Aug. '49

* Edited by * Milton B. Sleeper

PRINCIPAL TELEVISION AREAS

Based on the FCC's Proposed Allocations Plan, Released July 11, 1949

VHF AND UHF ALLOCATIONS TO AREAS OF 200,000 POPULATION OR MORE

AREA	POP. thous.	VHF	AREA	POP. thous.	VHF channels	UHF channels	AREA	POP. thous.	UHF channels
Birmingham	408	3	Albany	432	1	2	Akron	349	3
Boston	771	4	Atlanta	302	4	2	Bridgeport	217	2
	3,397	7		.047	3	2	Canton	200	2
Columbus	365	3		857	3	1	Easton	325	2
Dallas	377	3	Buffalo		3	2	Fall River	225	3
Denver	384	5	Cincinnati	789	-	2	Hartford	502	3
Fort Worth	208	3		1,214	4	4	Lawrence	232	2
Houston	510	4	Dayton	271	2	2	Scranton	630	2
Los Angeles		7		2,296	3	2	Youngstown	372	3
Kansas City	399	4	Dist. of Col	908	4	1	9 Areas	3,052	22
Memphis	332	5	Grand Rapids.	210	2	2			
Milwaukee	587	4	Indianapolis .	387	3	נ	MARKET	AN AL 3	
Minneapolis	911	6	Louisville	434	2	2			
Nashville	242	4	New Haven	308	1	2	AREAS OF 200,0		
Newark	430	1	Philadelphia	2,899	3	1		IF VHF-U	
New Orleans	540	5		1,994	2	2	Areas 2:	-	9
New York 1	1,691	6	Portland, Ore.	406	5	1		36 16,92	•
Okla. City	221	3	Providence	712	1	2	Channels 11		
Omaha	224	3	Rochester	412	1	3	AREAS OF 100,00 Areas		
St. Louis	816	6	San Diego	256	3	2		72 2,36	
St. Petersburg	210	6	Seattle	453	4	2	Channels 5		
Salt Lake City	204	5		341		2	ALL AREAS OF 100		
San Antonio	319	5	Toledo			38	Areas 4		
San Francisco	1,428	6	21 Areas1	6,928	55	38	Pop., thous. 30,3		- +
Syracuse	258	3						4 88-6	
25 Areas	8,136	111							

VHF AND UHF ALLOCATIONS TO AREAS OF 100,000 TO 200,000 POPULATION

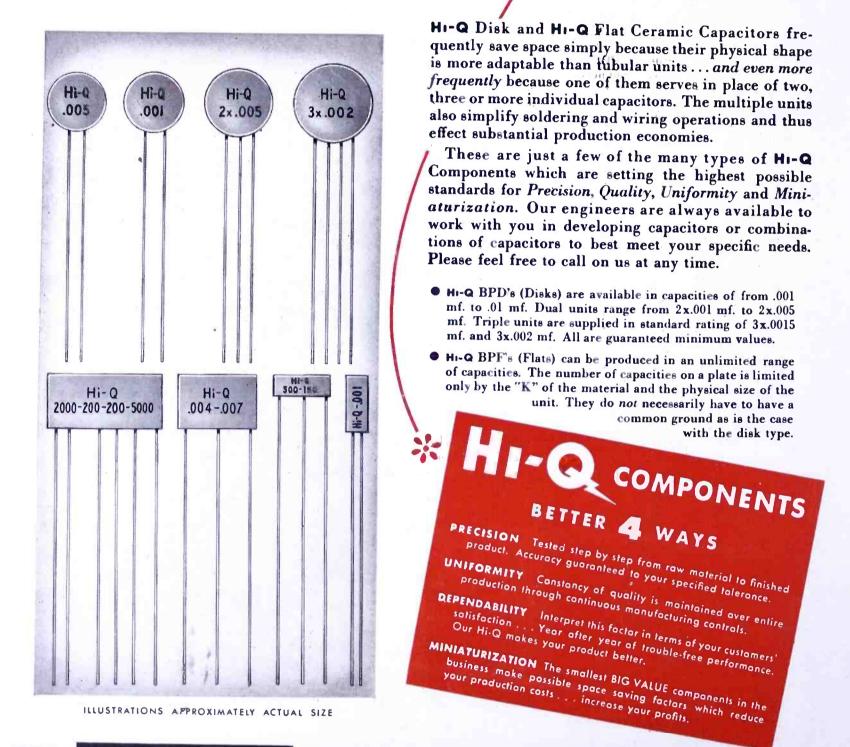
AREA	POP.	VHF	AREA	POP. thous.	VHF	UHF channels	AREA	POP. thous.	UHF channels	
	thous.	channels	n: 1 .	145	l	2	Altoona	114	1	
Charlotte	101	3	Binghamton		300	2		100	2	
Chattanooga .	193	- 3	El Paso	116	2	4	Atlantic City.		3	
Des Moines	184	3	Erie	124	3		Austin	106	3	
Duluth	136	5	Hamilton, O.	112	1	1	Flint	189	3	
Jacksonville	173	5	Johnstown	152	2	1	Fort Wayne	118	2	
		2	Lancaster	132	1	2	Gary	112	1	
Knoxville		3	Lansing	110	1	1	Harrisburg	173	2	
Little Rock	127	4	Moline	175	2	1	Kenosha	116	3	
Miami	172	4		191	5	2	Reading	175	2	
Mobile	115	4	Norfolk		3	1	Saginaw	153	2	
Portland, Me.	106	2	Peoria		- <u>-</u>	1			2	
Contraction of the second s		2	Phoenix		5	2	San Jose	129	3	
Shreveport		3	Port Arthur	139	2	3	South Bend	101	2	
Spokane	141	4	Richmond	193	3	3	Sp'gfield, Mass.	150	2	
Tacoma	156	2	Sacramento	159	2	2	Trenton	125	3	
Tuisa	189	3	Utica	197	1	1	Waterbury	145	2	
Wichita		3	Wilmington	189	i	2	Worcester	194	2	
15 Areas	2,172	53	16 Areas	2,360	33	27	16 Areas	2,200	37	
Convieta 1040	EAA TV	Mananina								

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9th Year of Service to Management and Engineering

COMPO TS-

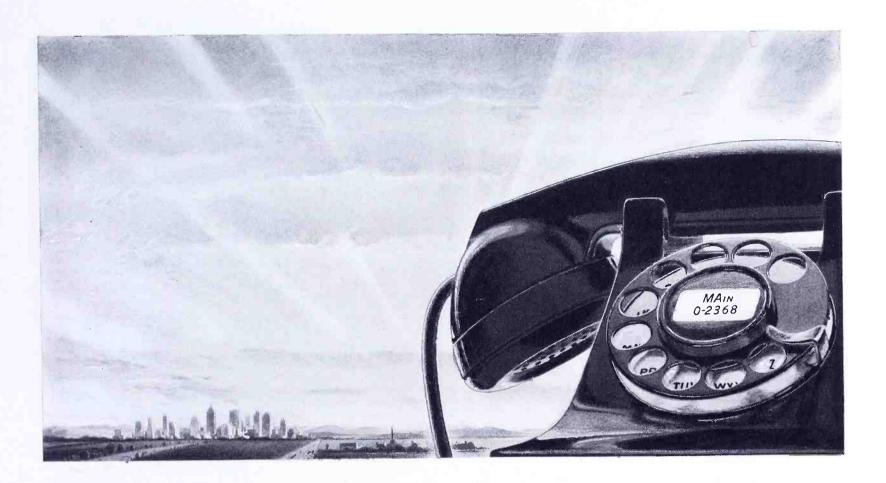
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- - -

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Neither chance nor mere good fortune has brought this nation the finest telephone service in the world. The service Americans enjoy in such abundance is directly the product of their own imagination, enterprise and common sense.

The people of America have put billions of dollars of their savings into building their telephone system. They have learned more and more ways to use the telephone to advantage, and have continuously encouraged invention and initiative to find new paths toward new horizons.

They have made the rendering of telephone service a public trust; at the same time, they have given the telephone companies, under regulation, the freedom and resources they must have to do their job as well as possible.

 I_N THIS climate of freedom and responsibility, the Bell System has provided service of steadily increasing value to more and more people. Our policy, often stated, is to give the best possible service at the lowest cost consistent with financial safety and fair treatment of employees. We are organized as we are in order to carry that policy out. **BELL** Telephone Laboratories lead the world in improving communication devices and techniques.

Western Electric Company provides the Bell operating companies with telephone equipment of the highest quality at reasonable prices, and can always be counted on in emergencies to deliver the goods whenever and wherever needed.

The operating telephone companies and the parent company work together so that improvements in one place may spread quickly to others. Because all units of the System have the same service goals, great benefits flow to the public.

Similarly, the financial good health of the Bell System over a period of many years has been to the advantage of the public no less than the stockholders and employees.

It is equally essential and in the public interest that telephone rates and earnings now and in the future be adequate to continue to pay good wages, protect the billions of dollars of savings invested in the System, and attract the new capital needed to meet the service opportunities and responsibilities ahead.

There is a tremendous amount of work to be done in the near future and the System's technical and human resources to do it have never been better. Our physical equipment is the best in history, though still heavily loaded, and we have many new and improved facilitics to incorporate in the plant. Employees are competent and courtcous. The long-standing Bell System policy of making promotions from the ranks assures the continuing vigor of the organization.

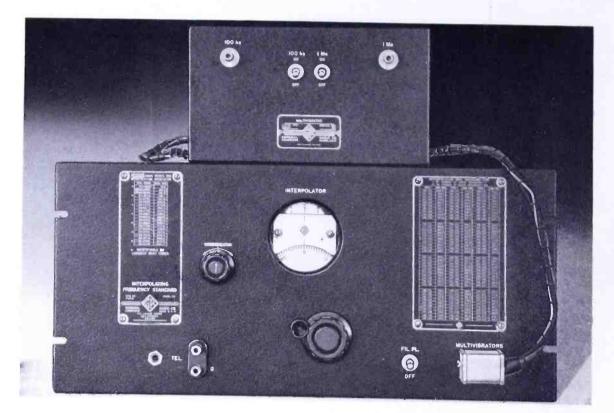
WITH these assets, with the traditional spirit of service to get the message through, and with confidence that the American people understand the need for maintaining on a sound financial basis the essential public services performed by the Bell System, we look forward to providing a service better and more valuable in the future than at any time in the past. We pledge our utmost efforts to that end.

LEROY A. WILSON, President American Telephone and Telegraph Company. (From the 1948 Annual Report.)

BELL TELEPHONE LABORATORIES PIONEERS IN THE RESEARCH OF FM. RADIO AND TELEVISION, AND ACTIVE IN DEVELOPING IMPROVEMENTS IN BOTH FIELDS TODAY.



August 1949-formerly FM, and FM RADIO-ELECTRONICS



FREQUENCY MEASUREMENTS UP TO 3,000 MC WITH ACCURACY OF = 25 PARTS PER MILLION

•Between 100 and several thousand megacycles, the present accuracy of heterodyne frequency meters ranges between 0.01 and 0.1 per cent. Continually increasing importance of frequencies within this range call for increased accuracy of measurements.

A reference standard and precise interpolation offer the simplest, most inexpensive and most direct method of increasing the accuracy of heterodyne frequency meters.

The Type 1110-A Interpolating Frequency Standard is composed of two units: a frequency standard variable over a range of 1000 to 1010 kc (1%), and a multivibrator unit for frequencies of 1 Mc and 100 kc. The frequency standard consists of a temperature-controlled 950 kc crystal oscillator, a highly-stable 50-60 kc bridge-type variable-frequency L-C oscillator, a modulator and a filter for selecting the sum of the two frequencies at the final output.

When the 100 kc multivibrator is used, the 100th harmonic has a range of 1% as the standard frequency is changed over the full range of the dial, covering 10.0 to 10.1 Mc. The multivibrator harmonics give complete frequency coverage from 100 Mc upward for the 1 Mc unit, and from 10 Mc upward for the 100 kc unit.

FEATURES

- ACCURACY OF MEASUREMENT: over-all accuracy is ± 25 parts per million using oscillator dial directly. If oscillator is carefully trimmed in terms of the crystal, the over-all accuracy is limited principally by the error of the crystal, or about ± 10 parts per million at room temperatures.
- SIMPLE TO CHECK ABSOLUTE ACCURACY: harmonics of multivibrators fall at all WWV standard frequencies. With suitable receiver the absolute accuracy, including that of the 950-kc crystal, may be checked readily.

