchild Model 663, offer unusual versatility if you consider adapting them to existing systems or designing them into new systems. Attack time of about 15 milliseconds is a function of their incandescent light sources. Because these units have no gain to contend with and virtually no insertion loss, and also because they are packaged for control panel mounting, they are unusually easy to incorporate into an existing system.

### Applications

In the block diagram of Fig. 2, a typical portion of an FM stereo mixing console is depicted. The two LDR's (labelled Comp. 1 and Comp. 2) are inserted between the master gain controls and the program amplifiers. System levels are indicated, including 15 db of gain reduction due to compression. The common light amplifier is bridged off the output of the program amplifiers through a resistance network to insure proper stereo isolation; at the same time it allows sufficient driving level to accomplish compression.

As the two LDR's are included in one compressor module (as many as 4 are possible), each channel will be compressed the same amount, regardless of which has the higher program level, and the common light amplifier provides the same time constant and controls. Because the threshold adjustment is a panel control, we can take advantage of a feature

not normally available in many other units. Without disturbing the system levels existing at the point of insertion, the threshold can be adjusted so as to start compressing below this level. If we assume that we are only interested in compressing levels above normal, there will be little need to adjust for compression loss.

The LDR compressors, as with many others in the list, act upon average program content rather than peak program energy. They may be set for some degree of compression at all times. During periods of prolonged levels which fall below the compression threshold, expansion back to normal system gain will take place, depending on the setting of the release time adjustment, a panel control. However, background noise will never be any higher than normal system noise, as there is no extra gain supplied. Adjusting the units to deliver a specified curve is simply a matter of strapping terminals or changing a resistor. The step-function curve of D in Fig. 1 is possible for those applications where compression is wanted only over a 6 db range, with return thereafter to a linear gain characteristic.

By raising the gain of the announce mic channel and adjusting the compression threshold appropriately, the program can be made to fade down under the announcer (sometimes called "ducking"). It will automatically fade back up again after he stops talking. The fade-up time is set by means of the release time control.

### Input Channel Uses

There are many compressor applications where it is undesirable



### Peak Limiters

Manufacturer & Model	Attack time	Release time	Max. Output Capability	Gain db	Solid State	Compression Meter
Bauer 920 Peak Master	fast	unstated	+24 dbm	24-34	no	yes
CBS Labs Volumax	fast	unstated	+20 dbm	50	yes	yes
Fairchild 660/670	fast	300 msec- 25 sec	+22 dbm	16	no	yes
Gates M-6144	fast	unstated	+24 dbm	63	no	yes
Northern Electric PCA-1	fast	500 msec- 8 sec	+18 dbm	50	yes	yes
Universal Audio 175-B	fast	27-527 msec	+24 dbm	24-34	no	yes

### Compressors—AGC Amplifiers

Altec 436-C	slow	300 msec- 1.3 sec	+24 dbm	40-56	no	yes
CBS Labs Audimax III	unstated	10 sec	+25 dbm	50	yes	yes
CCA Electronics AGC-1D	slow	5-15 sec	+20 dbm	60	no	yes
Fairchild 663	slow	300 msec- 7 sec	+25 dbm	none	yes	yes
Fairchild 660/670	fast	300 msec- 25 sec	+22 dbm	16	no	yes
G.E. BA-29A	slow	1 sec	+30 dbm	72	yes	no
Gates Level Devil	slow	1.5-2 sec	+14 dbm	50	no	yes
Grass Valley 641-R	fast	200 msec- 1 sec	+27 dbm	40-60	yes	yes
Langevin AM-5301	slow	500 msec- 3 sec	+26 dbm	53	no	yes
Melcor C-20	slow	250 msec- 8 sec	+20 dbm	none	yes	yes
Northern Electric PCA-1	fast	3-90 sec	+18 dbm	50	yes	yes
RCA BA-25A	slow	1 sec	+30 dbm	70	no	no
Teletronix LA-2A	fast	60 msec- 5 sec	+10 dbm	40	no	yes

to have the entire program essentially controlled by the level from one troublesome source. Because of its small size and low relative cost, the LDR compressor is logically adaptable to permanent insertion in several microphone or high level console inputs. Or several can be set up on jacks and patched in as needed. In this way any input with controversial levels may be individually compressed, and the compression characteristics adjusted to suit each one.

The abbreviated block diagram of Fig. 3 shows a typical system with a compressor inserted following a mic preamplifier, directly in a high level input line from another studio, a VTR, turntable or tape machine. Typical levels are indicated. Some compression at all times will relieve the engineer from tedious gain riding, and program levels will be definitely improved. Note that the input for the bridging light amplifier is always taken from the output side of the LDR. This forms a closed loop system, providing adequate stability and predictable compression curves.

### Special Devices

There are a few other available devices which are intended to solve or alleviate certain annoying audio problems. The Gates "Top Level" and Fairchild "Conax" are both designed to control splatter and overmodulation in FM transmitters caused by HF pre-emphasis. They logically are inserted between the peak limiter and the transmitter, where the

75 microsecond pre-emphasis network is in the transmitter. Considering the great amount of high frequency energy present in today's live and recorded (and equalized) program sources, these units will help to provide an increase in apparent loudness of the FM signal.

While these same components can also be applied to recording, which involves considerable HF pre-emphasis, two other devices are also of particular interest for tape recording. The EMT "Nois-Ex" and the Fairchild professional "Compander" are capable of not only compressing the dynamic range while recording, but also supplying complimentary expansion on playback. The net result is claimed to be an impressive improvement in signal/noise ratio.

### Summary

The foregoing is based upon the author's personal experience in testing and using several of the listed units. The information provided should be sufficiently practical to make a choice easier and to help guide in installation, considering both advantages and disadvantages. The emphasis on LDR compressors has been included only because they offer unique deviations in application.

By combining compression in the studio console with peak limiting at the transmitter, many annoying problems can be thoroughly alleviated. As increased market coverage is achieved at the same time, this is certainly a desirable mode of operation.

# PRODUCTION & RECORDING

## KEY TO STATION IMAGE

by Charlie Buffington

**P**RODUCTION, to most local stations in the early days of radio, meant the painstaking assemblage of various program constituents, such as orchestras, announcers, actors, etc., and combining their talents into a flawless musical, dramatic, or informational showcase designed to invigorate the listener's imagination and demand his rapt attention.

Back in those days, most stations depended heavily on a network for the bulk of their programming; the local staff had only to cut an occasional acetate disc and produce local news and sports programs. The overall sound of a station was pretty much determined by its network affiliation, and to a lesser degree, by a handful of local personalities.

As dependence on network programming diminished, and as the number of stations on the air increased, the evolution of the present music-news format began, thus requiring stations to produce their *own* sound. It has been, to be sure, a slow tedious process, but during the past few years

many stations have developed, or *produced*, a sound which is at least comparable to that of early network production — a sound which emanates excitement and drama in an amalgamation of music, commercials, news, and other features.

The techniques of producing commercials and other announcements, recording music, and producing news and sports programs, require the unfaltering effort and limitless imagination of a station's staff. The only alternative sound is that of an overgrown juke box with an announcer disinterestedly repeating record titles and artists names and *reading* commercials and news—a sound which does little to the listener's imagination and demands little of his attention!

### Where Do You Begin?

A fertile production department must be comprised of competent people and good equipment. Let us hasten to add, before anyone says, "I can't afford it," that this does

not mean buying a "package" of new people and new equipment. It would indeed be a rare case where there aren't any talented staffers with some imagination, and where there isn't any equipment other than that used for actual on-air programming. (Day-timers can even use equipment at night.)

In most cases, the only *full time* production people are copywriters and, perhaps, a production director. In most smaller stations, particularly, the production director and announcers double on the air. Therefore, the personnel cost of a good production department is within easy reach of any station.

Equipment requirements vary widely, from the bare essentials of a turntable, a small console (a remote amplifier, for example), a mic, and a tape recorder, to elaborate facilities with multiple turntables, multichannel consoles, mics, reel-to-reel tape machines, cartridge tape machines, and even sound-effects machines.

Production aids add to the quality and versatility of a production department. You can get by with music from the record library, or you can subscribe to a jingle service complete with logos, sigs, etc. However, the best jingle service is worthless if the staff and equipment are inferior or inadequate.

The old admonition "Start small" can surely be adopted by the beginner; he can start with the bare essentials and build as time and money permit. There is one certainty; dollars wisely invested in good production (people, equipment, aids, etc.) will pay off handsomely.

### **Staff Enthusiasm**

There is another vital and often

elusive element required of an efficient production department—*staff enthusiasm!* Deep within most radio people, there is some ham. Some have latent creative abilities which, when properly nurtured, can be evolved into original concepts of presentation. Thus, the potential of a good production department already may exist. The problem is bringing it out!

An experienced manager must tap the creativity within his people, using any means at his disposal—encouragement, suggestion, remuneration for above average effort, any stratagem which will "fire up" the staff.

This is not a job for a taskmaster; quite the opposite. The wise manager will create within his staff the will and the overwhelming desire to do the job right; he will instill in them the very real fact that their security, whether they own any of the station or not, depends directly on how well they do their work. In other words, the manager must give his people an incentive to go the extra step, to try a little harder—a goal taskmaster tactics will never achieve. By the same token, a manager who doesn't seem to care can hardly expect his staff to care.

Therefore, the first step for any station, wallowing in the mire of half-hearted "Well, I may as well get the job out of the way" attitudes, is to determine, or find someone who can determine, a basic concept of how the station should sound. Then, this image can be developed by the joint effort of even a small staff.

### **Developing a "Sound"**

In modern radio, developing a sound is tantamount to developing

station individuality. Primarily, station sound is decided by its *approach* and by its *format*—a *hard-sell* or a *soft-sell* approach within a music-news or talk format.

The hard-sell approach, of course, is the rapid, machine-gun style, exuding a constant, almost frenzied, "edge-of-your-seat" state of excitement. This approach places certain demands on air personnel; in addition to maintaining a "tight" sequence of various format elements (records, announcements, etc.), they themselves must sound excited, almost as if they were attempting to squeeze two minutes worth of material into one. Consequently, the hard-sell approach requires a staff capable of developing and holding high-spirited fervor.

The soft-sell approach, on the other hand, is any operational pace other than hard-sell, and isn't easily defined or categorized. It is, however, in no way less demanding (although perhaps less strenuous, physically); it does not suggest, and cannot tolerate, sloppy attention to sustaining a tight sequence of events. Air delivery can be more relaxed; general production material can be lower key, less frantic. But, the more relaxed approach requires just as much care in program element preparation as the hard-sell approach. Therefore, adopting a soft-sell sound is no easy way out of establishing good production standards; either approach is, in essence, equally demanding.