ZERO BEAT ADJUSTMENTS: no need for wide-band circuits or wide-band interpolating methods.

The Type 1110-A Interpolating Frequency Standard can be used for frequency measurements with high-frequency receivers provided the receiver calibrations can identify frequencies if separated by as little as 1 per cent.

TYPE 1110-A INTERPOLATING FREQUENCY STANDARD \$725.00





Formerly, FM MAGAZINE and FM RADIO-ELECTRONICS

VOL. 9 AUGUST, 1949 NO. 8

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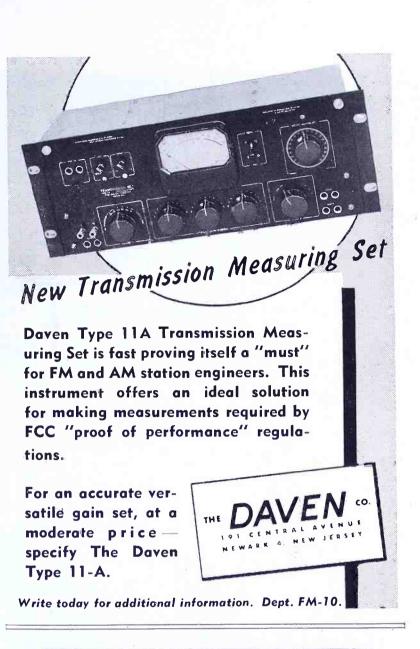
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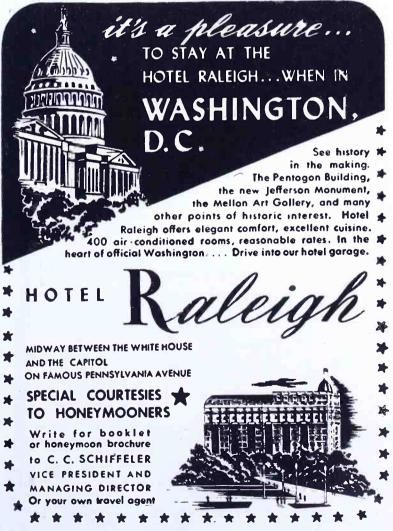
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Publication Office: 264 Main St., Gt. Barrington, Mass. Tel. Gt. Barrington 500 FM-TV Magazine is issued on the 20th of each month. Single copies 25c—Subscription rate: \$6.00 for three years, \$3.00 for one year in the U. S. A.—Canada, add 50c per year postage—foreign, add \$1.00 per year postage.

Contributions will be neither acknowledged nor returned unless accompanied by adequate postage, packing, and directions, nor will FM-TV Magazine be responsible for their safe handling in its office or in transit.





Entered as second-class matter August 22, 1946, at the Post Office, Great Barrington, Mass., under the Act of March 3, 1879. Additional entry at the Post Office, Boston, Mass. Printed in the U. S. A.

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Juality



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S ET production by RMA members to the first of June showed TV leveling off, and FM and AM down slightly below May. In any study of these figures and the trends they disclose, two qualifying factors should be borne in mind.

First, RMA figures do not include TV set production by Admiral. This concern has issued figures that show a monthly output of some 40,000 TV sets.

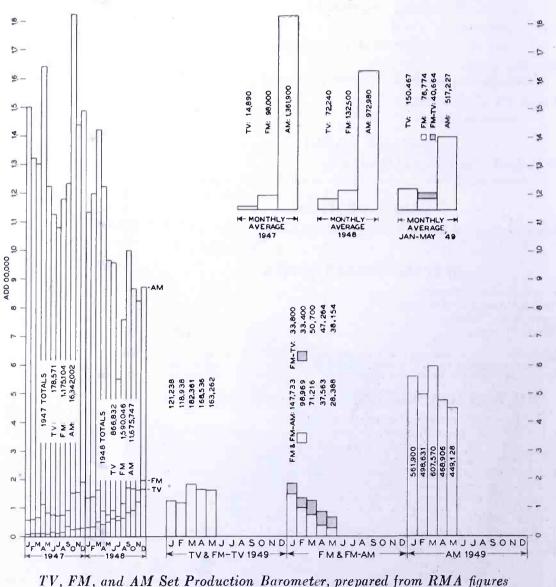
Second, in relating figures for FM sets to audience growth, an adjustment must be made for transitcasting and storecasting receivers. These sets may add little to the number of sets produced, but each one represents thousands of added FM listeners.

That is significant in any comparison with the AM audience, which is definitely on the decline. Even taking 10 years as the average useful life of an AM receiver, to maintain the postwar figure of 70,000,000 AM sets in use it would be necessary to produce 580,000 sets per month as replacements. In 1949, that figure was only reached in March. May hit a postwar record low, and June and July will certainly be lower still. And of course the RMA figures include export models.

Average AM set production for 7 months in 1949 will probably run 700,-000 short of the number required as replacements, indicating a 10% drop in the total AM sets in use.

Speculation is rife as to the effect of the FCC's allocations plan on TV set production. Will VHF sets still sell in areas where it is proposed to add UHF channels? What will happen where people have expected more VHF assignments, only to learn that they may not have any added service until UHF transmitters are installed? Will the manufacturers promote TV converters? Or will they come up with other ideas?

So many factors are involved that we can only hope for the best, and wait until public reaction is expressed by its effect on production schedules.



FM and TELEVISION



Told You and Your Customers The Truth About Television!

The Federal Communications Commission announced on May 26, that it expects to open new ultra high frequency channels this year. Thus—as Zenith predicted—when you sell Zenith Television, *your* customers are protected for the proposed new channels. Yes, Zenith told you—and America—the truth about Television.

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THIS MONTH'S COVER

Release of the FCC's television proposal prompts three extremely important questions: 1) What do the allocations mean in terms of potential audiences large enough to support profitable broadcast operations? 2) Where will we have the large markets for TV sets? 3) What is the breakdown on VHF-only, V-UHF, and UHF-only in those areas? The summary of the allocations, presented on this month's cover, answers all three of those questions. It shows the markets, their population, and the VHF and UHF stations planned for each one. What no one knows at this time is the extent to which the proposed allocations may be modified.



WHAT'S NEW THIS MONTH

1. FACTS ABOUT FM RECEPTION

FM Reception2. Data on Industrial Services2. Price Competition Is Keener on TV Sets

1. Strong feeling has been expressed at the FCC in favor of prohibiting the duplication of programs on FM and AM. No explanation of this opinion in terms of public interest, convenience and necessity has been forthcoming, but it would be interesting to know the reasoning behind this new idea.

We have found that, for one who is to write about radio, there is no substitute for listening to it. Presumably, listening is even more necessary to those who are charged with the public responsibility of regulating radio to the end that the best broadcast service will be made available to the largest number of people.

Of course, there are some sets in some places that give what might be called perfect AM reception. They may have such an installation at the FCC offices. If so, the Commissioners may feel that, since they get completely satisfactory reception of AM programs, the duplication on FM is a waste of FM channels.

And they would be completely justified in stopping FM-AM duplication if that were the prevailing condition in metropolitan and rural areas. Only it isn't.

We haven't ever listened in at the FCC Washington offices, but we did check reception recently right across the street, at Hotel Raleigh. Our room was equipped with a good AM set, too, but heaven help the people who have to put up with the amount of noise and interference we heard there in order to hear even news programs. As for music—it just wasn't worth the struggle. So we just unlimbered an FM table model, and settled down to a little geniune enjoyment which included the Lux Theatre, one of our favorite programs. If there was any waste of radio channels in FM-AM duplication, as far as we were concerned, it was in the AM transmission!

Here it should be pointed out that the set we used, although an inexpensive model, provided high sensitivity and good limiting action. Some receivers we have encountered would have been just as noisy on FM as the hotel's AM set.

If it seems unreasonable to say that radio channels are wasted not by FM but by AM, consider this incident: At Great Barrington, we were listening to a give-away program on WLAD-FM at Danbury, Conn., 64 miles away. We heard the mc call a telephone number at Candlewood Lake, about 8 miles from the transmitter. The woman who answered didn't have her radio on, but the mc gave her time to tune in, and even told her the station's AM frequency. Then we heard the mc say: "You can't get us? There's a storm? Well, that's too bad!" Yes, it certainly was too bad that she couldn't hear the AM signals at 8 miles while the FM signals were strong at 64 miles!

But that's not an unusual situation. There's a Mutual AM station 22 miles away in Pittsfield, but we've never heard it. We get our Mutual programs on FM from Springfield, at a distance of 36 miles.

Why, we didn't have any NBC service at all after sundown, even though WTIC Hartford, 34 miles away, puts out 50,000 watts on AM, until WTIC-FM was boosted to its full power.

And here's one for the record: The only commercial station in the New York City area, AM or FM, that we can hear (Continued on page 8)



WHITE RIVER

Bluff

THIS advanced system of taxicab dispatching used by Red Cab, Inc., of Indianapolis, Indiana, was especially developed by Red Cab, Inc., with the assistance and technical advice of Motorola Radio Engineers to answer the problem of congestion of the single radio frequency allowed to taxicab operators. Replacing the single central station and its single dispatcher with five independent stations, the system makes it possible for a large cab company to conduct many more times the business and radio dispatching without jamming the air. The five stations are

controlled by a set of toggle switches under the various dispatchers' fingertips so that any number of dispatchers from one to five may be used and so that each dispatcher may select one station at a time or any combination.

MASHINGTON

INDIANAPOLIS

And in every set in the 111 radioequipped cabs, Sylvania's rugged Lock-In Tubes are firmly seated in their sockets, performing admirably day in and day out, under all kinds of jarring road conditions! For information on Sylvania Tubes see Sylvania Distributors, or write Radio Division, Emporium, Pennsylvania.



30 TH ST

E. WASHINGTON

SQUENEASTON

DR.

PROSPECT ST.

SHERMAN

SYLVANIA RADIO TUBES IN

Motorola_RADIOS SPEED THE

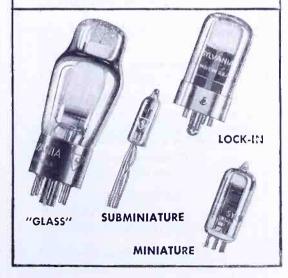
CAB-DIRECTING MESSAGES!

MICHIGAN ST.

CHURCHMAN

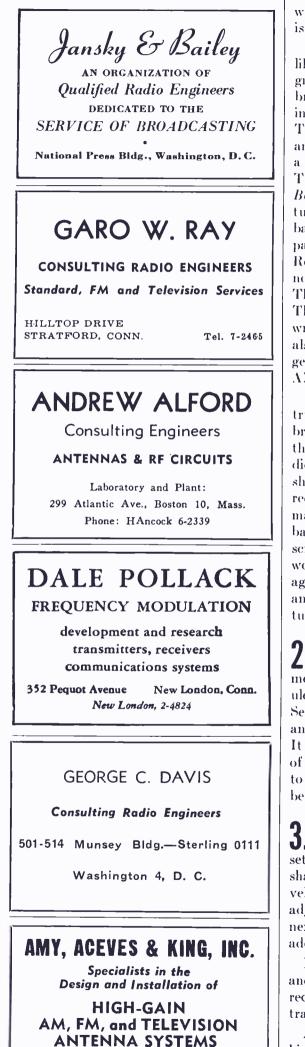
KEYSTONE

Red Cab driver receiving radioed instructions for picking up a fare in his district, in city of Indianapolis.



RADIO TUBES; CATHODE RAY TUBES; ELECTRONIC DEVICES; FLUORESCENT LAMPS, FIXTURES, WIRING DEVICES; ELECTRIC LIGHT BULBS; PHOTOLAMPS August 1949—formerly FM, and FM RADIO—ELECTRONICS





LOngacre 5-6622 11 West 42nd St., New York 18, N. Y.

WHAT'S NEW THIS MONTH

(Continued from page 6)

with positive, day-to-day dependability is WQXR-FM!

So some of the Commissioners would like to confine the most interesting programs to AM? Well, some of the AM broadcasters might cheer such a decision, in the hope of discouraging FM listening. That might explain a newspaper clipping and an indignant letter we received from a reader located in a suburb of Boston. The clipping was a full page from the Boston Sunday Herald, carrying a feature story about the coverage of the baseball games by WHDH, and a halfpage advertisement headed "Hear the Red Sox, Braves games over WHDH-now 50,000 watts, 850 on your dial." There was no mention of WHDH-FM. That was what riled our reader, for he wrote: "Their high-power FM station is also carrying the ball games with greater geographical coverage than WHDH-AM!"

If the FCC is concerned about spectrum utilization to the end that the best broadcast service be made available over the largest area, listening experience indicates that the most-wanted programs should be limited to FM. The use of records, even worn-out ones, doesn't make any difference on AM, because the background noise masks the needlescratch. The end result of such a plan would certainly benefit listeners, encourage the expansion of FM broadcasting, and give the audio receiver manufacturers a much-needed break.

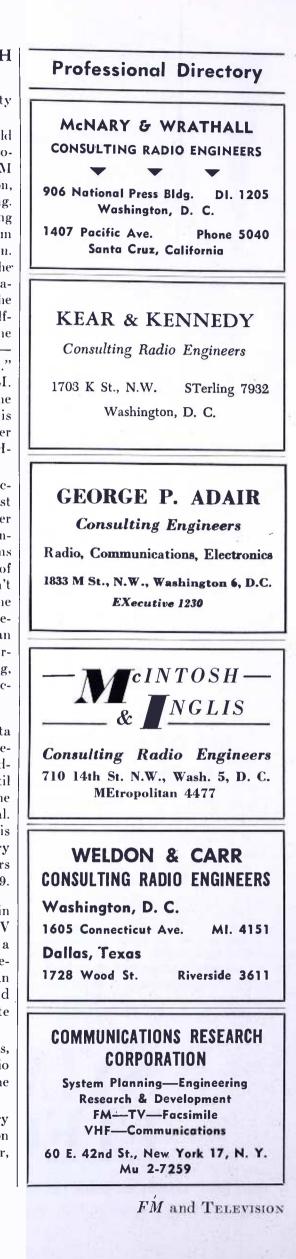
2. Part 3 of the quick-reference data on frequencies and technical requirements for mobile radio systems, scheduled for this issue, was put over until September in order to accommodate the analysis of the FCC's television proposal. It was not that the mobile radio data is of less importance, but it was necessary to get the TV information to our readers before the hearing starts on August 29.

3. Watching the steady increase in values offered at lower prices by TV set manufacturers, it's clear that a sharply competitive price situation is developing in this field. Is this merely an adjustment? What about this fall, and next year when new stations will create additional markets?

Let's take a look at the basic factors, and make some comparisons with audio receiving sets. First, let's go back to the transmitters, where the signals start.

Audio stations transmit signals of very high audio quality. Thus, depending on the design (and price) of the receiver,

(Continued on page 9)





WHAT'S NEW THIS MONTH

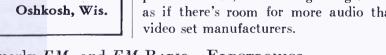
(Continued from page 8)

reproduction in the home may range from mere intelligibility to virtual recreation of the original performance as it is heard by the studio audience. Just what the individual customer spends is determined by his tastes and his pocketbook, and the skill and imagination of the salesman. Excluding cabinet cost, it may be anywhere from \$10 to \$1,000. Within this broad price range, each set manufacturer can find a market for the type of equipment to which his facilities are best suited.

Television presents a totally different set of conditions. The human eye sets a fairly uniform, minimum standard of optical quality. Below it, the eye tires quickly, and fails to perceive sufficient details, or information. The maximum degree of optical quality is fixed, under Government regulations, by the RF bandwidth assigned to the transmitter. This has been set at a point which is considered acceptable to the human eye, and is based to some extent on years of experience with the optical quality of motion pictures.

Now, there is only a very narrow range between the minimum acceptable quality of TV reception and the maximum of which transmitters are capable. As a result, there is very little lattitude in the design of TV receiver circuits. The eye will not accept any appreciable deterioration of optical quality, nor can it see any justification for expensive design and construction. Aside from cabinetwork, and most TV sets are table models now, the cheapest set must give about the same performance as the most expensive model with the same size of picture tube. As for the highest-priced sets, it is impossible to obtain great improvement over the most inexpensive models of accepted performance because of limitations imposed by the transmission. This is apart, of course, from the integrity of the design, the quality of the product, and the extent of the service with which the manufacturer backs up his guarantee. However, while these are factors of the retail price, they cannot be demonstrated by dealers as point-of-sale features.

Such a narrow performance range limits the price range, and a narrow price range limits competition to a matter of production cost and sales expense. This strengthens the position of the large producer, and weakens the position of the smaller concern. It's becoming increasingly clear that it is easier to get into manufacturing TV sets than to make a profit on them, and it's beginning to look as if there's room for more audio than video set manufacturers.





August 1949—formerly FM, and FM RADIO-ELECTRONICS

NATIONWIDE TV SERVICE

NEW FCC PLAN, COMBINING VHF AND UHF, IS INTENDED TO PROVIDE TELEVISION PROGRAM SERVICE TO 70,000,000 PEOPLE IN 1,421 AREAS—By MILTON B. SLEEPER

A FTER the most intensive and exhaustive study ever made by the FCC and co-operating consultants, the Commission has released its proposal for televison rules and frequency allocations.

From any angle of approach, it is easy to find many faults in the plan. If, however, the plan is examined in the light of its intended purpose, *viz.*, to give the best service possible to the greatest number of people, there is little to criticize except that, from a commercial point of view, the allocations are unrealistic.

Basic Allocations Plan:

The new TV plan retains the present 12 VHF channels, numbered 2 through 13, and adds forty-two 6-me. UHF channels, to be numbered 14 through 55. Channel 14 will start at about 470 or 500 me., depending upon the action taken with respect to a request by Bell Telephone Laboratories for space to operate a broad-band mobile communications system just below 500 mc. Of the 42 UHF television channels 32 will be for metropolitan stations and 10 for community stations. It is proposed that the same transmission standards will be used for these UHF stations as for the present VHF stations.

The balance of the UHF band, allocated to experimental TV, will be kept available for further research.

Color Television Transmission:

In its notice of the new TV proposal, the Commission announced that it will consider changes in transmission standards for channels 2 through 55 looking toward color transmission or other television systems only if it is shown that operation is possible within a 6-mc. channel, and that existing TV sets designed for present standards will be enabled, by "relatively minor modifications," to receive programs transmitted in accordance with any newly-proposed system.

This limitation seems to rule out any possibility of color transmission on channels 2 to 55. Certainly any reduction of detail below present standards would not be acceptable to viewers, and it is difficult to see how the present amount of information transmitted within a 6-mc. band could be trebled, as would be necessary to transmit three colors.

Wilmotte-deMars Polycasting:

The FCC will consider evidence with respect to the Polycasting system proposed by Raymond M. Wilmotte and Paul A. deMars in a petition filed with the Commission on November 30, 1948. The complete text of their proposal was published in FM-TV for December 1948.

Changes in VHF Allocations:

Only three changes in VHF allocations are contemplated. In Syracuse, N. Y., the present channel 5 assignment to WSYR-TV would be shifted to channel 3.

Channels 2, 6, and 11, now allocated to Rochester, N. Y., would be changed to 5, 22, 32, and 44. This would shift WHTM from channel 6 to 5.

Channels 2, 4, 5, 7, and 9, now allocated to Cleveland, would be changed to 8, 11, 40, and 42. This would shift WXEL from channel 9 to 11.

Under these modified assignments, Rochester, which was an all-VHF area, would become a V-UHF area, with only one VHF station. There would be a similar shift in the status of Cleveland, with VHF and UHF stations equally divided.

VHF. Interference:

The Commission's proposal makes no reference to interference between stations now on the air. Presumably, it is expected that this will be corrected by synchronized operation and the offset-frequency method now being tested. Such reports as have been made public indicate that these may prove to be satisfactory solutions.

Number of Stations & Areas:

A summary of the new allocations plan shows the following totals for VHF, V-UHF, and UHF areas:

	Areas	Population	Stations
VHF	91	31,554,000	269
V-UHF	116	21,228.000	232-221
UHF	1,213	16,900,000	1,431

Thus, provisions are made for a total of 488 VHF and 1,652 UHF transmitters.

It is very deceiving to draw any conclusions from these total figures as to potential audiences and markets for transmitters and receivers. The reason is that, in drawing up the allocations, no consistent effort was made to relate the number of allocations to the population of each area.

For example, VHF-only allocations were made in areas of as few as 1,000 population. Some 60 were made to areas of less than 50,000. V-UHF allocations were made to areas as small as 4,000 population, and allocations were made to 880 areas with populations of 100 to 10,000. We cannot expect, therefore, that all the allocations will be taken up. Rather, it appears that allocations were made wherever possible, whether or not a particular area had sufficient population to support program service.

Reasoning backward, it appears that those areas, which could have stations but can't support them will only get service if and when the range of transmitters in adjacent areas is increased beyond the estimates used for the allocations plan.

UHF for Large Cities:

Some apparent inequalities may be corrected in the forthcoming hearing. To pick just one instance, Boston, with a population of 771,000, is scheduled for 4 VHF channels, but none on UHF. Miles City, Mont., population 7,000, could have 3 VHF and 3 UHF channels. While Boston may be properly limited to 4 channels in the VHF band, it seems logical that it should have some UHF assignments, also. A similar discrepancy appears to exist in Chicago and New York City. In other words, failure to relate allocations to population has resulted in allowing for an excessive number of stations in low-population areas, and a potential insufficiency in highpopulation areas.

Perhaps it would be better not to confuse the public in those VHF-only sections now. If on the other hand, UHF television develops rapidly and successfully, it may be found advisable to move all TV broadcasting to UHF. Then, if UHF channels up to No. 55 are not available to the VHF stations, it will be necessary to give them still higher frequencies. That would be all right except that, quite probably, the new UHF sets won't be made to tune much above channel 55.

FCC's Television Hearing:

A hearing before the Commission en banc will commence at 10:00 A. M., on Sept. 26, to hear testimony and to receive evidence regarding the allocations proposal or other proposals as have been filed by interested persons. Prevailing opinion is that the hearing may extend over two to three months.

Following the closing of the record, the Commission will adopt the final rules, regulations, and standards. At this time, it seems probable that the green light for televison will be flashed about the first of February, 1950.

Analysis of the FCC Plan:

In the following pages, the FCC's proposal, with appropriate explanations and comments, is presented in six parts:

1. List of cities showing proposed frequency assignments and population.

1:

States are grouped according to standard geographical sections. Under each state, all VHF areas are listed first, then V-UHF areas, and UHF areas last. VHF channels already in use, or for which C.P's. have been issued, are enclosed by parentheses.

2. List of channels by numbers, showing proposed areas for each channel.

3. List of cities with population of 200,000 or more, and cities of 100,000 to

200,000 population, divided as to VHFonly, V-UHF, and UHF-only allocations. The complete table prepared for this section appears on front cover.

4. List of principles, in terms of priorities, on which the allocations table was planned.

5. Specifications of power, grades of service, and antennas.

6. Specifications of separation between stations, and service radii.

REAS proposed assignments of television channels

To help clarify the real significance of the FCC's plan for assigning television channels 2 to 55, the following allocations table has been arranged in state groups according to the standard plan for showing national distribution.

It must be emphasized that, in analyzing allocations in terms of potential audiences and markets for equipment, total figures taken from this table have little significance. Many of the allocations are most unrealistic, as is the case of 2 VHF and 3 UHF allocations to Havre, Mont., with a population of 6,000; or 4 VHF and 2 UHF channels for Butte, Mont., of 37,000; and 2 VHF and 4 UHF channels to Ely Nev., of 4,000. Moreover, 880 of the areas to which allocations are proposed have less than 10,-000 population. Thus, to obtain a clear picture of any market area, it is necessary to transfer the data from the table to a map of the area in question.

In this table, VHF frequencies now in use, or for which C.P.'s have been issued, appear within parentheses. Figures at right are for population in thousands.