### **Production Concepts**

Once the hard- or soft-sell decision has been made, a basic tailoring-to-format job must be undertaken. No matter what the

format—rock and roll, top 40, pop-standard, country-western, concert or classical music, or all talk and news—a general production concept or set of standards must be established for newscast and sportscast production, special events production, special feature or "gimmick" production, and, of course, commercial production. The concept must fit the format (obviously, production standards would differ between classical and country-western formats).

Production concept development requires intimate cooperation of the copy staff; all material must fit the overall production aim, whether hard- or soft-sell. Copy written for rapid delivery requires different treatment than that written for a more relaxed delivery; if nothing else, more words are needed for the rapid delivery. By the same token, if the copy people are to prepare suitable material, they must have complete cooperation from the sales department, such as adequate, accurate information for the message as well as advertiser preference of background music, jingles, etc. Of course, in smaller stations, fewer people are involved in these various inter-departmental relationships; the salesman may be the copywriter and may even assist with production, which may be better in some respects.

### **Production Aids**

The life-blood of any production department is a variety of production aids. At no additional cost, a station can accumulate, by careful listening and screening of all incoming records and albums, a vast selection of musical interludes, bridges, logos, sigs, and background music. Pro-

duction aids must be carefully indexed; otherwise, the very piece wanted for a specific use will be lost in a myriad of records and albums. If the specific record or album can't be kept in a special production filing area, the desired segment can be dubbed onto tape and filed with production materials.

An alert staff can uncover many unusual and unique production aids from many sources other than records—public service and commercial ETs, tapes, etc., or even from candid tape recordings (permission to use material may be required). Aside from do-it-yourself production aids, a good jingle service, including instrumental jingle logos, is a good investment, particularly where a more uniform sound is desired. However, with or without a jingle service, the resourcefulness of production people determines, to a large degree, the success of a consistent, individual sound.

A word of caution: The tendency to over-produce is quite natural with a staff just going into, or enlarging, an organized effort. Therefore, the need for careful planning can't be stressed too much. As Bud Clain, PD of WSPR (Springfield, Mass.) so aptly states, "Production makes the copy, but creative copy makes the production. Your biggest effort should go into the copy, for it's the copy that sells the product. If you can add some frosting-to-the-cake emphasis with production gimmicks, well and good; if not, let the copy go live."

## **Production Equipment**

It is in the area of equipment that most disagreements between

management and production arise. Naturally, an aggressive, anxious staff will want good, versatile equipment. Clumsy patching arrangements and equipment combinations severely hamper good clean production. If, for example, a man can't conveniently reach all necessary controls, flawless production may be very difficult to achieve. A good, flexible recording facility comprising available equipment, used properly, may result in better material than one where the best available equipment is arranged poorly and used improperly.

A wise manager will authorize the best equipment his budget will allow, and continue to improve the recording equipment as economic conditions permit. If this intent is known by the staff, they will willingly extend themselves to do a good job; they will exert the little extra effort needed to make do with the available equipment. The feeling to be avoided is that management wants superior performance with antiquated and hazardly arranged equipment.

Also, a wise manager will insist that equipment be properly maintained to ensure best possible quality production. A rather rigid preventive maintenance schedule is vital to proper performance and long useful equipment life.

In conclusion, let us simply state that it behooves the manager of any radio station to initiate and strive for the best possible production facility, in line with the desired station image and in accordance with its economic potential. Cutting corners unnecessarily is comparable to a prizefighter with one hand tied behind him; you can't de-

liver the Sunday punch that may barely getting by or being the mean the difference between just decisive winnah!

## ENGINEERING AND MAINTENANCE

Dramatic engineering adds a vital element to recorded announcements. Long, slow fades are useless, since they are mostly offset by limiters and compressors. Sharp fades and "stings" (quickly bringing up music or jingle) are much more effective.

Consistent recording levels can't be stressed too strongly; if the level is too low, background noise begins creeping up; if it's too high, the result is distortion due to equipment overload. Then, too, a standard recording level for all production results in more reliable on-air levels.

Thorough tape erasing is essential; otherwise, you run the risk of airing an occasional blip or unerased sound. When using bulk tape erasers, adequate erasing time should be allowed for each tape (15 to 30 seconds). The eraser should be passed over the tape or cartridge in a brisk, circular, or elliptical motion, so as to cut the maximum lines of force.

Maintenance is important, particularly for tape machines. Many stations have thousands of dollars invested in tape machines, logically necessitating a religious maintenance schedule. Test tapes for head alignment, any special wrenches needed to adjust heads, and a head demagnetizer should be provided and used. Wiring harnesses for out-of-rack operation of rack-mounted machines greatly facilitates service and adjustment procedures.

Maintenance records, including notes showing normal operating and performance parameters, will aid in spotting trouble before it actually happens. For example, data might include pinchwheel tension, lever position adjustments, solenoid voltages, control voltages, B-plus voltages, etc. Armed with this data, anyone on the staff can ascertain when any piece of equipment is not operating properly.

A spare parts stock, at least for cartridge machines, may eliminate long periods of down time. Items to consider include spare motors, capstan idlers, replacement heads, power supply diodes, cartridge positioning springs, and a spare set of tubes.

A tone test tape, with 50 to 15,000 cps tones recorded on a new machine, or one known to be operating properly, periodically played on all equipment and compared with previous readings, will give advance notice of deteriorating quality.

Tape heads should be cleaned often, especially those on regularly-used machines; the best time to do this is after sign-off, at least for on-air machines.

Each tape transport mechanism should be disassembled periodically (except sealed bearings and press-fit assemblies), and thoroughly cleaned and

lightly lubricated. This procedure should include inspections for worn parts and other potential trouble spots. Vital working parts should be sparingly lubricated when required (over-lubrication brings on unnecessary troubles). A spray can of silicone lubricant is suitable for some cartridge machine brake assemblies, particularly older types. Vaseline is ideal for cartridge hub bearing lubrication.

A stereo reel-to-reel recorder can be used in some cases for master tape recording, especially where frequent copy changes (with the same production) are required. In this manner, only the copy track on the stereo tape need be re-recorded; the two are mixed when dubbing to the cartridge.

NOTE: The NAB Engineering Dept. has published standards for reel-to-reel and cartridge tape recording and reproduction. The data is essential to all broadcast engineering departments. Available from NAB, 1771 N St., N.W., Washington, D.C. 20036.

## TAILORING, MUSIC, COPY, AND TECHNIQUES

Copy must fit production music if it is to sound professional. The music must end decisively at the conclusion of the copy, not just fade out. One method of "sectioning" is to select a music cut with a natural ending; then with levels set, record the spot (music and copy) on a reel-to-reel tape. On another tape, record the last few seconds of music and the last few words of copy, making sure the copy ends at the desired place just prior to the end of the music. Next, mark, with a grease pencil, the beginning of any suitable word, preferably a word beginning with a hard sound (like D or G) on each tape. Then, splice, at the grease pencil marks, the end of the spot. On replay, the spot should sound as if the music was tailored for the copy, provided, of course, all levels were constant.

If cartridge tapes are used, the same principle may be applied, only in a much simpler way. First, the spot and music is recorded on a reel-to-reel tape, but the music is faded out just before the copy ends. Then, when dubbing to the cartridge, fade in the musical ending at the proper time (begin fade-in where fade-out begins on the tape.)

In difficult editing jobs, sounds are much easier to identify if they are recorded at 15 ips, then replayed in slow motion at 7½ ips.

Cartridge labeling can be used as an on-air production aid; in addition to cartridge number and client name, its helpful for the airman to know how the spot ends—music or voice—and if voice, the last several words. It prevents the guessing which often results in either dead air or "stepping" on spots.

Where multiple back-to-back spots are necessary, the on-air insertion of an ID jingle, or short logo or



interlude, helps break monotony and adds some measure of prestige. Logos may be any variety of lengths—5 or 10 seconds or more—to fit existing time limitations.

Unless a cartridge tape is recorded just following the splice, the danger of a blip or muffled sound will result as the stiff splice passes the head. An easy and quick method of locating the splice is to loop the cartridge tape over the capstan on a reel-to-reel tape machine with an exposed capstan. (The stopper arm must be defeated by holding it in the running position with, for example, a rubber band.) Grasp the cartridge so that your forefinger releases the cartridge brake, then push the fast forward switch on the tape machine. By watching carefully, you can stop the machine as the cartridge splice comes around. Of course, you must have a reel-to-reel machine.

Network affiliates are wise to make use of any promo service offered by the net, such as program promos recorded by net personalities. Most offer this service, tailored to your situation, if you supply the tape. If your network will supply you with copies of their themes, especially news and sports, it's wise to obtain them and use for local news and sports; this gives all news and sports a "universal" sound.

# ***Setting Up An SCA Background Music Operation***

by John J. Markovich

**A** SMALL BUT GROWING group of FM broadcasters are becoming aware that there can be *more money* in what the public *doesn't hear* than what they do hear! The key to more profit for an FM operation may be the addition of subcarrier services.

In subcarrier broadcasting, a special subcarrier is generated

and transmitted right along with the regular FM programming (whether it be standard monaural or modern stereo multiplex). Fig. 1 illustrates how subcarriers are inserted in a 200-kc FM channel. The standard home receiver will not detect the subcarrier, but in a special subcarrier receiver, the transmitting process is reversed.

The subcarrier receiver detects only the program information contained on the subcarrier. To the subcarrier receiver, the "main" program channel does not exist!

In reality, this permits the FM broadcaster, with subcarrier equipment, to broadcast two (or more) separate and (if desired) distinctly different programs at the same time. (Fig. 2).

### What Can You Do With It?

OK, so you have the legal basis for subcarrier service and the technique whereby it can be accomplished. Now what do you do with it? There may be a few exceptions in the industry, but the majority of FM broadcasters utilizing subcarrier rights do so for the transmission of continuous background music.

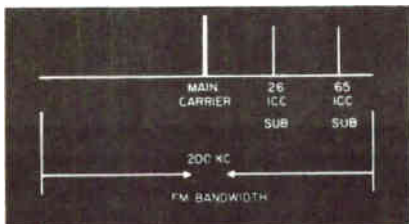


Fig. 1. The main carrier/subcarrier relationship in a standard FM channel.

Background music in the United States is a multi-million dollar industry. One background music service operator in a large Texas city grossed over \$4,000,000 last year. Another in a midwest city of around a half million residents grossed over \$2,000,000. The FM subcarrier background music service is the FM operator's passport to just this kind of potential income.

There are, at the present time, three variations in the technique of providing background music on

## FCC Rules

### 3.292 Subsidiary Communications Authorizations.

An FM broadcast licensee or permittee may apply for a Subsidiary Communications Authorization (SCA) to engage in a limited type of nonbroadcast service. These services are restricted to those involving programming consisting of news, music, time, weather, and other similar program categories. (The functional music services whereby FM stations undertake to supply programs of a predominantly musical nature to commercial establishments is an example of such an SCA service.)

a commercial basis. The FM operator anticipating subcarrier background music service should know just how each type is operated to be competitive.

### Leased Line Service

The leased line approach to background music is probably the best established technique in the industry. Fig. 3 shows how this type of system is set up. The background music company sets up a master tape deck machine in the heart of the market to be served. The tape equipment is loaded with long playing reels of prerecorded background music, which is distributed to commercial customers on lines leased from the local telephone company. In the actual building or office of the client the leased line is terminated in an audio amplifier, which in turn distributes music throughout the building on wiring installed by the background music company.

Charges (see table) are reflected as a function of how many

speakers are tied to the system on the customer's premises. In addition to the actual background music charges, the customer also pays the cost of the leased telephone line. The cost of such a line varies from state to state and from one telephone company to another, but \$2.40 per month per  $\frac{1}{4}$  mile is typical.

### Leased Machine Service

A competitive service to the leased-line approach is the leased machine, or in-plant, service. In this operation the background service operator actually places an individual tape deck (or decks) on the premises of each customer. Music is distributed throughout the building or offices on wiring installed by the operator and terminated in the appropriate number of speakers. The charge is basic—so much per month for the service plus so much per month for each speaker. This type of operator services the machines,

supplies new tapes at regular intervals, and maintains equipment.

Frequently, the operator offering this type of service also supplies a juke box. One marketing approach used by this operator is to reduce the apparent charges for the background service for permission to install the juke box. In many locations (especially commercial bars and clubs) the income from the juke box is better than the income from the background service, in which case the background service becomes a "price leader."

### FM Subcarrier

The third and newest entrant into the background music field is the FM broadcaster with his subcarrier service. As shown in Fig. 2, this service involves no leased lines and only the single tape-deck installation at the FM station or transmitter. The subcarrier receiver is installed at the customer's location, and audio

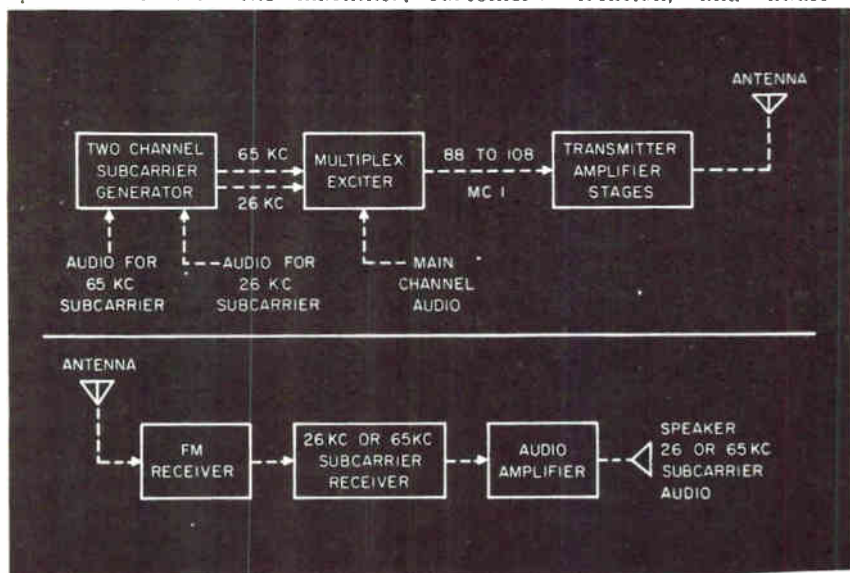


Fig. 2. Transmitting and receiving FM subcarrier signals.

## Who Do You Sell?

Most of the available background music services are programmed so as to be present but not overpowering. This music format has been chosen after considerable trial and error on the part of music suppliers, because it fits into the scheme of a truly **background service**.

A partial list of some of the better prospects for background music service is as follows:

- Professional offices (i.e. Doctors, Dentists, etc.)
- Banks
- Retail stores
- Restaurants
- Hotels, motels
- "Office" offices
- Barber shops, beauty salons
- Bars and clubs
- "Quiet" factories (electronic plants, others where residual noise is low)
- Apartment buildings
- Service districts (utility companies operating in your area)
- Stock and other types of brokerage agencies
- Large office buildings (as opposed to individual offices within the building)

## How Do You Sell

Keep in mind one important fact when selling subcarrier background service; neither you nor the customer will be required to pay line charges from a central location. This means that if your marketing area has one or more leased-line services, chances are very good that the competitive service is concentrated only in the region close to the central tape-deck location. Towns or suburbs located around the fringe of the market probably have no background service at all, thus no competition. As long as your FM signal can reach the area with a signal level of 100 microvolts or better on a dipole mounted outside the building, the area is prime prospect for your service. Weaker signal levels will still work, but may require yagi or other high gain antennas.

One very effective means of demonstrating your service is to carry a portable receiver with a built-in antenna. Leave the receiver with the prospect for a day or so and let the music sell the service for you.

Your big sales points are as follows: You provide, service, and maintain all necessary equipment. There are no line lease charges in addition to the service charge. There are no tapes or machines on the premises, and no servicing personnel dropping in every week to ten days to replace tapes. Your rates are competitive with other services, perhaps slightly lower.

(music) is distributed throughout the building on wiring installed

by the background music operator. Again, there is a base charge per month for the service, and a monthly charge for each speaker.

## Charges and Market Size

The leased-line service seems to be confined (generally) to larger metropolitan areas, say the top 200 markets. Charges are

pretty standard throughout the country, although the individual operator, of course, runs his own business and sets his own rates.

The on-premise tape-deck operator tends to be a local operator in smaller markets where leased-line service does not operate, or in a small portion of a larger market. Because maintenance costs, the actual distribution of tapes, and other factors increase the cost of doing business in this type of operation, his charges

unloading of the tape machine) with his regular personnel. He must buy or lease the receivers, service and install them and the associated audio amplifiers, and install wiring and speakers.

### Lease or Operate

The question now becomes: Should you operate the subcarrier service through the FM station, and run the background music operation, or should you lease the

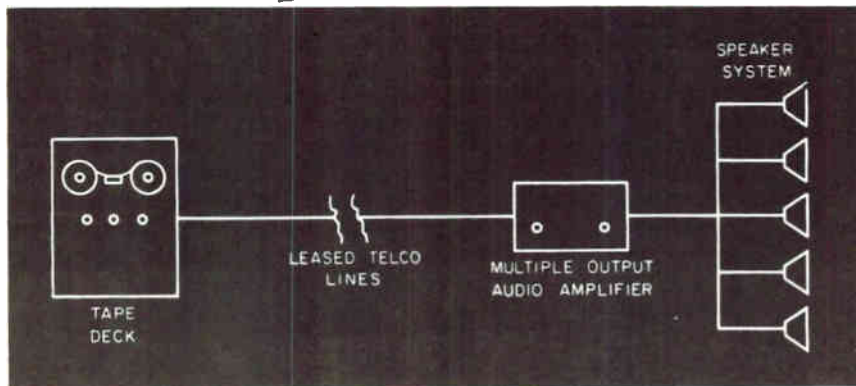


Fig. 3. Typical background music system using leased lines to each subscriber.

tend to be higher than the leased-line service. However, this is where the juke box operator comes in. He, too, is in a very competitive business, and he can lower his costs of maintaining and supplying music to his juke boxes by also adding the tape-deck background service. The same man, truck, etc., handles both. Here, in many cases, the tape deck operator receives his music from companies offering prerecorded tapes.

The FM subcarrier operator has problems of a slightly different hue. This background service operator can cover his transmission costs (maintenance on the subcarrier generator and loading-

subcarrier to another individual or firm and let them run the background music service? Either approach is legal, and both are being done.

Let's assume that you go the way of the majority and lease out the subcarrier. You install the subcarrier generator, but you may or may not install the tape-deck machine. You probably will *not* provide the audio source (music).

All right, what can you charge for the subcarrier? This is a difficult question to answer unless you are willing to assume the responsibility of accepting what follows as representative only. The exact rate you might charge

in your own market will be dictated by your own individual economic situation.

In San Francisco, the seventh largest marketing area in the country, the rate for leased subcarriers varies from \$750 to \$1,000 per month. In Los Angeles,

## Operating Considerations

Let's consider what you have to do before you can lease (or operate your own) subcarrier service. First you will need subcarrier generating equipment. Prices for this vary with manu-

Average Customer Charges		
Type of Service	Base Charge	Charge Each Spkr
Leased Line*	\$18 - \$22	\$2 - \$5
On Premise Tape Deck	\$20 - \$25	\$2 - \$5
FM Subcarrier	\$15 - \$22	\$2 - \$5

Charge is per month per unit, and includes all service on equipment.  
\* In addition, customer pays charge for actual leased line on his regular telephone bill.

Equipment Costs	
Equipment Type	Price Category
Subcarrier Generator	\$1,300 to \$4,500
26 and 65 kc multiplex (dual) subcarrier generator	\$2,500 to \$7,500
Subcarrier Receiver(s)	\$110.00 up*

\* Priced usually in groups with discounts for larger quantities. Special models also available with additional audio amplifiers to feed up to several hundred speaker locations.

the second largest marketing area, the rate runs up to \$1,250 per month. In two smaller markets (150,000 population), the rate runs \$400 to \$500 per month.

The \$400 to \$500 per month fee seems to be as low as the subcarrier operator can drop without going into the red ink column. In your case even this may be too low.

facturers. You probably will also need a tape deck, and if you operate your own service, you will need taped music.

There is another factor to be considered. *Time*. Billing and other office functions probably can be assimilated very nicely by existing office personnel. But, what about your hours of operation? Are they long enough?

Bars, restaurants, and busi-

nesses stay open until midnight, 2 AM, 3 AM, etc., depending upon the market and state laws. If you sign up these establishments, you must provide the background service at least up to their closing time. Yet, you may be now signing off at 11 PM, or midnight. Obviously, your main carrier is going to have to stay on the air, in some form, until you can afford to shut down the subcarrier also. This may be a tail-wagging-the-dog situation, but it is a point due serious consideration; extra air time is extra expense.

Assuming that you decide to lease out the service, keep in mind that while you may not be directly involved in the actual operation of the service, you are still responsible to the FCC for what goes on the subcarrier channel, and the technical quality of what is transmitted.