NEW	ENGLAND		Jamestown	17	43	Danville	37	33	Greenville	38 40		3.5
			Malone	30	9	Emporia	27	3	Greenwood	31		13
	4 V-UHF 6 UHF		Massena	21	11	Fredericksburg	41 45	10	Myrtle Beach	37		2
	6 13	106	Middletown	35	22	Harrisonburg	36	8	Orangeburg	45		11
	8 10 19 21 23	19	Ogdensburg	34	16	Lexington	42	4	Rockhill	29		15
Bangor-Old Town		37 5	Olean	19	22	Lynchburg	14 16 31	51	Seneca	35		2 32
	2 7 14 16 18	6	Oneonta Oswego	27 20	12 22	Martinsville Norton	32	10	Spartanburg Sumter	22 24 32		16
Ft. Kent-St. Francis Biddeford-Saco	14 16	28	Plattsburg	32	16	Petersburg	21	31	Walterboro	34		3
	44	7	Poughkeepsie	40	40	Pulaski	39	9	Wanerboro	34		0
	25 27 29	7	Saranac Lake	39	7	Staunton	34	13	GEORGIA 3	VHE 2 V-UHE	: 27	UHE
	28 30	58	Tupper Lake	19	5	Suffolk	23	11	Cairo	6	*	5
	31 33 35	17	Watertown	41 43	33	Waynesboro	38	7	Cordele	13		8
Waterville	32 34	16				Winchester	25	12	Savannah	3 9 11		96
			NEW JERSEY	1 VHF 5 UHF					Atlanta	(2 5 8) 11 32	34	302
	IRE 1 V-UHF 5 UI	HF .	Newark	(13)	413		NIA 1 VHF 3 V	-UHF	Augusta	6 12 17		66
	9 29	81	Asbury Park	46	15	10 UH	F		Albany	42		19
	26	19 27	Atlantic City	23 25 27	100 38	Beckley	4	13	Americus	20 21 23		21
ooneora	31 33 35	13	New Brunswick Trenton	48 15 17 41	125	Charleston	8 12 30 40	68	Athens Bainbridge	21 23		6
addonia	35	15	Vineland	39	8	Huntington-	151.05	70	Brunswick	37 39		15
Littleton- Bethlehem	40	5	vinerana	57	Ŭ	Ashland	(5) 25 7 28 41	79 61	Cartersville	39		6
	39 41	14	PENNSYLVAN	IA 5 V-UHF L	6 UHF	Wheeling Bluefield	15	21				
			Erie	(12) 45	134	Clarksburg	17	31	Cedartown	19		9
VERMONT 1 V	-UHE 5 UHE		Johnstown	6 (13) 21	152	Elkins	23	8	Columbus	36 38 40		53
	3 20 22	8	Lancaster	(4) 26 28	132	Fairmont	31	23	Dolton	25		1.0
	18	10	Philadelphia	(3 6 10) 44	2,899	Hinton	24	6	Dawson	25		4
Burlington	15 17	28	Pittsburgh	(3) 9 24 26	1,994	Martinsburg	27	15	Douglas Dublin	30 43		8
	38	5	Altoona	15	114	Montgomery	34	3	Fitzgerald	27		7
	37	17	Du Bois	43	12	Parkersburg	43 45	30	Gainsville	15		10
St. Albans	24	0	Easton-Allentown- Bethelhem	19 21	325	Sutton	33 19	8	Griffin	29		13
	TTC 1 VUE 7 114	c	Emporium	33	323	Weston	19	0	Jessup	35		3
	TTS 1 VHF 7 UH	771	Greensburg	48	17	NOPTH CAP	OLINA 1 VHF 3	V-UHE	La Grange	22 24		22
Boston Barnstable-	(2 4) 5 (7)	// 1	Harrisburg	22 42	173	25			Macon	14 16 18		58 7
	37	8	Hazelton	38	38			101	Milled geville Moultrie	26 15		10
Brockton	48	62	Lebanon	24	27	Charlotte Greensboro	(3) 9 11 (2) 41 43 45	59	Rome	42		26
Fall River-			Lewistown	40	13	Wilmington	5 14 16	33	Statesboro	19		5
	19 21 23	225	Meadville New Castle	47 30	19 48	Winston-Salem	6 13 17	80	Thomasville	32 34		13
Lawrence-Lowell-		000	Reading	34 36	175	Ahoski	39	2	Thomson	41		3
Haverhill	25 27	232 50	Scranton-	34 30		Asheville	14 18	51-	Toccoa	27		5
Pittsfield	28	50	Wilkes Barre	31 45	630	Belhaven	20	2	Valdosta	17		16
Springfield-	36 38	150	Uniontown	46	22	Durham	33 35	60	Waycross	21 23		17
Holyoke Worcester	43 45	194	Williamsport	29	44	Elizabeth City	31 38.40	12 17			25	11115
worcester			York	18 20	93.	Fayetteville Gastonia	42	21	FLORIDA 3	2 (4) 5 8 10	35	173
RHODE ISLAN	D 1 V-UHF					Goldsboro	26	īż	Jacksonville Miami	2 (4) 5 8 10	12	172
Providence	(11) 15 17	712			_	Greenville	36	13	St. Petersburg-	3 6 (7) 9	12	17.4
			COULT	H ATLANTIC	1	Henderson	18	8	Tampa	1113		210
CONNECTICUT	T 1 V-UHF 3 UHF				·	Hendersonville	20	8	Tallahossee	12 28		16
New Haven	(6) 20 22	308		1 V-UHF 1 UHF		Hickory	34	13 38	Apolachicolo	44		3
Bridgeport	14 16	217	Wilmington	(7) 30 32	189	High Point Jacksonville	23 25 22	30	Belle-Glade-			
Hortford-N. Britain		502	Dover	47 c	6	Kannopolis	19	25	Chosen	26		4
Woterbury	24 26	145			-	Kinston	42	15	Cleor Water Crestview	43 18		10
	- ATLANTIC		MARYLAND	1 V-UHF 5 UH		Lenoir	36	8	Cross City	24		2
	E ATLANTIC		Boltimore	(2 11 13) 14 16		Morehead City	45	4	Doytono Beoch	32 34 36		23
NEW YORK 2	VHF 5 V-UHF 19	UHF	Annopolis Cumberlond	49 c 39 44	13 39	New Bern	32	12	Deland	19		7
New York City-	(2 4 5 7		Frederick	37 44	16	Raleigh	28 30	47	Everglades	40		0.6
NE New Jersey	9 11) 1	1,691	Hagerstown	35	33	Rocky Mount	24	26 19	Fort Lauderdole	30 32		18
Syrocuse	(3 8 10)	258	Salisbury	43	13	Salisbury Shelby	21 44	14	Fort Myers	35 37		11
Albany-Schenec-						Wilson	44	19	Fort Pierce	39		8
tady-Troy	(4) 42 44	432	DISTRICT OF	COLUMBIA 1	V-UHF	Woshington	34	9	Gainesville	14 16	4.1	14
Binghamton	(12) 23 25	145 857	Washington	(4 5 7 9) 33	908				Hollywood Key West	34 19 21		13
Buffolo-Niogaro	2 (4) 7 27 (5) 22 32 44	412				SOUTH CAR	OLINA 2 V-UHI	F14 UHF	Loke City	26		6
Rochester Utico-Rome	(13) 33	197	VIRGINIA 3	V-UHF 16 UHF		Chorleston	2 8 13 28 30	71	Lakelond	33		22
Auburn	18	36	Norfolk-P'tsmouth	n-		Columbia	4 7 10 39	62	Lakeworth	28		22 7 5 3 9
Batavia	36	17		s 4 10 12 25 29	191	Anderson	33	19	Leesburg	27		5
Dunkirk	31	18	Richmond	3 (6) 8 15 17 1		Barnwell	25	2	Mariana	37		5
Elmira-Corning	14 16	61	Roanoke	7 10 20 22	69	Bennettsville	15	5	Melbourne	15		3
Hornell	39	17	Charlottesville	32 29	19	Florence	27	16	Ocala	38 21 23 25		37
lthaca	37	20	Covington	27	6	Georgetown	18	6	Orlando	21 23 23		57