Now what about the reverse side of the coin—the FM operator who handles the entire operation himself? It is no particular secret that background music oriented businessmen have, in many locations across the country, installed medium to high power FM outlets merely for the purpose of developing a means of transmitting the subcarrier service. This fact alone should suggest that perhaps there is good money in such an operation.

For example, a very successful operation works this way. The broadcaster has a maximum power Class B outlet in a market of over 100,000. His service area covers a radius of approximately 75 miles, over 200,000 people. The regular FM programming is multiplex stereo, and every attention is given to radiating a clean, multiplex signal.

Advertising on the stereo channels is light by comparison to other stations. The community regards the operation as a backbone of public service due to the great number of local sports and community interest broadcasts.

In the rear of the same modern plant are separate offices for the background music company. As a separate corporation, it leases the subcarrier rights from the parent FM operation. The income passing from the background service company to the FM operation keeps the FM station in the black.

Music is leased from taped music service. The receivers are purchased from a supplier by the background music company and leased out to local clients. The lease is carried by a third corporation, the leasing company. All three corporations are owned essentially by the same operation.

The background music service company employs four youthful, aggressive salesmen who ply the coverage area selling accounts. Within a week of the sale, a service and installation truck manned by two installation technicians arrives at the client's premises and installs the subcarrier receiver and the associated wiring and speakers.

The same operator is considering joining forces with one or more other similar operators and manufacturing their own background (subcarrier) receivers.

There can be little doubt that there is good income to be had in subcarrier background operation, if the initial operation of the plant is set up in such a way as to spread overhead between the necessary operations.

Another approach worth noting

is employed by a California operator in a market of 100,000 people. In this situation the FM broadcaster installed the subcarrier equipment and set out to sell subcarrier receivers to home owners. He did his marketing through builders, in homes selling for \$25,000 and up. Each receiver sold was installed, with the audio wiring and extra speakers, by a two-man installation crew employed by the operator.

Other subcarrier operators disagree with this approach. "The real money in the subcarrier business is in the continuing income, month after month, from receivers out on lease," notes one.

"The Internal Revenue Service allows a five-year quick depreciation schedule on electronic equipment, and I take it," quips another. "When the receivers have depreciated out to salvage value at the end of five years, I will have my receivers reconditioned and put back into service on a new depreciation schedule," the same operator notes.

One operator who holds an FM license to enable him to operate his subcarrier service has an interesting view about the future of his operation. "The FM operation in my market would never be a good money maker—at least not now or in the next couple of years. But, in five years I expect the number of FM receivers in this area to be at least triple what they are now. In that period I am going to build up one heck of an audience by giving the listeners the best possible stereo multiplex and promoting FM at every opportunity. Then when I decide to sell off the FM station I will probably be able to sell it for three to five times as much as I put into it."

This is a good capital gains situation made possible by the more immediately profitable subcarrier operation.

Regardless of how you approach subcarrier broadcasting, you will have some problems identical with those others have had. You will need equipment—the subcarrier generator and possibly the tape deck. The subcarrier generator may, in some cases, be leased from the manufacturer. The tape deck and the music can

### Suppliers of Prerecorded Music

#### International Good Music

Box 943  
Bellingham, Wash.  
*Supply tapes and lease tape deck*

#### Muzak Div. of Wrather Corp.

229 Park Ave. South  
New York 3, N. Y.  
*Supply tapes and lease tape deck*  
*Service is exclusive in subscribers area*

#### Seeburg Background Music

360 N. Michigan Ave.  
Chicago, Ill.  
*Supply tapes*

#### Tape-Athon, Inc.

523 S. Hindry  
Inglewood, Cal.  
*Supply tapes and equipment*

#### National Musitime Corp.

770 Lexington Ave.  
New York 21, N. Y.  
*Supply tapes*

be leased by the month from several sources (see box).

If you rent or lease a tape deck with the music service, or merely lease the prerecorded tapes (music service), someone is going to have to be responsible for ASCAP, BMI, etc., fees. In



almost all rental or lease situations, the fee is paid by the company supplying the music service. Should you make up your own music tapes, you will be responsible for these fees.

Lately, a new type of customer for the background music service has emerged—the CATV operator. The cable operator frequently has a background music service which he feeds through his cable as an audio channel on one of his unused TV channels. If he provides such a service, he can either install his own tape decks (from a company supplying same with the music service), or contract with the FM subcarrier operator for lease rights on a receiver and the service. The rate for such a customer is normally higher than a

regular single commercial customer, but not as high as might be expected by the total number of subscribers (the CATV customers). Usually, the rate per month to the CATV operator is around \$80 to \$100 for the service, lower than the fee the CATV operator would pay on his own for a leased tape deck and music service.

FM subcarrier service is a new and growing industry, with potential still largely unexplored. Every FM operator owes it to himself to investigate his own market situation and the availability of background music service in his area. You may find, as many have, that adding some form of subcarrier operation may make an otherwise unprofitable operation profitable.

## Using Promotions to Build Audience & Sales

by Joseph D. Coons

**T**HERE isn't a truly successful radio station in the country that isn't using one or more methods to build an audience, or to increase billings. The most important factors to consider when planning promotional activities is to make sure they are carefully oriented to do the job, at a price that's worthwhile, with results that are tangible, and using an idea that is unique in the city where the station is located.

### Audience Promotions

Audience promotions may take the form of advertising in other media; spots on the promoting station; contests in stores, by mail, or on the air; stunts performed with some kind of public exposure; unusual services in the interest of community service and audience information; or any of a legion of other forms. In each case, the intent will be for the listener to



# WOHI



**HELPING . . . AND JOINING  
 IN OUR  
 GROWING EAST LIVERPOOL**

**HELPING . . . . .**  
 with over \$56,000.00 of time  
 donated to community service causes  
 and organizations (we never charge  
 for public service announcements)

with top-notch programming for our  
 audiences, AM and FM . . .

**GROWING . . . . .**  
 with new, double power on AM  
 early next year . . .

with new, expanded separate AM  
 and FM programming . . .

with exciting new horizons  
 of thought.

**WON'T YOU JOIN US?**

**WOHI  
 1490 kc AM**

**WOHI - FM  
 104.3 mc FM**

"WHERE ADVERTISERS MEET IDEAS"

be attracted, either aesthetically or materially, to *listen*.

Since listening is the key to audience promotions, some abstract determination of the worth of a new listener, in dollars and cents, must be made. For example, if a contest costs \$1,000 to run and attracts ten permanent listeners, it could be construed to be too expensive per listener gained. On the other hand, if management values listeners at \$100 each, the

contest would be worthwhile. In determining what kind of contest to run, management should also determine *why* the audience should be built. If a bigger audience won't make any difference in earnings, there may be no reason to enlarge the audience at all. This can be the situation, for a station may be virtually sold out, with rates that cannot be increased without going beyond available customers' budgets. To do a better job for the



HURRY

# ONE WEEK LEFT . .

To WIN These Prizes Worth Over

# \$ 675.00



The WOH! Spring Sweepstakes ends next Saturday, as does your chance to win the prizes listed here. If you don't win one of these, you are eligible to win the GRAND PRIZE of \$100 to be drawn by WOH! from entries at each participating advertiser.

Each of the places listed has a drawing. Ask for your entry blank—stop at as many firms listed as you can—hurry—there's no obligation. Join the fun from WOH!.

Drawings Monday Morning, April 19.  
You Need Not Be Present To Win.

**Grand Prize—\$100 CASH**



Ad from East Liverpool Review is an example of "prizes" promotion conducted by WOH!. Each of 18 participating merchants offered prizes. Drawings for prizes were held at each store.

advertiser, in terms of circulation, would add only to operating costs, and not to earnings.

Once the worth of a listener and the reason for gaining him is determined, the next order of

business should be to determine why he isn't listening. After all, if programming is terrible or the station's technical sound is bad, a contest won't attract any permanent listeners, but a change in

### The 7 Qualities of a Good Promotion

1. It builds the station's image.
2. If a sales promotion, it builds rather than switches business.
3. If a program promotion, it does not cost more than it's worth, per listener gained.
4. It is a coordinated effort between all station departments, including engineering and news.
5. It is presented at a time when it is needed, both seasonally and at the right time of day.
6. It is well advertised in other media.
7. It is handled without diverting staff time from day-to-day work that is more important in the long run.

other areas might help a great deal. In fact, the latter course of action, *without* a promotion, will save money, since the program or technical change will have to be made sooner or later, anyway.

Having determined what new listeners are worth, and also having concluded that the only reason they aren't listening is either that they haven't tried the station or don't have any great preference, the station must try to get the non-listener to tune in, and get the indiscriminating listener to settle on the promoter's dial position as a habit. *This* is the purpose of an audience promotion. All too often stations run audience promotions that are expensive attempts to do something other than *switch* listeners to the station, or develop listener preference. These attempts are doomed to failure from the start, since listeners will quickly tune out when they discover the same sloppy, ill-sounding programming.

Most personnel improvements are, in fact, audience promotions.

When a show, personality, or policy that folks will want to hear is adopted, the station should actively publicize the fact in other media as well as on the station. Like the preacher who sermonizes on the people who aren't in church, the station that uses only its own circulation for promotion just isn't reaching the right people—the *non*-listener. I have found it most interesting to note studies of the industry which indicate that radio stations don't spend any substantial money on advertising. Yet, we are supposed to recognize the value of advertising!

A good non-listener catching format is the contest which involves the listeners on the air. People will often be anxious to hear themselves, their families, or their friends, no matter what the station preference. Remotes in stores, shopping centers, home shows and fairs, are good builders if they include some kind of interview setup for later playback. One of the best ideas that comes to mind was created by Pepsi-Cola in 1954. Citizens were invited to call an advertised phone number and submit a slogan which was

#### Promotion Franchisers

Zingo (Bingo)

Lucky Bucks, Social Security Numbers: Azrael Productions, 913 N. Charles St., Baltimore, Maryland

Kasho: Vana Associates, Trades Publishing Bldg., Albert Lea, Minnesota

Decals: John Deal Co., 939 Trinity Lane, Nashville, Tenn.

Bumper Stickers: Enameloid Sign & Display Co., 140 Peach St., Reading, Pa.

later played back on the air. Then, if a person recognized himself delivering the slogan, he won a prize. The reverse procedure has worked at our station, with the station calling a listener's number; if the listener answered the phone in a way that indicated he or she was listening at that moment, they earned a prize.

Another type of audience promotion is the audience-keeping promotion. Here, the promotion effort must be tailored to *keeping* the listener as a faithful member of the audience. This type of promotion should be oriented toward giving the station a high identity with its audience, so that call letters and dial position are familiar. Such promotions provide listeners with some material advantage, such as special days or nights in theatres, shopping centers, etc.; other ideas include picnics, contests, and give-aways just for listeners, or emphasizing the specials a listener is getting, and of course station program promotion spots and programs on the air.

### **Sales Promotions**

Actually, a good audience promotion is usually a good sales promotion. A good promotion for a station is that which integrates outstanding activities in sales, programming, engineering, and administration to achieve more business. Thus, it is doubly important, when choosing a sales promotion, to be selective, and determine first, a goal. There can be many reasons for running a promotion—to attract new business; to give existing customers a "special" to build their enthusiasm; to create excitement among advertisers; to prove the station's pulling-power to existing as well as new advertisers, etc.

### **Stuffed Animal Drawing**

There are numerous stuffed animal suppliers hawking their wares for this one. It is a good contest at Easter or Christmas time, although it loses its impact after a run or two, at least in a small town. This promotion has the advantage of a fixed cost per sponsor, the cost of the animals, plus coupons and posters, so no matter how few are sold, cost is fairly linear.

### **Sponsor-Prize Drawings**

This promotion is inexpensive and easy to run. A special price is established for advertising. As a credit against this price, the station will pay an advertiser up to \$25 (or some other such figure) toward the wholesale price of his prize. The station provides entry forms, posters, and runs ads in newspapers or other media promoting all participating stores and services. The cost is linear, allowing any number of sales with a profit to the station. The idea of giving a credit to the advertisers for their prize allows the station to be sure the prizes are uniformly good from store to store, and are of equal value so that no one shop steals the spotlight. It has a community service aspect, too, since the station is running a town-wide promotion. Merchants will like this one; it's a good traffic-builder.

### **Bingo Games**

These are supplied by a variety of syndicators and card suppliers. The idea is simple enough: Customers get cards from an advertiser, listen to a specified program which includes a listing of numbers, and if they win, collect a prize from the sponsor or the station. In spite of arguments to the contrary, bingo doesn't seem to harm the image of a station, is easy to run, and is relatively inexpensive. Be sure to arrange a way of checking winners' cards, however, to avoid errors and hard feelings.

Once the goal is determined, it is necessary to select the promotion that will achieve the goal. This is the most difficult part of the job, and one where the biggest mistakes are made. When selecting the promotion, imperative questions to ask are: (1) What is the cost? (2) What will it net, after commissions? (3) How much of the volume will be "switch" rather than new business? (4) Will it require a high acceptance to make money, because of high initial expense, or will expenses be a fixed percentage of each sale? (5) Will you be paying others for services or prizes that you can provide yourself for less? (6) Will the timing be to your best advantage, with the resulting revenues coming when you need them? (7) How many potential customers do you have at the price required? (8) Will the sales time taken by the promotion be more than would be required to get an equal net return on non-promotional selling? (9) Will the promotion contribute to the station's reputation?

### Promotion Coordination

An effective promotion must be well coordinated. This means more than just a sales or program staff meeting; it means that all departments of the station must have an opportunity to meet together and iron out problems, with an open mind to non-sales or program-oriented comments. The chief engineer might point out some equipment limitation to the project, one which might be significantly improved by a modification of either the promotion or the equipment. The C.E. might also have some observations that, from his point of view, would shed new light on the need for a promotion and in which area it should

### Sports Drawing

This promotion was used successfully by WOHI to get advertisers for its baseball coverage. Each participating sponsor held a drawing, free of charge, for anyone who wished to register. Each month during the season, the station sent a bus to the game, with tickets and bus cost paid by the station. The bus was decorated with appropriate banners, and advertisers were invited to give their winners appropriate souvenirs of the trip. The promotion thereby gave advertisers traffic, and a record of it, while listeners were encouraged to stop in, and could win a nice prize. The cost to station was covered through just one sale to one of six participants, and the station was able to develop more baseball business than it had had in prior years. Cost of posters, stubs, etc., was the only expense, other than tickets and buses, which was all paid for by sponsors.

### Community Club Awards

This is a syndicated sales promotion, developed by Community Club Awards, Inc., Westport, Connecticut. It involves the accumulation of receipts and other proofs-of-purchase by members of competing organizations, submitted to the station weekly with a tabulation of points earned. Each week, the club accumulating the most points earns a cash award, and a grand prize is given at the conclusion of the contest. Because of the cash prizes, and a franchise fee to CCA, this copyrighted promotion has a relatively high break-even point. On the other hand, it does a tremendous job of getting traffic for advertisers, and proves it. It is also a community service, since it helps the participating clubs accomplish their objectives by assisting their treasuries. When considering CCA, major costs are printing, franchise fees, and prizes. Advertiser support must be reasonably substantial.

## Crazy Days

This is the most exciting promotion ever run at WOHI. Arrangements were made with the publisher of a "Community Shopper" newspaper to publish a special issue. Advertisers were solicited for combined radio-shopper ads for a period of a week. Shoppers were bulk-mailed to everyone in the listening area. Each shopper was numbered, and recipients were encouraged to visit the stores to see if their number qualified them for "crazy" bargains, like a 10¢ car, \$1 mink coat, etc. Because of the odds, with only one winning number out of all the shoppers mailed, clients can run big specials for winners without great risk. In addition, numbers can be posted throughout the stores for little item specials. This is a great traffic-builder, with lots of excitement. The station also gets into every home via the shopper. Costs are high, but the excitement makes it worthwhile. Be sure to investigate printing, addressing, and mailing requirements carefully with the printer, post office, and advertisers. Be ready for layout work at the last minute, as you try your hand at the print media.

be undertaken. Likewise, station bookkeepers will need to know how commissions and expenses are to be handled. Arrangements should also be made at such meetings to keep a special accounting of expenditures on, and income from, the promotional effort, in order to know if it was worthwhile.

Nor should group discussion prior to selection of a promotion be overlooked. Some of the best ideas we have had came out of

## Litter Box

Here is a good promotion for publicizing a station. Automobile litter boxes, distributed to customers by the sponsor, are displayed on the shelf below the rear window. Each day, the station sends out a staff member to spot cars, and prizes are given for displaying the box. The promotion is a natural for a gasoline company, with five gallons of the advertised fuel as the prize. Our station paid for the litter boxes and provided them to the advertiser in return for a big schedule and for providing the prizes. It's a big boost for the station when call letters appear around the area in the windows. Variations on the theme are bumper stickers and decals, although the litter boxes have a certain public-service aspect.

### "Mobile Medium" Promotion

This is an audience builder. The station remote unit cruises within the station's service area, and announces the license number of a car he's following over the air. If the driver pulls over to the side, indicating he is listening, he gets \$1. If he does not stop, the amount is added to the next prize.

brainstorm sessions with the staff.

## Sample Promotions

There are as many promotions as there are radio stations, but they are all varieties of contests, give-aways, special prices, special programs, or community service. Any promotion will do better in some areas than in others. The competent manager will balance the considerations and arrive at the best alternative.



# IMPROVED OFFICE PRACTICES FOR THE BROADCASTER

By Joseph D. Coons

Like many station owners, we have often been stunned at the end of the month to learn what a large percentage of our overhead is the result of laborious, repetitive work. Such efforts, usually expended on paperwork necessary to expedite orders, consume a great deal of time and have little direct impact upon sales volume. In 1961, shortly after acquiring our station, we decided to do something about it.

## **The Problem**

At WOHI, we were concerned with staff productivity in several areas. Our traffic girl spent at least four hours a day typing logs. My secretary, who doubles as bookkeeper, was constantly behind schedule (through no fault of her own). In addition, errors occurred (one of them cost us several hundred dollars in lost sales), and we were determined to eliminate them. As a manager, I found it difficult to trace mistakes; so many different staff members handled paperwork in various stages it was impossible to tell who had added the erroneous information. Personnel, especially salesmen, often passed the buck

for order preparation to other staff members. We were not always fully aware of all details, since many pieces of paper had to be assembled for complete information. Communications were weak. And we are in the communications business!

## **The Solution**

To begin doing something about the situation, we outlined the major problems and responsibilities in sales, traffic, logging, and accounting.

Then we proceeded to develop procedures which would be self-liquidating and easy for our personnel to understand. The procedures we evolved were the result of three years of improvement and a great deal of research. They break down into two interrelated areas: (1) Ordering-scheduling-accounting-billing-reporting; and (2) Scheduling-logging.

## **Systematized Ordering-Scheduling-Bookkeeping-Billing**

In our station, as in most, there are usually ten items of record or activity associated with these four operations: (1) Contracts; (2) Sponsor start orders; (3) Con-



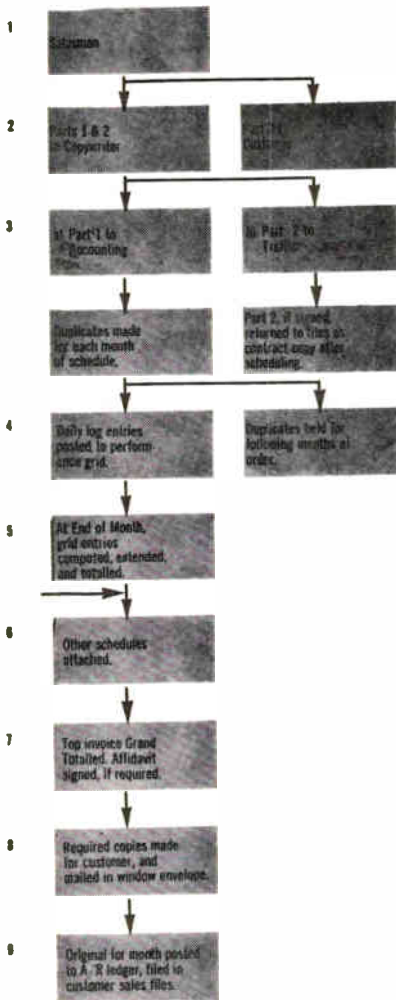


Fig. 2. Flow chart of order form use in 9-step procedure.

Now, let's follow this form along as it goes to work. The flow chart in Fig. 2 shows the 9-step procedure we use.

1. The salesman writes the order, filling in the left and center portions of the form completely. If the order is the first in a contract year, he has the advertiser sign the right side

of the second page, and gives the customer the carbon confirmation, page 3.