August 1949-formerly FM, and FM RADIO-ELECTRONICS

Platka 40		7 Holland	27							
Palm Beach 24			26 27	15	Dothon	45	17	Ottumwa	20 38	32
	16 13	2 Iron River	14	4	Enterprise Florence	39 43	4	Red Oak	42	6
	22 24 37		30	13	Gadsden	43	15	Shenandoah	16	7
Perry 22 Plant City 21		- india child	20	9	Greenville	43	37	Storm Lake	35	5
Plant City 31 Quincy 19	· · · · · · · · · · · · · · · · · · ·	Juckson	20 22	50	Huntsville	26	13	Waterloo-Cedar Falls	22.07	
Sebring 17		Logingion	30 15	9	Jasper	20	7	Webster City	22 26 19	67
	44 12		27	5	Opelika Selma	31	8			
Sanford 29	10) Midland	28	10	Sheffield	30 45	20	MISSOURI 4	VHF 1 V-UHF 2	8 UHF
Sulphur Spgs. 45	4	Muskegan	17 19	48	Talladego	43	8	De Soto	2	o Unr
	16 18 22 34		29 31	6	Tuscaloosa	23	9 27	Kansas City	2 (4) 5 9	399
Winter Haven 41	6	i onnae	48 c	67	Troy	21	7	St. Louis	4 (5) 7 9 11 13	816
EAST NODE	CENTRAL	Port Huron	46 c	33			1	Springfield	3 10 12	61
EAST NORI	TH CENTRAL	Rogers City Saginaw-	42	3	MISSISSIPPI	2 VHF 25 UHF		Jefferson City	6 43	24
OHIO 1 VHF 5 V	V-UHF 14 UHF	Bay City	18 21 32	153	Jackson	3 9 12	88	Cape Girardeau Carrollton	45	19
Columbus (3	6 10) 365	Tawas City	25	155	Macon	2	2	Corthage	40 25	4
	7 11) 22 24 789		41 43	14	Aberdeen	15	5	Chillicotte	44	11
	5) 8 (11)	West Branch	36	2	Biloxi	31 33	17	Clinton	20	6
40				-	Brookshaven Canton	18	6	Columbia	15	18
	13) 14 16 271		2 VHF 27 UHF		Clarksdale	24	6	Flat River	31	5
Hamilton-	112	Milwaukee	(3) 6 8 10	587	Columbia	29 31 29	12	Fulton	33	8
Middletown 2 3	14 112 39 43 341	oopenior-borom	3 6 8 10 12	136	Columbus	25	6	Hannibal	25	21
	36 38 349	Antigo	22	9	Greenville	43 45	14	Hermitage	23	0.3
Canton 32			28 42	28	Greenwood	21	15	Joplin Lebanon	19 22 27	37
Chillicothe 37	20	Beloit	18	11 25	Grenada	17	6	Lexington	31	55
Gallipolis 27	7	Eau Clair	27 29	31	Gulfport	21 23	15	Louisiana	39	5
Lima 28		Fond du Lac	21	27	Hattiesburg	40 42	21	Marshall	17	9
Mansfield 21		Green Bay	40 42	46	Laurel Koscius k o	1.6 1.9	21	Maryville	30	6
Marion 33 Newark 29	35 30 31	Hayward	36	6	McComb	20 22	4	Mexico	22	9
Newark 29 Portsmouth 18		Janesville	39	23	Meridian	36 38	10 35	Moberly	36	13
Sandusky-Fremont 17	25	Kenosha-Racine Ladysmith	32 34 36 45	116	Natchez	25 27	15	Nevada Poplar Bluff	34	8
Springfield 26		La Crosse	41 43	4	Pascagoula	28	6	Rolla	21 35	11
Steubenville 22	37	Madison	14 23 25	43	Philadelphia	34	4	St. Joseph	35 37	5 76
Youngstown 14	16 18 372	Marshfield	35	10	Picayune	44	5	Salem	14	3
Zanesville 15	37	Medford	15	2	Starkville	28	5	Sedalia	29	20
		Merrill	19	9	Tupelo Vicksburg	22	8	Sikeston	26	. 8
INDIANA 2 VHF	1 V-UHF 16 UHF	Oshkosh	16 31	39	West Point	35 37 32	24	Van Buren	38	0.5
Bloomington (10)	21	Praire du Chien	30	4	Yazoo City	41	6	Washington	19	7
Tell City 3	5	Rice Lake	23	6	rdroo eny	41	/	West Plains	41	- 4
) 12 45 387	Rhinelander Shawano	39	9	WEST N	ORTH CENTRA		NORTH DAKO	TA 1 VHF 5 V	
Anderson 27 Bedford 33	42	Sheboygan	44 38	6			L	25 U		/-UHF
Columbus 43	13	Sparta	17	41		1 VHF 34 UHF		Dickinson		
	18 20 97	Stevens Point	24 26	6	Minneapolis-	2 (4 5) 7		Bismarck	2 4 9 5 7 12 20 22	6
Fort Wayne 25 3		Whitehall	20	1	St. Paul Albert Lea	(9) 11 13	911	Fargo	6 10 13 14 16 1	15 8 33
Gary 48 c		Warsaw	37	27	Alexandria	24 29	12	Grand Forks	2 4 8 33 35 39	20
Kokomo 23	34	Wisc. Rapids	33	11	Austin	16	5	Minot	3 6 10 16 18	17
LaFayette 37	29	E			Bemidji	22	18	Williston	8 11 23 25 27	6
Logansport 21 Marion 18	20 27	EAST SC	DUTH CENTRA	AL	Brainerd	43	12	Ashley	36	1
Marion 18 Muncie 32	50	KENTUCKY 1	VHF 1 V-UHF 1	опыс	Chisholm	44	7	Botteneau Bowman	32	2
Richmond 41	35	Paducah	12	34	Crookston	20	7	Carrington	43 45 17	1
Seymour 17	9	Louisville	(5 9) 29 31	434	Detroit Lakes Duluth-Superior (27	5	Cooperstown	28	1
South Bend 40 4	12 101	Ashland (see We	est Virginia)		Ely	18	~~	Crosby	36 38	í
Terre Haute 28 3	39 63	Bowling Green	34	15	Eveleth	37	4	Devils Lake	19	6
Vincennes 14	18	Corbin	45	8	Fairmont	26	7	Ft. Yates	29	ĩ
		Danville Frankfort	38	7	Faribault	21	15	Grafton	26 30	4
ILLINOIS 2 VHF 3		Glasgow	15 40	11	Fergus Falls	38	11	Harvey Hettinger	44	2
Carthage 10 Chicago 2 (4	5 7 9) 3	Hazard	23	6 7	Grand Rapids	26	5	Jamestown	32 34 25	1
2 (4		Henderson	41	13	Hastings	40	6	Kenmore	30	9
Moline-Rock	3,377	Hopkinsville	36	12	Hibbing Intern'I Falls	39 41 14 16	16		41 43	22
Island-Dav. (4 5)	42 175	Lexington	19	49	Little Falls	25	6	Larimore	45	ĩ
Peoria (6) 1	2 31 105	Madisonville	25	8	Mankato	44	6 16	Mandan	33 35 37	7
Springfield 3 17		Mayfield	17	9	Marshall	20	5	Napoleon	27	1
Aurora 414		Maysville Middlesborough	39	7	Montevideo	36	5	New Rockford Oakes	15	2
Bloomington 26 Cairo 15	33	Murray	41 39	12	Moorhead (see			Rolla	40 42 23	2
Centralia 24	14	Owensboro	44	4 30	New Ulm	28	9	Rugby	21	2
Champaign 15	23	Richmond	21	7	Northfield Owatonna	14 42	5	Stanley	42	1
Clinton 38	6	Somerset	35	6	Pine City	31	9	Stanton	14	4
Danville 19	37	Vancleve	28	.75	Red Wind	18	2 10		31	6
Decatur 34 30		Winchester	42	9	Rochester	32 34	26	Wahpeton	34	4
Elgin 20	38	TENNESSEE 5	VHF 22 UHF		St. Cloud	17 19	24	SOUTH DAKO	TA 3 VHF 2 V	11115
Gailsburg 21	29	Chattanooga	3 9 12	193	Thief River Falls	24	6			-UHF
Harrisburg 32	ĩí	Knoxville	6 10 13	152	Virginia	21	12	26 UI Mitchell		
Herrin 37	9	Lexington	5	3	Wadena Willmar	32 15	3		4 3 6 10	11
Jacksonville 23	20	Memphis	(4) 6 8 10 13	332	Winona	38	8 22		7 12	14
Joliet 24 Kankakee 30	42	Nashville	2 (4) 7 11	242	Worthington	23	<u>~ ~</u>		3 9 26 30	17
Kewanee 16	22	Bristol	26	14			0	Sioux Falls	11 13 14 16 18	41
La Salle 33	17	Clarksville Cleveland	42 30	12	IOWA 8 VH				20	3
	13	Columbia	21	11	Ames	(4)	13		41 43 45 30	5
Lincoln 44						10				0.5
Lincoln 44 Litchfield 29	7	Cookeville			Algona Cedar Papids	(4) 10 7 9	5			2
Lincoln 44 Litchfield 29 Metropolis 22	7		37 30	4	Cedar Rapids	79	62	Chamberlin	23	2
Lincoln 44 Litchfield 29 Metropolis 22 Mt. Carmel 35	7 6 7	Cookeville Dyersburg Fayetteville	37 30 16		Cedar Rapids Charles City	7 9 12	62 2	Chamberlin Custer	23 16	2
Lincoln 44 Litchfield 29 Metropolis 22 Mt. Carmel 35 Mt. Vernon 27	7 6 7 15	Cookeville Dyersburg Fayetteville Harriman	37 30 16 17	4 10 5 6	Cedar Rapids	7 9 12 3	62 2 5	Chamberlin Custer Deadwood Dupree	23 16 35 17	0.5 2 4 0.5
Lincoln 44 Litchfield 29 Metropolis 22 Mt. Carmel 35 Mt. Vernon 27 Quincy 18 30	7 6 7 15 0 40	Cookeville Dyersburg Fayetteville Harriman Humboldt	37 30 16 17 35	4 10 5 6 5	Cedar Rapids Charles City Decorah	7 9 12 3	62 2 5 184	Chamberlin Custer Deadwood Dupree Edgemont	23 16 35 17 39 41	0.5
Lincoln 44 Litchfield 29 Metropolis 22 Mt. Carmel 35 Mt. Vernon 27 Quincy 18 30 Rockford 27 29	7 6 7 15 40 85	Cookeville Dyersburg Fayetteville Harriman Humboldt Jackson	37 30 16 17 35 24	4 10 5 6 5 24	Cedar Rapids Charles City Decorah Des Moines Iowa City Sioux City	7 9 12 3	62 2 5	Chamberlin Custer Deadwood Dupree Edgemont Gettysburg	23 16 35 17 39 41 19	0.5 2 1
Lincoln 44 Litchfield 29 Metropolis 22 Mt. Carmel 35 Mt. Vernon 27 Quincy 18 30 Rockford 27 29 Sterling 35	7 6 7 15 40 85 11	Cookeville Dyersburg Fayetteville Harriman Humboldt Jackson Johnson City	37 30 16 17 35 24 16	4 10 5 6 5 24 25	Cedar Rapids Charles City Decorah Des Moines Iowa City Sioux City Davenport, Rock	7 9 12 3 8 11 13 2 5 9	62 2 5 184 17 82	Chamberlin Custer Deadwood Dupree Edgemont Gettysburg Hot Springs	23 16 35 17 39 41 19 33	0.5 2 1 3
Lincoln 44 Litchfield 29 Metropolis 22 Mt. Carmel 35 Mt. Vernon 27 Quincy 18 30 Rockford 27 29	7 6 7 15 9 40 85 11	Cookeville Dyersburg Fayetteville Harriman Humboldt Jackson Johnson City Lebanon	37 30 16 17 35 24 16 27	4 10 5 6 5 24	Cedar Rapids Charles City Decorah Des Moines Iowa City Sioux City Davenport, Rock Island, Moline	7 9 12 3 8 11 13 2 5 9 (4 5) 42	62 2 5 184 17 82	Chamberlin Custer Deadwood Dupree Edgemont Gettysburg Hot Springs Huron	23 16 35 17 39 41 19 33 32 35	0.5 2 1 3 11
Lincoln 44 Litchfield 29 Metropolis 22 Mt. Carmel 35 Mt. Vernon 27 Quincy 18 30 Rockford 27 29 Sterling 35 Urbana 22	7 6 7 15 40 85 11	Cookeville Dyersburg Fayetteville Harriman Humboldt Jackson Johnson City Lebanon Lewisburg	37 30 16 17 35 24 16 27 29	4 10 5 24 25 6 4	Cedar Rapids Charles City Decorah Des Moines Iowa City Sioux City Davenport, Rock Island, Moline Albia	7 9 12 3 8 11 13 2 5 9 (4 5) 42 34	62 2 5 184 17 82 175 5	Chamberlin Custer Deadwood Dupree Edgemont Gettysburg Hot Springs Huron Lake Andes	23 16 35 17 39 41 19 33 32 35 27	0.5 2 1 3 11 0.8
Lincoln 44 Litchfield 29 Metropolis 22 Mt. Carmel 35 Mt. Vernon 27 Quincy 18 30 Rockford 27 29 Sterling 35 Urbana 22 Vandalia 40 Waukegan 46 c	7 6 7 15 40 85 11 14 5 34	Cookeville Dyersburg Fayetteville Harriman Humboldt Jackson Johnson City Lebanon Lewisburg Morristown	37 30 16 17 35 24 16 27 29 43	4 10 5 24 25 6 4 8	Cedar Rapids Charles City Decorah Des Moines Iowa City Sioux City Davenport, Rock Island, Moline Albia Atlantic	7 9 12 3 8 11 13 2 5 9 (4 5) 42 34 32	62 2 5 184 17 82 175 5 6	Chamberlin Custer Deadwood Dupree Edgemont Gettysburg Hot Springs Huron Lake Andes Lead	23 16 35 17 39 41 19 33 32 35 27 27	0.5 2 1 3 11 0.8 8
Lincoln 44 Litchfield 29 Metropolis 22 Mt. Carmel 35 Mt. Vernon 27 Quincy 18 30 Rockford 27 29 Sterling 35 Urbana 22 Vandalia 40 Waukegan 46 c MICHIGAN 2 VHF 7	7 6 7 15 40 85 11 14 5 34	Cookeville Dyersburg Fayetteville Harriman Humboldt Jackson Johnson City Lebanon Lewisburg	37 30 16 17 35 24 16 27 29	4 10 5 24 25 6 4	Cedar Rapids Charles City Decorah Des Moines Iowa City Sioux City Davenport, Rock Island, Moline Albia Atlantic Boone	7 9 12 3 8 11 13 2 5 9 (4 5) 42 34 32 25	62 5 184 17 82 175 5 6 12	Chamberlin Custer Deadwood Dupree Edgemont Gettysburg Hot Springs Huron Lake Andes Lead McIntosh	23 16 35 17 39 41 19 33 32 35 27 27 24	0.5 2 1 3 11 0.8 8 0.6
Lincoln 44 Litchfield 29 Metropolis 22 Mt. Carmel 35 Mt. Vernon 27 Quincy 18 30 Rockford 27 29 Sterling 35 Urbana 22 Vandalia 40 Waukegan 46 c MICHIGAN 2 VHF 7 Cheboygan-	7 6 7 15 40 85 11 14 5 34 7 V-UHF 28 UHF	Cookeville Dyersburg Fayetteville Harriman Humboldt Jackson Johnson City Lebanon Lewisburg Morristown Murfreesboro Paris Pulaski	37 30 16 17 35 24 16 27 29 43 14 19 38	4 10 5 24 25 6 4 8 9 6 5	Cedar Rapids Charles City Decorah Des Moines Iowa City Sioux City Davenport, Rock Island, Moline Albia Atlantic	7 9 12 3 8 11 13 2 5 9 (4 5) 42 34 32	62 2 5 184 17 82 175 5 6 12 26	Chamberlin Custer Deadwood Dupree Edgemont Gettysburg Hot Springs Huron Lake Andes Lead McIntosh Madison Martin	23 16 35 17 39 41 19 33 32 35 27 27 27 24 37 39 31	0.5 2 1 3 11 0.8 8