2. The salesman gives Parts 1 and 2 to the copywriter, alerting him to the need for copy. The copywriter notes on a corner of Part 2 the cartridge or live copy number, and gives it to the traffic clerk. Part 1 is given to the bookkeeper.
- 3a. The bookkeeper makes extra copies on a copying machine, one for each month of the schedule, and places them in a file indexed by month. One-month-only orders require no copying.
- 3b. The traffic clerk posts the order to the program schedule, and files it in dead storage until the schedule has run. It is then discarded unless it is a signed order, in which case it is filed for future reference.
4. Each day, the bookkeeper obtains data on commercial time from the performance log, summarizes it on a customer list, and then posts the information on the "grid" portion of the start order copy (Part 1) assigned to the month.
5. At the end of the month, the bookkeeper extends and totals under "total-this-invoice" the cost of the schedule.
6. She then attaches any other schedules run, adds them up, and posts them to the top invoice.
7. She enters the grand total. The affidavit section is signed and notarized if necessary. The top invoice is rubber-stamped "INVOICE" in large letters.
8. The number of copies required by the customer are made on a copying machine, and mailed in a window envelope.
9. Following mailing, the original

copy of Part 1 for the month, still retained by the station, is posted to the accounts receivable ledger and filed, an exact record of the customer's billing for the month, including his schedule and the number of spots run.

### What These 9 Steps Accomplish

Notice that basic information is never retyped or copied, except on a copier. Therefore, the chance for human error is reduced considerably. In addition, all printed forms, except the order form, are eliminated. If an error is made along the way, it can be immediately traced. Since the salesman's data must be right for his order to be executed, he stops taking short cuts. Another advantage of the system is the trustworthiness it instills in our clients, who receive bills that look just like the original order.

The greatest difficulty we had in installing the system was with the salesmen; they opposed having to fill out the order in full. Once they became used to the procedure, however, they stopped complaining, especially when they found it eliminated errors in the execu-

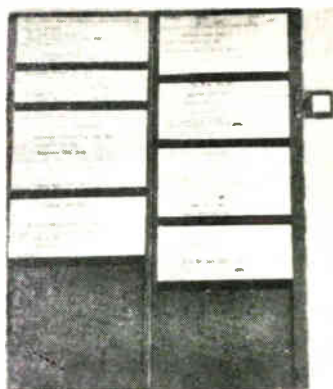


Fig. 4. Laminated cardboard strips containing program schedules are inserted in "hour-long" panels. Nine "sides" hold data for 18-hour day.

tion of their orders and provided them with a fast, complete, ready reference for future sales.

As for the economics<sup>2</sup> of the system, the costs of the 3-part forms and the Xerox copies are less than for our old forms. This saving is modest. BUT—and this is the key to our love for the arrangement—we now make virtually no errors.

### Systematized Scheduling-Continuity-Programming-Logging

Even though the ordering system has eliminated most of the errors, we are even more enthusiastic about our scheduling and programming system, which has saved us a lot of time—and money. For an order to be properly scheduled and programmed, the following activities are completed:

1. Copy is prepared and scheduled, either live, ET, or taped.
2. Cartridges, if used, are labelled and assigned.
3. The order is scheduled.
4. The schedule is made flexible enough to accommodate pre-emptions, additions, etc.

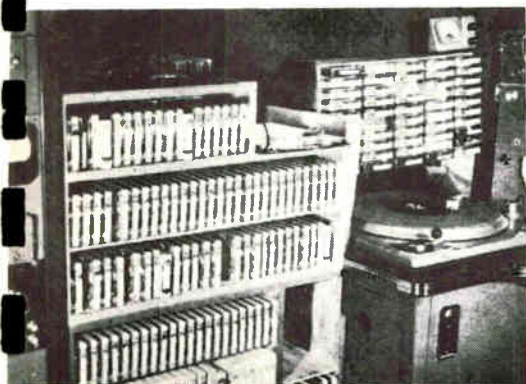


Fig. 3. Tape cartridge numbers identify length and sponsor.



Fig. 5. Traffic clerk Joy Thomas preparing frames for program schedules.

5. An accurate record is provided for bookkeeping and the FCC.
6. Competitive separation for sponsors is maintained.
7. Commercial codes and other time limits are maintained.
8. A clear and legible form is provided to all concerned.
9. Compliance with FCC Rules is provided for.

No matter how you look at it, this is a lot to ask of a schedule. If your station is doing this in less than an hour a day, don't read any further. You're either not selling time, or you're using a system like ours. If, like us, you've been spending three, four, or more hours a day in your best months, turning out a schedule that doesn't meet all these requirements, read on and learn how we cut the time to an hour a day.

### Basic System Requirements

To fit the system, we set up means for identifying copy. All live material is indexed by letter and number: A-1, 2, 3, etc., to 31, then B-1, 2, 3, etc., to 31. Since we use only about twenty pieces of live copy, recording the rest,

except for public service, we use just A, B, C, and D.

Recorded copy is indexed differently, using a series of cartridge numbers. We now have the following assortment of cartridges:

- 180 seventy second
- 50 three minute
- 10 five minute
- 2 ten minute
- 5 fifteen minute
- 3 thirty minute

Carefully reviewing each customer's normal needs, we determined how many cartridges he would require. We then assigned him that number of cartridges. In other words, a meat packer who sometimes uses one, sometimes two pieces of copy, rotating, was permanently assigned two cartridges *all his own*.

Naturally, there are short-term sponsors of one kind or another who share cartridges with other short-term or seasonal users, but these account for only 20% of our total file. (See Fig. 3.)

We numbered our cartridges consecutively, using a felt marking pen and a two-digit system. The first digit is the length of the cartridge (not used on 1-minute cartridges); the second is the serial number. Thus, #36 is a 70-second cartridge, 36th in the series; #5-6 is a five-minute cartridge, the 6th in the series.

To allow ourselves flexibility, we made wooden blocks, the size of a cartridge, affixed with nameplates of the type used on apartment house mailboxes. These "dummies" are used to substitute special copy for a sponsor. If the log calls for cartridge #43, the announcer may find a dummy labelled "43 use 3-29," which tells him to use 3-29 instead. We have ten dummies that allow for odd

scheduling with minimum fuss.

To make this system as efficient as possible, we instituted a policy change. We try to avoid, if at all possible, selling long term schedules which vary times ordered from week to week. We stress ordering the same schedule every Monday, every Tuesday, every Wednesday, etc.

### System Control

To keep track of and control scheduling, we purchased special frames from Acme Visible Records, Inc. (Crozet, Virginia). These frames make use of laminated cardboard strips of various colors, and comprise our program log (see Fig. 4). There are two hour-long columns on both sides of each frame, and we use nine sides for our 18-hour day. We have enough frames to make up 9-side sets for every day of the week, plus about ten extras. The frames, specially ordered, cost about \$160.

The cardboard strips are available in six colors and two widths, 1/6" and 1/3". We use the wide strips for minute spots, the narrow for 20- and 30-second spots, as well as for program informa-

tion. Competitive sponsor strips are color-coded. In addition, colored plastic "signals" can be slipped over the strips if we wish to indicate something special about them. We use yellow to indicate what we call "one-time" orders, and green to indicate pre-empted spots. As shown in Fig. 5, the traffic girl, in preparing the schedule, follows this routine each day:

1. Takes out the frames for the day being prepared.
2. Removes all old strips for schedules which are ending.
3. Removes all strips with yellow "signals."
4. Replaces any green-signaled strips in original positions.
5. Examines orders for day, dividing into two groups, *One-time orders*, and *two-or-more-times orders*, which are to run not only on the day scheduled, but also one week from the day scheduled.
6. Inserts the strips for all more-than-one-time orders in appropriate places.
7. Puts a yellow signal on all the one-time strips, inserting them in the available times.
8. If necessary, removes strips

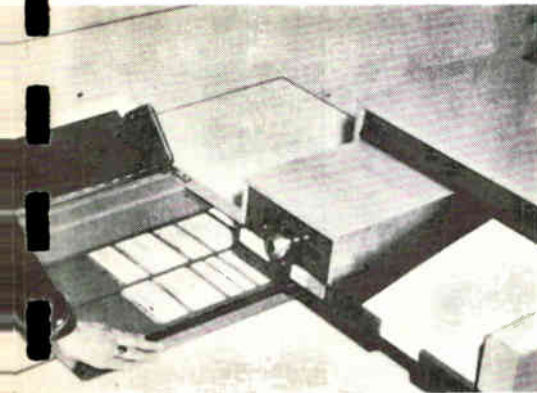


Fig. 6. Traffic clerk duplicating frames on copier.

TIME	PROGRAM	SPOTS	REMARKS
6:00-7:00	Golden Hour (G)	3-05	
7:00-8:00	News at 7:00 (N)	1-00	
8:00-9:00	8:00 News (N)	1-00	
9:00-10:00	9:00 News (N)	1-00	
10:00-11:00	10:00 News (N)	1-00	
11:00-12:00	11:00 News (N)	1-00	
12:00-1:00	12:00 News (N)	1-00	
1:00-2:00	1:00 News (N)	1-00	
2:00-3:00	2:00 News (N)	1-00	
3:00-4:00	3:00 News (N)	1-00	
4:00-5:00	4:00 News (N)	1-00	
5:00-6:00	5:00 News (N)	1-00	
6:00-7:00	6:00 News (N)	1-00	
7:00-8:00	7:00 News (N)	1-00	
8:00-9:00	8:00 News (N)	1-00	
9:00-10:00	9:00 News (N)	1-00	
10:00-11:00	10:00 News (N)	1-00	
11:00-12:00	11:00 News (N)	1-00	
12:00-1:00	12:00 News (N)	1-00	
1:00-2:00	1:00 News (N)	1-00	
2:00-3:00	2:00 News (N)	1-00	
3:00-4:00	3:00 News (N)	1-00	
4:00-5:00	4:00 News (N)	1-00	
5:00-6:00	5:00 News (N)	1-00	
6:00-7:00	6:00 News (N)	1-00	
7:00-8:00	7:00 News (N)	1-00	
8:00-9:00	8:00 News (N)	1-00	
9:00-10:00	9:00 News (N)	1-00	
10:00-11:00	10:00 News (N)	1-00	
11:00-12:00	11:00 News (N)	1-00	
12:00-1:00	12:00 News (N)	1-00	
1:00-2:00	1:00 News (N)	1-00	
2:00-3:00	2:00 News (N)	1-00	
3:00-4:00	3:00 News (N)	1-00	
4:00-5:00	4:00 News (N)	1-00	
5:00-6:00	5:00 News (N)	1-00	
6:00-7:00	6:00 News (N)	1-00	
7:00-8:00	7:00 News (N)	1-00	
8:00-9:00	8:00 News (N)	1-00	
9:00-10:00	9:00 News (N)	1-00	
10:00-11:00	10:00 News (N)	1-00	
11:00-12:00	11:00 News (N)	1-00	
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1:00-2:00	1:00 News (N)	1-00	
2:00-3:00	2:00 News (N)	1-00	
3:00-4:00	3:00 News (N)	1-00	
4:00-5:00	4:00 News (N)	1-00	
5:00-6:00	5:00 News (N)	1-00	
6:00-7:00	6:00 News (N)	1-00	
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4:00-5:00	4:00 News (N)	1-00	
5:00-6:00	5:00 News (N)	1-00	
6:00-7:00	6:00 News (N)	1-00	
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2:00-3:00	2:00 News (N)	1-00	
3:00-4:00	3:00 News (N)	1-00	
4:00-5:00	4:00 News (N)	1-00	
5:00-6:00	5:00 News (N)	1-00	
6:00-7:00	6:00 News (N)	1-00	
7:00-8:00	7:00 News (N)	1-00	
8:00-9:00	8:00 News (N)	1-00	
9:00-10:00	9:00 News (N)	1-00	
10:00-11:00	10:00 News (N)	1-00	
11:00-12:00	11:00 News (N)	1-00	
12:00-1:00	12:00 News (N)	1-00	
1:00-2:00	1:00 News (N)	1-00	
2:00-3:00	2:00 News (N)	1-00	
3:00-4:00	3:00 News (N)	1-00	
4:00-5:00	4:00 News (N)	1-00	
5:00-6:00	5:00 News (N)	1-00	
6:00-7:00	6:00 News (N)	1-00	
7:00-8:00	7:00 News (N)	1-00	
8:00-9:00	8:00 News (N)	1-00	
9:00-10:00	9:00 News (N)	1-00	
10:00-11:00	10:00 News (N)	1-00	
11:00-12:00	11:00 News (N)	1-00	
12:00-1:00	12:00 News (N)	1-00	
1:00-2:00	1:00 News (N)	1-00	
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3:00-4:00	3:00 News (N)	1-00	
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10:00-11:00	10:00 News (N)	1-00	
11:00-12:00	11:00 News (N)	1-00	
12:00-1:00	12:00 News (N)	1-00	
1:00-2:00	1:00 News (N)	1-00	

from any period to be pre-empted, puts on green signals, and relocates them.

Once strips are typed for a customer, they are stored after use, since he will use the same cartridge over and over. Unless there is a totally new customer to be scheduled, there is little need to type new strips.

In addition, public service spots are assigned fixed positions and logged just as "public service."

book sections as we wish, and put it on cartridge, too.

Once the frames are complete, they are copied (see Fig. 6). The schedule is then ready for programming and, as it is used, the times are logged to the right of the strips in the blank area. (See Fig. 7.)

### The Results

The system is a great time-saver. It accomplishes everything

### The Copying Machine

Our copying machine is a Xerox 914, which costs 5½¢ per copy, including supplies, with a 2,000 copy minimum. To offset the expense, we offer a copying service, advertised on our station three times a day. We charge 15¢ each for the first ten copies, 10¢ each for the next ten copies, and 7¢ each for all copies over twenty. For three months in a row, we earned over \$100 on this service. In other words, we got our copier for nothing.

We use it for copies of FCC forms, profit and loss reports, proof-of-performance forms, continuity duplication, the billing system, and the logging system. One month we studied how we were using it. Customers bought 550 copies; the log took about 400 copies; billing and office work 750; continuity and co-op copies 300. That was when we were using about 2,000. Now we use about 2,400 a month, with customers taking up the slack.

We have B-18 thru B-31 in our live copy book, plus a 10-minute cartridge of ten spots rotating, and a 1-minute cartridge which is used for special local public service messages we wish to saturate. We can use any of the three through the use of our dummy cartridges, even though the log carries all three numbers. We keep a little notebook of changes with entries like "12/10/64—changed B-24 to Xmas Seals." Then whenever B-24 comes up, it is a Christmas Seal spot. To saturate, we can put duplicate messages in as many of the copy

a good system could, fully meeting all the requirements. Training personnel is far less laborious than before, since the log is prepared by use of a simple check-list rather than by having to outline each customer's individual requirement. The system saves over \$1000 a year in traffic-clerk time alone, which we have yielded by cutting the job to half-days, still giving her time to do other jobs.

To sum up, then, our total-system analysis and application has been as worthwhile as any management endeavor we have undertaken and we recommend it to others.

# RATES—and the Rate Card

by Joseph D. Coons

AT ONE TIME or another every commercial broadcaster is faced with a variety of decisions that affect the pricing of his time—his rates. He then moves mentally from the world of decisions based upon tangible data to the world of decisions based upon psychology, ethics, superstition, precedent, and experience. As a station manager, I have gone through such times, and have come to some conclusions that may add new life to some old debates. Reviewing our sales progress, we feel our rate and pricing policies have played a major role in our growth—adding more than 60% to our sales in less than five years. If you feel price is important in your sales, some of our philosophies may help you.

Questions about rates fall into several categories: (1) How many rate cards should there be? (2) What should the cards look like? (3) What discounts should be offered? (4) How many "classes" of time should there be? (5) How many different spot lengths should be offered? (6) What about "Special Rates?" (7) How should rate changes be handled?

Most managers faced with the problem of answering these questions seem to follow either of two paths: They play a hunch, depending on intuition to make the right decision; or, they look up data gathered by NAB, RAB, etc., or SRDS, and see what the

other guy is doing. The first course presupposes the manager is right, and the second assumes the other guy is right. But any manager worth his salt knows he can reach the best decisions only after consulting all the other people involved.

We have never made decisions regarding rates without holding meetings with our salesmen, confiding in our most helpful and loyal customers, conferring with our reps, and discussing proposed changes with our community financial prophet, our banker. The resulting comments have often startled us.

## How Many Cards?

The old local-vs-national rate controversy is ever present. As for our own experience, we have received may calls from agencies using the old dodge, "This is a local buy, we just set it up." And from our reps, perhaps two out of three memos in the past, emphasized quoting the right rate—the one the rep quoted. These situations were unsettling enough, coupled with the Commission's concern about double billing and other double-rate practices, but there were still other factors to be considered: What of the 15% agency commission? Could we cut our revenues for regional and national sales by 15%? How about the rep's commission?

Perhaps the final blow came in 1961 when an auto firm, well-known for "tough" buying prac-



tices, issued the ultimatum: no local rate, no national business. Although this encouraged our subsequent decision to abandon a national card, there were many other arguments in favor of this decision.

The first point in favor of a single rate is elimination of rate-confusion, rate jumping, and double billing. It's amazing how easy it is to say, "Yes, agency, that's our rate, the local rate, the only rate. No one pays less than that, so you must pay it, too." It's a lot easier than trying to explain to a local beer distributor why he must pay national rates through the agency.

The American Association of Advertising Agencies, 200 Park Ave., N.Y., publishes a standard rate card layout. They will send you a sample card and description of the layout. There are advantages to following a standard form. Once your printer has set up type for your card, he can produce subsequent issues at a lower cost than the original, and by using a different color with the same design, it will be more easily recognized. Your card will maintain a character of its own, and consistency of design will allow you to reissue a card which will be familiar to those who work with it.

Of course, we're getting 15% less for the time when the order comes through the agency. Does the agency earn it? We look at it this way: The agency prepares the copy (otherwise the station must); the agency offers assurance of prompt payment, or at least a record of payment to rely upon (which the station does not always have with non-agency customers); the agency sells the ad-

vertising (which is otherwise the station's job); and finally, the agency understands how to buy station time with a minimum of confusion and for maximum benefit (which the station must do for local customers).

Each of these jobs are no longer the station's. Are they worth 15% of the bill? We say *yes*. Agency orders are, we believe, 15% less expensive for us to handle. We see no reason not to subcontract the work for 15% of gross.

Of course, there's still the rep's commission—which cuts out another 15%. But on local sales, we give a 15% commission to our salesmen, so it's all the same. We never think of our rep in any way except as a salesman who calls on out-of-the-area customers. He earns his money; in fact, if we were to replace him, we could not call on his customers for the 15% he gets. We think that 70% of national time, net, is fair. All we have to do is *run* the commercials—no writing, no selling, no talent, no production—just run them. I wish all accounts were like that!

## Frequency Discounts

Setting up a discount pattern and the rates for frequency discounts becomes a matter each station must consider on its own. Factors which influence discount rates are:

1. The revenue goals of the station.
2. The current rates being charged.
3. Forestalling use of short spots for economy purposes only; i.e., making it attractive to use minutes rather than thirties or twenties.
4. Making prices and discounts

fair to the buyer, without excessively steep or slight discounts.

Each of these factors should be kept in mind as each rate is fixed; in addition, rates should be mathematically simple, rounded off at easily-computed figures. This standardization of figures will save a lot of computation time while the card is in effect. Raising all rates by the same percentage factor makes an increase easier to define to clients. "It's a 10% increase" is much easier to explain than different time and spot increases.

### Classes of Rates

The other day I was looking at a card prepared by a major-market high power station. It was complicated by time classifications and bonus plans, concocted, no doubt, with one of two goals—getting more money from the advertiser, or getting the advertiser to use less desirable time. Our "Combination Plan," is designed to give more time at a better rate, rather than get more revenue from our time. The result is better distribution of business around the clock, but little increase in revenue. Unless you are the clear channel station in a top market, you are competing for business, and the best way to compete is to *give the client what he wants at a price that is fair to all*. A bonus plan, for example, offers the client something he doesn't want, and alludes that your time isn't worth the rate-card price. You become a wheeler-and-dealer, instead of a solid seller, just like a car salesman who throws in a radio. (Let's keep the auto dealers throwing in radios, but not throw in our time!)

With our give-him-what-he-wants credo, we use two classes of time—*A* for all daytime, *B* for all nighttime. When we are asked for avails, we guarantee no more than one-half the schedule in traffic times. When we can, we give more; especially if the client can get something out of traffic times. Our salesmen, however, keep selling non-traffic hours because of the specialized audience.

### Lengths of Spots

In most markets there are a few huge clients, more large clients, even more middle-sized clients, and a great number of small clients. The rate card, and station policy on announcement length, must be designed to give all potential accounts access to the airwaves at prices they can afford.

We do this by offering three spot lengths—60, 30, and 20 seconds. But, unlike many major-market stations, our price ratios of 100%, 55%, and 40% do not vary in direct proportion to spot length. Thus, the small advertiser can afford to buy a 20 from us at our rate. That's what we feel a 20 is for, basically—a small advertiser. Most big accounts would rather have a 60 and will pay the price when our representative emphasizes the extra time for jingles, etc. If he wants a dense schedule, we use 30's and 60's and give him frequency, always trying to balance spot length to desired frequency, budget limits, and copy demands.