Lincoln 44 Litchfield 29 Metropolis 22 Mt. Carmel 35 Mt. Vernon 27 Quincy 18 30 Rockford 27 29 Sterling 35 Urbana 22 Vandalia 40 Waukegan 46 c MICHIGAN 2 VHF 7 Cheboygan- Mackinaw 4	7 6 7 15 40 85 11 14 5 34 7 V-UHF 28 UHF	Cookeville Dyersburg Fayetteville Harriman Humboldt Jackson Johnson City Lebanon Lewisburg Morristown Murfreesboro Paris Pulaski Shelbyville	37 30 16 17 35 24 16 27 29 43 14 19 38 31	4 10 5 24 25 6 4 8 9 6 5 7	Cedar Rapids Charles City Decorah Des Moines Iowa City Sioux City Davenport, Rock Island, Moline Albia Atlantic Boone Burlington Carrol Centerville	7 9 12 3 8 11 13 2 5 9 (4 5) 42 34 32 25 28 40 26	62 5 184 17 82 175 5 6 12	Chamberlin Custer Deadwood Dupree Edgemont Gettysburg Hot Springs Huron Lake Andes Lead McIntosh Madison Martin Miller	23 16 35 17 39 41 19 33 32 35 27 27 27 24 37 39 31 15	0.5 2 1 3 11 0.8 8 0.6 5 1
Lincoln 44 Litchfield 29 Metropolis 22 Mt. Carmel 35 Mt. Vernon 27 Quincy 18 30 Rockford 27 29 Sterling 35 Urbana 22 Vandalia 40 Waukegan 46 c MICHIGAN 2 VHF 7 Cheboygan- Mackinaw 4 Gladstone 13	7 6 7 15 40 85 11 14 5 34 7 V-UHF 28 UHF 6 5	Cookeville Dyersburg Fayetteville Harriman Humboldt Jackson Johnson City Lebanon Lewisburg Morristown Murfreesboro Paris Pulaski Shelbyville Springfield	37 30 16 17 35 24 16 27 29 43 14 19 38 31 23	4 10 5 24 25 6 4 8 9 6 5 7 7	Cedar Rapids Charles City Decorah Des Moines Iowa City Sioux City Davenport, Rock Island, Moline Albia Atlantic Boone Burlington Carrol Centerville Chariton	7 9 12 3 8 11 13 2 5 9 (4 5) 42 34 32 25 28 40 26 41	62 2 5 184 17 82 175 5 6 12 26 5	Chamberlin Custer Deadwood Dupree Edgemont Gettysburg Hot Springs Huron Lake Andes Lead McIntosh Madison Martin Miller	23 16 35 17 39 41 19 33 32 35 27 27 27 24 37 39 31	0.5 2 1 3 11 0.8 8 0.6
Lincoln 44 Litchfield 29 Metropolis 22 Mt. Carmel 35 Mt. Vernon 27 Quincy 18 30 Rockford 27 29 Sterling 35 Urbana 22 Vandalia 40 Waukegan 46 c MICHIGAN 2 VHF 7 Cheboygan- Mackinaw 4 Gladstone 13 Detroit (2 4 7	7 6 7 15 40 85 11 14 5 34 7 V-UHF 28 UHF 6 5 7) 24 27 2,296	Cookeville Dyersburg Fayetteville Harriman Humboldt Jackson Johnson City Lebanon Lewisburg Morristown Murfreesboro Paris Pulaski Shelbyville Springfield Jullahoma	37 30 16 17 35 24 16 27 29 43 14 19 38 31 23 33	4 10 5 6 5 24 25 6 4 8 9 6 5 7 7 5	Cedar Rapids Charles City Decorah Des Moines Iowa City Sioux City Davenport, Rock Island, Moline Albia Atlantic Boone Burlington Carrol Centerville Chariton Cherokee	7 9 12 3 8 11 13 2 5 9 (4 5) 42 34 32 25 28 40 26 41 38	62 2 5 184 17 82 175 5 6 12 26 5 8 6 7	Chamberlin Custer Deadwood Dupree Edgemont Gettysburg Hot Springs Huron Lake Andes Lead McIntosh Madison Martin Miller Mohridge	23 16 35 17 39 41 19 33 32 35 27 27 27 27 27 27 27 27 27 37 39 31 15 39 41	0.5 2 1 3 11 0.8 8 0.6 5 1 1 3
Lincoln 44 Litchfield 29 Metropolis 22 Mt. Carmel 35 Mt. Vernon 27 Quincy 18 30 Rockford 27 29 Sterling 35 Urbana 22 Vandalia 40 Waukegan 46 c MICHIGAN 2 VHF 7 Cheboygan- Mackinaw 4 Gladstone 13 Detroit (2 4 7 Grand Rapids (7) 12 Iron Mountain 7 9 3	7 6 7 15 40 85 11 14 5 34 7 V-UHF 28 UHF 6 7) 24 27 2,296 33 35 210	Cookeville Dyersburg Fayetteville Harriman Humboldt Jackson Johnson City Lebanon Lewisburg Morristown Murfreesboro Paris Pulaski Shelbyville Springfield Tullahoma Union City	37 30 16 17 35 24 16 27 29 43 14 19 38 31 23 33 28	4 10 5 24 25 6 4 8 9 6 5 7 7 5 7	Cedar Rapids Charles City Decorah Des Moines Iowa City Sioux City Davenport, Rock Island, Moline Albia Atlantic Boone Burlington Carrol Centerville Chariton Cherokee Clarinda	7 9 12 3 8 11 13 2 5 9 (4 5) 42 34 32 25 28 40 26 41 38 23	62 2 5 184 17 82 175 5 6 12 26 5 8 6 7 5	Chamberlin Custer Deadwood Dupree Edgemont Gettysburg Hot Springs Huron Lake Andes Lead McIntosh Martin Maller Mohridge Phillip	23 16 35 17 39 41 19 33 32 35 27 24 37 39 31 15 39 41 14	0.5 2 1 3 11 0.8 8 0.6 5 1 1 3 0.8
Lincoln 44 Litchfield 29 Metropolis 22 Mt. Carmel 35 Mt. Vernon 27 Quincy 18 30 Rockford 27 29 Sterling 35 Urbana 22 Vandalia 40 Waukegan 46 c MICHIGAN 2 VHF 7 Cheboygan- Mackinaw 4 Gladstone 13 Detroit (2 4 7 Grand Rapids (7) 12 Iron Mountain 7 9 3 Kalamazoo (3) 15	7 6 7 15 40 85 11 14 5 34 7 V-UHF 28 UHF 6 5 7) 24 27 2,296 33 35 210 2 34 11 77	Cookeville Dyersburg Fayetteville Harriman Humboldt Jackson Johnson City Lebanon Lewisburg Morristown Murfreesboro Paris Pulaski Shelbyville Springfield Tullahoma Union City Winchester	37 30 16 17 35 24 16 27 43 14 29 43 14 19 38 31 23 33 28 18	4 10 5 6 5 24 25 6 4 8 9 6 5 7 7 5	Cedar Rapids Charles City Decorah Des Moines Iowa City Sioux City Davenport, Rock Island, Moline Albia Atlantic Boone Burlington Carrol Centerville Chariton Cherokee Clarinda Clinton	7 9 12 3 8 11 13 2 5 9 (4 5) 42 34 32 25 28 40 26 41 38 23 37	62 2 5 184 17 82 175 5 6 12 26 5 8 6 7 5 26	Chamberlin Custer Deadwood Dupree Edgemont Gettysburg Hot Springs Huron Lake Andes Lead McIntosh Madison Martin Miller Mohridge Phillip Pine Ridge	23 16 35 17 39 41 19 33 32 35 27 24 37 39 31 15 39 41 14 43 45	0.5 2 1 3 11 0.8 8 0.6 5 1 1 3 0.8
Lincoln 44 Litchfield 29 Metropolis 22 Mt. Carmel 35 Mt. Vernon 27 Quincy 18 30 Rockford 27 29 Sterling 35 Urbana 22 Vandalia 40 Waukegan 46 c MICHIGAN 2 VHF 7 Cheboygan- Mackinaw 4 Gladstone 13 Detroit (2 4 7 Grand Rapids (7) 12 Iron Mountain 7 9 3 Kalamazoo (3) 15 Lansing (6) 45	7 6 7 15 40 85 11 14 5 34 7 V-UHF 28 UHF 6 5 34 7 V-UHF 28 UHF 6 5 33 35 210 2 34 11 77 71 10	Cookeville Dyersburg Fayetteville Harriman Humboldt Jackson Johnson City Lebanon Lewisburg Morristown Murfreesboro Paris Pulaski Shelbyville Springfield Tullahoma Union City	37 30 16 17 35 24 16 27 43 14 29 43 14 19 38 31 23 33 28 18	4 10 5 24 25 6 4 8 9 6 5 7 7 5 7	Cedar Rapids Charles City Decorah Des Moines Iowa City Sioux City Davenport, Rock Island, Moline Albia Atlantic Boone Burlington Carrol Centerville Chariton Cherokee Clarinda Clinton Creston	7 9 12 3 8 11 13 2 5 9 (4 5) 42 34 32 25 28 40 26 41 38 23 37 21	62 25 184 17 82 175 6 12 26 5 8 6 7 5 26 8	Chamberlin Custer Deadwood Dupree Edgemont Gettysburg Hot Springs Huron Lake Andes Lead McIntosh Madison Martin Miller Mohridge Phillip Pine Ridge Sissiton	23 16 35 17 39 41 19 33 32 35 27 27 24 37 39 31 15 39 41 14 43 45 44	0.5 2 1 3 11 0.8 8 0.6 5 1 3 0.8 2 2
Lincoln 44 Litchfield 29 Metropolis 22 Mt. Carmel 35 Mt. Vernon 27 Quincy 18 30 Rockford 27 29 Sterling 35 Urbana 22 Vandalia 40 Waukegan 46 c MICHIGAN 2 VHF 7 Cheboygan- Mackinaw 4 Gladstone 13 Detroit (2 4 7 Grand Rapids (7) 12 Iron Mountain 7 9 3 Kalamazoo (3) 15 Lansing (6) 45 Marquette 3 5 1	7 6 7 15 40 85 11 14 5 34 7 V-UHF 28 UHF 6 5 7) 24 27 2,296 33 35 210 2 34 11 77 110 148 16	Cookeville Dyersburg Fayetteville Harriman Humboldt Jackson Johnson City Lebanon Lewisburg Morristown Murfreesboro Paris Putaski Shelbyville Springfield Tullahoma Union City Winchester ALABAMA 4 Birmingham	37 30 16 17 35 24 16 27 43 14 29 43 14 19 38 31 23 33 28 18	4 10 5 24 25 6 4 8 9 6 5 7 7 5 7	Cedar Rapids Charles City Decorah Des Moines Iowa City Sioux City Davenport, Rock Island, Moline Albia Atlantic Boone Burlington Carrol Centerville Chariton Cherokee Clarinda Clinton	7 9 12 3 8 11 13 2 5 9 (4 5) 42 34 32 25 28 40 26 41 38 23 37 21 45	62 2 5 184 17 82 175 5 6 12 26 5 8 6 7 5 26	Chamberlin Custer Deadwood Dupree Edgemont Gettysburg Hot Springs Huron Lake Andes Lead McIntosh Madison Martin Miller Mohridge Phillip Pine Ridge Sissiton Vermillion	23 16 35 17 39 41 19 33 32 35 27 24 37 39 31 15 39 41 14 43 45	0.5 2 1 3 11 0.8 8 0.6 5 1 1 3 0.8 2 2 3
Lincoln 44 Litchfield 29 Metropolis 22 Mt. Carmel 35 Mt. Vernon 27 Quincy 18 30 Rockford 27 29 Sterling 35 Urbana 22 Vandalia 40 Waukegan 46 c MICHIGAN 2 VHF 7 Cheboygan- Mackinaw 4 Gladstone 13 Detroit (2 4 7 Grand Rapids (7) 12 Iron Mountain 7 9 3 Kalamazoo (3) 15 Lansing (6) 45 Marquette 3 5 1	7 6 7 15 40 85 11 14 5 34 7 V-UHF 28 UHF 6 5 7) 24 27 2,296 5 33 35 210 2 34 11 77 110 1 18 16 14 16 16	Cookeville Dyersburg Fayetteville Harriman Humboldt Jackson Johnson City Lebanon Lewisburg Morristown Murfreesboro Paris Pulaski Shelbyville Springfield Tullahoma Union City Winchester ALABAMA 4 Birmingham Eufaula	37 30 16 17 35 24 16 27 29 43 14 19 38 31 23 33 28 18 VHF 20 UHF (4) 6 (13) 3	4 10 5 6 5 24 25 6 4 8 9 6 5 7 7 5 7 3 408 6	Cedar Rapids Charles City Decorah Des Moines Iowa City Sioux City Davenport, Rock Island, Moline Albia Atlantic Boone Burlington Carrol Centerville Chariton Cherokee Clarinda Clinton Creston Dubuque	7 9 12 3 8 11 13 2 5 9 (4 5) 42 34 32 25 28 40 26 41 38 23 37 21	62 25 184 17 82 175 56 12 26 8 6 7 5 26 8 44 7	Chamberlin Custer Deadwood Dupree Edgemont Gettysburg Hot Springs Huron Lake Andes Lead McIntosh Madison Martin Miller Mohridge Phillip Pine Ridge Sissiton Vermillion Watertown White River	23 16 35 17 39 41 19 33 32 35 27 24 37 39 31 15 39 41 14 43 45 44 31 33 22 24 21	0.5 2 1 3 11 0.8 8 0.6 5 1 1 3 0.8 2 2 3 11 0.6
Lincoln 44 Litchfield 29 Metropolis 22 Mt. Carmel 35 Mt. Vernon 27 Quincy 18 30 Rockford 27 29 Sterling 35 Urbana 22 Vandalia 40 Waukegan 46 c MICHIGAN 2 VHF 7 Cheboygan- Mackinaw 4 Gladstone 13 Detroit (2 4 7 Grand Rapids (7) 12 Iron Mountain 7 9 3 Kalamazoo (3) 15 Lansing (6) 45 Marquette 3 5 1 Sault Ste. Marie 8 10	7 6 7 15 40 85 11 14 5 34 7 V-UHF 28 UHF 6 5 34 7 V-UHF 28 UHF 6 5 33 35 210 2 34 11 10 1 18 16 14 16 16 13	Cookeville Dyersburg Fayetteville Harriman Humboldt Jackson Johnson City Lebanon Lewisburg Morristown Murfreesboro Paris Pulaski Shelbyville Springfield Tullahoma Union City Winchester ALABAMA 4 Birmingham Eufaula Mobile	37 30 16 17 35 24 16 27 29 43 14 19 38 31 23 33 28 18 VHF 20 UHF (4) 6 (13) 3 5 8 11 13	4 10 5 6 5 24 25 6 4 8 9 6 5 7 7 5 7 3 408 6 115	Cedar Rapids Charles City Decorah Des Moines Iowa City Sioux City Davenport, Rock Island, Moline Albia Atlantic Boone Burlington Carrol Centerville Chariton Cherokee Clarinda Clinton Creston Dubuque Fairfield Fort Dodge Fort Madison	7 9 12 3 8 11 13 2 5 9 (4 5) 42 34 32 25 28 40 26 41 38 23 37 21 45 24 17 14	62 25 184 17 82 175 6 12 26 5 8 6 7 5 26 8	Chamberlin Custer Deadwood Dupree Edgemont Gettysburg Hot Springs Huron Lake Andes Lead McIntosh Madison Martin Miller Mohridge Phillip Pine Ridge Sissiton Vermillion Watertown White River	23 16 35 17 39 41 19 33 32 35 27 24 37 39 31 15 39 41 14 43 45 44 31 33 22 24 21 24 21 24 24 24	0.5 2 1 3 11 0.8 8 0.6 5 1 1 3 0.8 2 2 3 11 0.6
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FM and TELEVISION

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Ainsworth	38		Shreveport	3 10 13	112	Eagle Pass	16	6	Lewistown	17 35.37	6 2
Alliance	15 37		Abbeville	28	2	Edinburg	21	9	Libby Livingston	32 34	7
Atkinson	34		Bastrop	23 43 45	7 35	El Campo Eldorado	38 33	2	Malta	27	2
Bayard Beatrice	42 45		Baton Rouge Bogalusa	26	15	Falfurrias	23	6	Paradise	42	0.35
Bridgeport	40		Crowley	17	iõ	Ft, Davis	14	1	Philipsburg	29	1
Broken Bow	16		DeRidder	29	4	Ft, Stockton	31	3	Plentywood Polson	29 31 44 27	2
Columbus	26	-	Eunice	38 14	5	Fredericksburg Galveston	22 21 24	72	Red Lodge	29	3
Crawford Fairbury	22 43		Hammond Houma	24	9	Graham	15	5	Roundup	35	3
Falls City	33		Jennings	31	9	Greenville	24	14	Saco	45	0.5
Fremont	36		Lafayette	41	19	Gonzales	15	5	Scobey	41 14 16	3
Gothenburg	14		Lake Charles	23	21	Hamilton	39 28	3	Shelby Sidney	15 17	3
Grand Island	35 37 25		Minden	14 32 39	7 28	Hamlin Harlingen	14	13	Stanford	15	1
Holdrige Kearney	21 23		Natchitoches	24	7	Haskell	30	3	Thompson Falls	25	0.7
Lexington	18	4	New Iberia	34	14	Henrietta	23	2	Virginia City	45 22	0.4
Nebraska City	14	7	Oakdale	19	4	Hereford	42	3 8	Whitehall White Sulphur	22	
Neligh	17 15	2 10	Opelousas Pineville	15 21	9 4	Hillsboro Huntsville	25 17	ŝ	Springs	20	1
Norfolk Ogallala	24	3	Ruston	16	7	Jacksonville	15	7	Wibaux	40	0.6
O'Neill	20	3 3	Tallulah	30	6	Junction	27	2	Winifred	41	0.3
Ord	30	2	Thibodoux	32	6	Kermit	38	3	Winnett Wolf Point	42 33	2
Scottsbluff	18 20	12	Winnfield	36	5	Kerrville Kilgore	17 31	67	WOIT FOINT	55	
Seward Sidney	24 32	3	OKIAHOMA	2 VHF 3 V-UH	-	Kingsville	17	8	IDAHO 1 VH	F 5 V-UHF 32	UHF
Stanton	22	2	29 U			La Grange	43	3	Boise	2 4 5 7	26-
Superior	29	3	Oklahoma City	(4) 7 9	221	Lamesa	41 35	6 3	Coeur D'Alene	9 12 41 43 3 6 19 21	10 15
Valentine	28 44	2 3	Tulsa	2 (6) 11	189	Lampassas Liberty	44	3	Idaho Falls Nampa	9 12 23 25	12
West Point York	19	5	Enid	13 15	28	Livingston	42	2	Pocatello	8 10 35	18
	.,		Muskogee	8 23	32 15	Littlefield	39	4	Twin Falls	11 13 16	12
KANSAS 4	VHF 1 V-UHF 40 U	JHF	Ada Altus	20 16	9	Longview	30 35	14	Aberdeen	43 28	0.5
Garden City	9 11	6	Alva	23	5	Lufkin Marfa	20 25	4	Arco Blackfoot	33	4
Junction City	8 11 13	9 68	Ardmore	32	17	Marshall	37	18	Bonners Ferry	31 33	1
Topeka Wichita		115	Bartlesville	14	16	Mexia	34	6	Buhl	44	2
Great Bend	5 14	9	Beaver Boise City	36 30	i	McAllen Midland	26 29	12	Burley	24	5
Anthony	39	3	Chickasha	45	14	Midland	29	3	Caldwell	35 37	7
Arkansas City	37 18	13 13	Clinton	31	7	Mineral Wells	42	6	Cascade	18	1
Atchison Baster Spas.	38	5	Duncan	35	9 10	Mount Pleasant	33	5	Challis	26	0.6
Belleville	27	3	Durant Elk City	40 14	5	Nacogdoches	28 18	8 7	Council	31 39	0.7
Clay Center	38	5	El Reno	22	10	Orange Ozona	45	2	Diggs Dubois	39	
Coffeyville	44	17	Frederick	27	5	Paris	19	13	Gooding	22	0.3 3
Colby Concordia	26 34	2 6	Guthrie	24	10	Pampa	17	19	Grangerville	45	2
Dodge City	24 43	8	Guymon Hobart	20 25	2	Pearsall	34 27	3	Kellogg Wardner	16 36	4
El Dorado	16	10	Hugo	29	6	Pecos Perryton	34	2	Ketchum Lewiston	32 34	11
Emporia	21	13 11	Lawton	18	18	Plainview	23	8	MacKay	38	0.8
Ft. Scott Goodland	32 28	3	Miami	36	8 12	Presido	16	1	Malad City	45	3
Hays	22	6	McAlester Norman	34	11	Rankin Bio Connela	42 29	0.5 3	Montpelier	26 21	3
Hutchinson	20	30	Okeene	29	4	Rio Grande Robstown	27	7	Moscow Mountain Home	39	1
lola	41 K = 11 = 1	12	Okmulgee	28	16	Rock Springs	20	1	Orafino	36	2
Kansas City (se Kinsley	41 45	2	Ponca City	27	17	Rosenberg	36	3	Preston	15 17	4
Larned	30	4	Seminole Shattuck Jnc.	43 40	ī	Sabinal Sanderson	44 23	25	St. Anthony	41 18	3 2
Lawrence	39	14	Shawnee	30	22	San Benito	34	10	St. Maries Salmon	15	2
Liberal	38	4	Stillwater	17	10	San Diego	37	3	Sandpoint	20 22	4
Lindsborg	28	-	Woodward	4.5	5	San Marcos	45	~ ~	Chashana	14	1
MCPherson				40					Shoshone		;
McPherson Manhatten	15	12				Shamrock	21	3	Soda Springs	37	1
Manhatten Newton	15 31	11	TEXAS 12 V	HF 8 V-UHF 11		Shamrock Sequin	21 41	3 7 17	Soda Springs Wallace	37 39	1 4 4
Manhatten Newton Norton	15 31 36	11 3	TEXAS 12 V Alpine	HF 8 V-UHF 11	8 UHF 4 53	Shamrock	21	7	Soda Springs	37	1 4 4
Manhatten Newton Norton Oberlin	15 31 36 33	11 3 2	TEXAS 12 V	THF 8 V-UHF 11 12 2 4 5 7 10 4 5 9	4 53 22	Shamrock Sequin Sherman Seymour Sierra Blanca	21 41 14 34 32	7 17	Soda Springs Wallace Weiser	37 39	IF
Manhatten Newton Norton	15 31 36	11 3 2 5 2	TEXAS 12 V Alpine Amarillo Brownsville Dallas	HF 8 V-UHF 11 12 2 4 5 7 10 4 5 9 (4 8) 12	4 53 22 377	Shamrock Sequin Sherman Seymour Sierra Blanca Snyder	21 41 14 34 32 22	7 17 3 1 4	Soda Springs Wallace Weiser WYOMING 4 Casper	37 39 27 29 V-UHF 25 UH 3 6 8 24	IF 18
Manhatten Newton Norton Oberlin Osawatomie Osborne Ottawa	15 31 36 33 24 17 26	11 3 2 5 2 10	TEXAS 12 V Alpine Amarillo Brownsville Dallas Ft. Worth	HF 8 V-UHF 11 12 2 4 5 7 10 4 5 9 (4 8) 12 2 (5) 10	4 53 22 377 208	Shamrock Sequin Sherman Seymour Sierra Blanca Snyder Sonora	21 41 14 34 32	7 17	Soda Springs Wallace Weiser WYOMING 4 Casper Cheyenne	37 39 27 29 V-UHF 25 UH 3 6 8 24 11 13 14 16	IF 18 28
Manhatten Newton Norton Oberlin Osawatomie Osborne Ottawa Phillipsburg	15 31 36 33 24 17 26 44	11 3 2 5 2 10 2	TEXAS 12 V Alpine Amarillo Brownsville Dallas Ft. Worth Houston	HF 8 V-UHF 11 12 2 4 5 7 10 4 5 9 (4 8) 12	4 53 22 377 208 510 3	Shamrock Sequin Sherman Seymour Sierra Blanca Snyder	21 41 14 34 32 22 15 44 20 40	7 17 3 1 4 3 2 5	Soda Springs Wallace Weiser WYOMING 4 Casper Cheyenne Riverton	37 39 27 29 V-UHF 25 UH 3 6 8 24 11 13 14 16 10 18 20	1 F 18 28 3
Manhatten Newton Norton Oberlin Osawatomie Osborne Ottawa Phillipsburg Pittsburg	15 31 36 33 24 17 26 44 30	11 3 2 5 2 10 2 18	TEXAS 12 V Alpine Amarillo Brownsville Dallas Ft. Worth Houston Jasper Laredo	HF 8 V-UHF 11 12 2 4 5 7 10 4 5 9 (4 8) 12 2 (5) 10 (2) 8 11 13 9 3 8	4 53 22 377 208 510 3 39	Shamrock Sequin Sherman Sierra Blanca Snyder Sonora Spur Stanford Stephenville	21 41 14 34 32 22 15 44 20 40 29	7 17 3 1 4 3 2	Soda Springs Wallace Weiser WYOMING 4 Casper Cheyenne	37 39 27 29 V-UHF 25 UH 3 6 8 24 11 13 14 16 10 18 20 9 11 13 15 17 38	1F 18 28 3 11 1
Manhatten Newton Norton Oberlin Osawatomie Osborne Ottawa Phillipsburg	15 31 36 33 24 17 26 44	11 3 5 2 10 2 18 2 5 5	TEXAS 12 V Alpine Amarillo Brownsville Dallas Ft. Worth Houston Jasper Laredo Palestine	PHF 8 V-UHF 11 12 2 4 5 7 10 4 5 9 (4 8) 12 2 (5) 10 (5) 10 (2) 8 11 13 9 3 8 7 7	4 53 22 377 208 510 3 39 12	Shamrock Sequin Sherman Seymour Sierra Blanca Snyder Sonora Spur Stanford Stephenville Sterling City	21 41 14 34 32 22 15 44 20 40 29 16	7 17 3 1 4 3 2 5 5 1	Soda Springs Wallace Weiser WYOMING 4 Casper Cheyenne Riverton Sheridan Basin Buffalo	37 39 27 29 V-UHF 25 UF 3 6 8 24 11 13 14 16 10 18 20 9 11 13 15 17 38 22	IF 18 28 3 11 1 2