Some stations don't sell anything less than a minute. But wouldn't any manager rather sell two 30's for 110% of the minute rate, or three 20's for 120% of the minute rate? If a client is sold on radio, he will buy not what is

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— 1949 —

P. O. Box 760  
East Liverpool, Ohio  
Code 216-385-1490

"where advertisers meet ideas"

Rate Card #10  
Effective Jan. 1, 1965  
A Single Rate Station

**1-PERSONNEL**

Joseph D. Coons, General Manager

**2-REPRESENTATIVES**

Penn State Representatives, Inc., &  
Ohio Stations Representatives, Inc.,  
Regional Representatives  
Crant Webb & Company,  
National Representatives

**3-MAILING INSTRUCTIONS  
AND CLOSING TIMES**

Mail to Box 760, East Liverpool, Ohio.  
Closing 12 hours prior to broadcast

**4-FACILITIES**

- a - Power - AM - 500 watts Day  
250 watts Night
- b - Frequency - AM - 1490 KC
- c - Hours - 6:00 A.M. - Midnight Mon.-Sat.  
7:45 A.M. - Midnight Sunday  
Daylight Savings Time Used
- d - Transmitter - WOH I View, ShadySide  
Avenue, East Liverpool, Ohio

**5-COMMISSIONS  
AND DISCOUNTS**

- a - 15% agency commission on time charges  
to recognized agencies.
- b - 2% discount for cash - ten days, Net 30,  
end of month billing.

**6-RATE POLICIES**

- a - Rate must be earned within one year from  
date of first announcement.
- b - Advertisers will receive rate protection for  
60 days following ending date of sched-  
ule at time of increase.

**7-RATES - ANNOUNCEMENTS****Class A**

6:30 A.M. - 6:29 P.M., Mon.-Fri.

	Min.	30 Sec.	20 Sec.
1 time	5.00	2.75	2.00
20 times	4.70	xxx	xxx
40 "	4.55	2.60	xxx
60 "	4.45	2.55	1.90
80 "	4.35	2.50	1.85
100 "	4.20	2.40	1.80
200 "	3.70	2.35	1.75
300 "	3.20	2.10	1.70
400 "	2.75	1.80	1.50
500 "	2.60	1.55	1.30
1000 "	2.50	1.45	1.10

**8-RATES - PACKAGE PLANS****A - B COMBINATION, One Spot**

Each Class of Time, Same Day

One combination counts two times

	Min.	30 Sec.	20 Sec.
2 times	7.75	4.35	3.20
20 "	7.35	xxx	xxx
40 "	7.15	4.15	xxx
60 "	6.95	4.00	3.05
80 "	6.75	3.90	2.95
100 "	6.55	3.80	2.85
200 "	5.80	3.70	2.75
300 "	5.00	3.25	2.70
400 "	4.25	2.85	2.40
500 "	3.95	2.40	2.10
1000 "	3.85	2.30	1.75

Standard Form of Rate Card recommended by the American Association of Advertising Agencies, Incorporated

**6-RATE POLICIES**

(Continued)

- c - Advertisers who earn new discount rates  
will receive rebates.

**7-RATES - ANNOUNCEMENTS**

(Continued)

**Class B**6:00 - 6:29 A.M., 6:30 P.M. - Midnight  
Mon. - Fri.

S.O - Midnight, Saturday &amp; Sunday

	Min.	30 Sec.	20 Sec.
1 time	3.70	2.05	1.50
20 times	3.50	xxx	xxx
40 "	3.40	1.95	xxx
60 "	3.30	1.90	1.45
80 "	3.20	1.85	1.40
100 "	3.15	1.80	1.35
200 "	2.75	1.70	1.30
300 "	2.40	1.55	1.25
400 "	2.05	1.35	1.10
500 "	1.95	1.15	1.00
1000 "	1.85	1.05	.85

**8-RATES - PACKAGE PLANS**

(Continued)

**"Seven for Six" Plan**

- a - Seven run of schedule twenty-second spots  
per week, \$6.00 per week.
- b - One year, Non-cancellable contract.
- c - Spots ordered under the "Seven-for-Six"  
plan cannot be combined for discount  
purposes.
- d - Station-supplied copy limited to one change  
per month.

**10-RATES - PROGRAMS & NEWS**

News and Program Rates on request.

**11-GENERAL**

- a - Sports - WOH I carries Cleveland Browns,  
High School Sports, Etc. Contact Sales  
Manager.
- b - Contracts - One year from Date of First  
announcement. AAAA Form Accepted.
- c - Copy and Length - WOH I conforms to the  
NAB Code
- d - Affidavits - On Request Only.

W O H I  
East Liverpool, Ohio

RATE CARD #10 EFFECTIVE JANUARY 1, 1965

NEWS	20x	40x	60x	80x	100x	200x	300x	400x	500x	BASE
5 min.	6.50	8.65	8.10	8.20	7.95	7.00	6.10	5.15	4.90	9.35
10 min.	12.55	12.20	11.90	11.55	11.20	9.90	8.60	7.25	6.95	13.20
15 min.	16.70	16.30	15.85	15.40	14.30	13.20	11.45	9.70	9.25	17.60

Spots in newcasts are billed at the regular spot earned rate plus 25%. Above prices include commercial continuity of 1:30, 2:10, and 3:00 in 5, 10, and 15 minute programs.

PROGRAMS	20x	40x	60x	80x	100x	200x	300x	400x	500x	BASE
2 Min.	5.45	5.30	5.15	5.00	4.85	4.20	3.72	3.15	3.00	5.70
3 Min.	6.05	5.90	5.75	5.60	5.40	4.80	4.15	3.50	3.35	6.40
4 Min.	6.70	6.50	6.34	6.20	6.00	5.30	4.60	3.85	3.70	7.05
5 Min.	7.30	7.15	6.95	6.75	6.55	5.80	5.00	4.25	4.05	7.70
10 Min.	11.00	10.70	10.40	10.10	9.80	8.65	7.50	6.35	6.05	11.55
15 Min.	14.65	14.25	13.85	13.50	12.10	11.55	10.00	8.45	8.10	15.40
30 Min.	26.15	25.45	24.50	24.05	23.40	20.65	17.90	15.15	14.30	27.50
60 Min.	41.80	40.70	39.60	38.50	37.40	33.00				44.00

Commercial Limits: 2 mins. pgs. : 40" ; 3 mins. pgs. : 60" ; 4 mins. pgs. : 1:15 ; 5 mins. pgs. : 1:30 ; 10 mins. pgs. : 2:10 ; 15 mins. pgs. : 3 mins ; 30 mins. pgs. : 4:15 ; 60 mins. pgs. : 7 mins.

Times shown all programs 5 minutes and up less 30 seconds for station identification.

SPORTS	1x	2x	3x	4x	10x	15x
Football						
Local	40.00		35.00		30.00	
Local	75.00		65.00		57.50	
Browns	20.00				15.00	
Browns	37.50				29.00	
(Penguins)						
(Penguins)	17.50	17.00	16.50	16.00	15.00	(Both Basketball & Football)

Package Deal	30.00	27.50	25.00	22.50
Local	55.00	50.00	45.00	40.00

Engineering Fees: Programs up one hour: \$5.00 Other rates on request.

Notre Dame Football:  $\frac{1}{2}$ : \$15.00  $\frac{3}{4}$ : 27.50 No discounts.

WOHI IS A SINGLE RATE CARD STATION.

8 -- RATES -- PACKAGE PLAN -- (Continued)  
Effective January 1, 1965

In order to better serve advertisers who are in the habit of purchasing several weeks a year of saturated advertising rather than continuing programs throughout a contract year, WOHI offers the following weekly package plan:

NUMBER OF SPOTS IN THE PACKAGE WEEK

Min.	30 Sec.	20 Sec.
10 Times --	42.00	34.00
15 " --	55.50	35.25
20 " --	64.00	42.00
30 " --	82.50	54.00
40 " --	104.00	62.00
50 " --	125.00	72.50

PACKAGE RATES CAN NOT BE COMBINED WITH CONTRACT SPOTS TO EARN CONTRACT RATES

Rate cards, and rates, are a vital part of successful station management. Used constructively and prepared carefully, they will do much to make management easier, public relations better, and efficiency greater. WOHI is a single rate card station; the same rates apply to both national and local spots. Spot announcement and program rate cards are simple, easy-to-understand.

cheapest, but what will do the job best.

Of course, all this is a waste of time if spot length is not controlled—running a 30 that has been recorded 36" long amounts to a 20% rate cut. We say a 60 must be at least 58", not over 61"; a 30 must be 28", not over 31"; and a 20 must be 20" or less. NO EXCEPTIONS! On agency copy that is long we simply inform the agency of the error, and make agreed upon cuts in continuity.

We have found that availability of shorter spots has increased our potential customers. We keep a customer in what we think is his category, and rates and discount schedules to some extent discourage cheaper schedules for the sake of saving money alone.

### Special Rates

We have prepared a "program" rate card. It shows rates for news programs, as well as the varying lengths of "prepared" programs. The use of the word "prepared" here is important, for it allows us to surcharge the customer, if necessary, for announcing and engineering talent, line charges, mileage, etc. "Prepared" rates mean the cost of time and control room facilities alone, not preparation of program content. If we expend any effort on preparation, or in providing more than our regular staff announcer and engineer, we charge more.

The biggest advantage of a complete rate structure is the elimination of wheeling and dealing. We can always "promo" a show, schedule exceptionally good talent at our expense, or help to merchandise—but brother if a client wants time, the price is set. It's amazing what such a firm

rate policy can do to help your sales . . . and your image.

### Announcing a Rate Change

We've noticed that many stations announce a rate change as late as possible, sometimes only a day or two before the effective date. What reaction does this cause?

To a businessman in a stable, well-organized business—say a bank—it creates budget problems. It also makes a client wonder about the station's planning. "Why didn't I know of this sooner?" he may think.

Then, a few weeks after the new rates are announced, some customers, usually the ones who yelled the day the increase was announced, get their first hiked bill. They have just cooled off, and they get hot all over again.

The last time we raised rates, we did it differently. We announced the increase *six months* before it was to become effective, with a letter explaining why it was necessary for us and why it was worth it to clients. We got all the usual gripes, but everyone had six months grace to buy at the old rates. Budgets could be planned in at least half the cases. Our friends at the newspaper tried to capitalize on the increase, but their last rate hike increase was already in effect—ours had just been announced.

Then came the date of increase. We rubber-stamped all invoices that month "This invoice reflects rate increase announced July 1, 1964." Everyone knew about it, had stewed about it, and was still on the schedule. If they weren't ready, it wasn't because they hadn't known. We have over 300 good accounts. We lost *one* because of the increase, just one—a 10% across-the-board hike. ●

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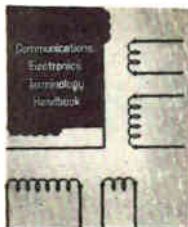
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