Manhatten Newton Norton Osberlin Osborne Ottawa Phillipsburg Pittsburg Pratt Russell Salina	15 31 36 33 24 17 26 44 30 18 32 40	11 3 2 5 2 10 2 18 2 5 21	TEXAS 12 V Alpine Amarillo Brownsville Dallas Ft. Worth Houston Jasper Laredo Palestine San Angelo	IP 8 V-UHF III 12 2 4 5 7 10 4 5 9 (4 8) 12 2 (5) 10 (4 8) 12 2 (5) 10 (2) 8 11 13 9 3 8 7 2 6 5 10	4 53 22 377 208 510 3 39	Shamrock Sequin Sherman Seymour Sierra Blanca Snyder Sonora Spur Stanford Stephenville Sterling City Sulphur Spring	21 41 14 34 32 22 15 44 20 40 29	7 17 3 1 4 3 2 5 5 1 7 8	Soda Springs Wallace Weiser WYOMING 4 Casper Cheyenne Riverton Sheridan Basin Buffalo Cody	37 39 27 29 V-UHF 25 UF 3 6 8 24 11 13 14 16 10 18 20 9 11 13 15 17 38 22 23 25	IF 18 28 3 11 1 2 3
Manhatten Newton Oberlin Osawatomie Osborne Ottawa Phillipsburg Pittsburg Pratt Russell Salina Scott City	15 31 36 33 24 17 26 44 30 18 32 40 31	11 3 5 2 10 2 18 2 5 5	TEXAS 12 V Alpine Amarillo Brownsville Dallas Ft. Worth Houston Jasper Laredo Palestine	PHF 8 V-UHF 11 12 2 4 5 7 10 4 5 9 (4 8) 12 2 (5) 10 (5) 10 (2) 8 11 13 9 3 8 7 7	4 53 22 377 208 510 3 39 12 26 319 45	Shamrock Sequin Sherman Seymour Sierra Blanca Snyder Sonora Spur Stanford Stephenville Sterling City	21 41 14 34 32 22 15 44 20 40 29 16 26 23 37	7 17 3 1 4 3 2 5 1 7 8 15	Soda Springs Wallace Weiser WYOMING 4 Casper Cheyenne Riverton Sheridan Basin Buffalo Cody Douglas	37 39 27 29 V-UHF 25 UH 3 6 8 24 11 13 14 16 10 18 20 9 11 13 15 17 38 22 23 25 36	IF 18 28 3 11 1 2 3 2 4
Manhatten Newton Oberlin Osawatomie Osborne Ottawa Phillipsburg Pratt Russell Salina Scott City Sharon Spgs.	15 31 36 33 24 17 26 44 30 18 32 40	11 3 2 5 2 10 2 18 2 5 21 2 1 1	TEXAS 12 V Alpine Amarillo Brownsville Dallas Ft. Worth Houston Jasper Laredo Palestine San Angelo San Antonio Wichita Falls Abilene	PHF 8 V-UHF 11 12 2 4 5 7 10 4 5 9 (4 8) 12 2 (5) 10 (2 5 7 10 4 5 9 (4 8) 12 2 (5) 10 (2) 8 11 13 9 3 8 7 2 6 (4 5) 7 9 12 3 6 9 24 9 12 3 4 5 7 9 12 3 6 9 24 4 12 13 13 12 13 13 12 12 12	4 53 22 377 208 510 3 39 12 26 319	Shamrock Sequin Sherman Seymour Sierra Blanca Snyder Sonora Spur Stanford Stephenville Sterling City Sulphur Spring Taylor Temple Terrell	21 41 14 34 32 22 15 44 20 40 29 16 26 23 37 38	7 17 3 1 4 3 2 5 5 1 7 8	Soda Springs Wallace Weiser WYOMING 4 Casper Cheyenne Riverton Sheridan Basin Buffalo Cody Douglas Evanston Gillette	37 39 27 29 V-UHF 25 UF 3 6 8 24 11 13 14 16 10 18 20 9 11 13 15 17 38 22 23 25 36 36 30	IF 18 28 3 11 1 2 3 2 4 4 2
Manhatten Newton Norton Oberlin Osawatomie Osborne Ottawa Phillipsburg Pittsburg Pratt Russell Salina Scott City Sharon Spgs. Syracuse Wellington	15 31 36 33 24 17 26 44 30 18 30 18 32 40 31 21 29 33	11 3 2 5 2 10 2 18 2 5 21 2 1 1 7	TEXAS 12 V Alpine Amarillo Brownsville Dallas Ft. Worth Houston Jasper Laredo Palestine San Angelo San Antonio Wichita Falls Abilene Beaumont-	HF 8 V-UHF 111 12 2 4 5 7 10 4 5 9 (4 8) 12 2 (5) 10 (2) 8 11 13 9 3 8 7 2 6 (4 5) 7 9 12 3 6 9 24 4 6 26 4 5 7 9 12 3 6 9 24 4 6 26 4 5 26 4 5 5 7 9 12 3 6 9 24 4 6 26 4 5 5 5 5 12 3 6 9 24 4 6 26 6 13 13 14 15 15 15 12 14 12 14 14 12 14 14 15 12 14 15 15	4 53 22 377 208 510 39 12 26 319 45 27	Shamrock Sequin Sherman Seymour Sierra Blanca Snyder Sonora Spur Stanford Stephenville Stephenville Stephenville Sterling City Sulphur Spring Taylor Temple Terrell Texarkana (see J	21 41 14 34 32 22 15 44 20 40 29 16 26 23 37 38 Arkansas)	7 17 3 1 4 3 2 5 5 1 7 8 15 19	Soda Springs Wallace Weiser WYOMING 4 Casper Cheyenne Riverton Sheridan Basin Buffalo Cody Douglas Evanston Gillette Green River	37 39 27 29 V-UHF 25 UH 3 6 8 24 11 13 14 16 10 18 20 9 11 13 15 17 38 22 23 25 36 36 30 41	IF 18 28 3 11 1 2 3 2 4 4 2 3
Manhatten Newton Norton Oberlin Osawatomie Osborne Ottawa Phillipsburg Pratt Russell Salina Scott City Sharon Spgs: Syracuse	15 31 36 33 24 17 26 44 30 18 32 40 31 21 29	11 3 2 5 2 10 2 18 2 5 21 2 1 1	TEXAS 12 V Alpine Amarillo Brownsville Dallas Ft. Worth Houston Jasper Laredo Palestine San Angelo San Antonio Wichita Falls Abilene Beaumont- Port Arthur	PHF 8 V-UHF 11 12 2 4 5 7 10 4 5 9 (4 8) 12 2 (5) 10 (2 5 7 10 4 5 9 (4 8) 12 2 (5) 10 (2) 8 11 13 9 3 8 7 2 6 (4 5) 7 9 12 3 6 9 24 9 12 3 4 5 7 9 12 3 6 9 24 4 12 13 13 12 13 13 12 12 12	4 53 22 377 208 510 3 39 12 26 319 45	Shamrock Sequin Sherman Seymour Sierra Blanca Snyder Sonora Spur Stanford Stephenville Sterling City Sulphur Spring Taylor Temple Terrell	21 41 14 34 32 22 15 44 20 40 29 16 26 23 37 38 Arkansas) 45 14	7 17 3 1 4 3 2 5 1 7 8 15 19 28 7	Soda Springs Wallace Weiser WyOMING 4 Casper Cheyenne Riverton Sheridan Basin Buffalo Cody Douglas Evanston Gillette Green River Hanna	37 39 27 29 V-UHF 25 UF 3 6 8 24 11 13 14 16 10 18 20 9 11 13 15 17 38 22 23 25 36 36 36 30 41 15	IF 18 28 3 11 2 3 2 4 4 2 3 1 1
Manhatten Newton Oberlin Osawatomie Osborne Ottawa Phillipsburg Pratt Russell Salina Scott City Sharon Spgs. Syracuse Wellington Winfield	15 31 36 33 24 17 26 44 30 18 32 40 31 21 21 29 33 35	11 3 2 5 2 10 2 18 2 5 21 2 1 1 7 10	TEXAS 12 V Alpine Amarillo Brownsville Dallas Ft. Worth Houston Jasper Laredo Palestine San Angelo San Antonio Wichita Falls Abilene Beaumont-	PHF 8 V-UHF 111 12 2 4 5 7 4 5 9 (4 8) 12 2 (5) 10 (2) 8 11 13 9 3 8 7 2 6 (4 5) 7 9 12 3 6 9 2.4 4 6 26 33 39 6 10 31 33 2 4 5 7 9 12 3 6 10 31 33 2 4 5 7 9 12 3 6 10 31 33 2 4 5 7 9 12 3 2 4 5 7 9 12 3 2 10 31 33 2 4 5 7 9 12 3 2 10 31 33 2 4 5	4 53 22 377 208 510 39 12 26 319 45 27 139 71	Shamrock Sequin Sherman Seymour Sierra Blanca Snyder Sonora Spur Stanford Stephenville Stephenville Stephenville Stephenville Stuphur Spring Taylor Temple Terrell Texarkana (see A Tyler Uvalde Van Horn	21 41 14 34 32 22 15 44 20 40 29 16 26 23 37 38 Arkansas) 45 14 18	7 17 3 1 4 3 2 5 5 1 7 8 15 19 28 7 1	Soda Springs Wallace Weiser WYOMING 4 Casper Cheyenne Riverton Sheridan Basin Buffalo Cody Douglas Evanston Gillette Green River	37 39 27 29 V-UHF 25 UF 3 6 8 24 11 13 14 16 10 18 20 9 11 13 15 17 38 22 23 25 36 30 41 15 44 23	IF 18 28 3 11 2 3 2 4 4 2 3 1 1
Manhatten Newton Oberlin Osawatomie Osborne Ottawa Phillipsburg Pratt Russell Salina Scott City Sharon Spgs. Syracuse W ellington Winfield	15 31 36 33 24 17 26 44 30 18 32 40 31 21 29 33 35 SOUTH CENTRA	11 3 2 5 2 10 2 18 2 5 21 2 1 1 7 10	TEXAS 12 V Alpine Amarillo Brownsville Dallas Ft. Worth Houston Jasper Laredo Palestine San Angelo San Antonio Wichita Falls Abilene Beaumont- Port Arthur Corpus Christi El Paso	PHF 8 V-UHF 111 12 2 4 5 7 10 4 5 9 (4 8) 12 2 (5) 10 (2) 8 1 12 2 (5) 10 (2) 8 11 13 9 3 8 7 2 6 (4 5) 7 9 12 3 6 9 2 4 6 26 33 39 6 10 31 33 2 4 5 7 9 41 44	4 53 22 377 208 510 3 39 12 266 319 45 27 139 71	Shamrock Sequin Sherman Seymour Sierra Blanca Snyder Sonora Spur Stanford Stephenville Sterling City Sulphur Spring Taylor Temple Terrell Texarkana (see Tyler Uvalde Van Horn Vernon	21 41 14 34 32 22 15 44 20 40 29 16 23 37 38 Arkansas) 45 14 18 38	7 17 3 1 4 3 2 5 5 1 7 8 15 19 28 7 1 9	Soda Springs Wallace Weiser WyOMING 4 Casper Cheyenne Riverton Sheridan Basin Buffalo Cody Douglas Evanston Gillette Green River Hanna Jackson Kemmerer Lander	37 39 27 29 V-UHF 25 UF 3 6 8 24 11 13 14 16 10 18 20 9 11 13 15 17 38 22 23 25 36 36 30 41 15 44 23 16	IF 18 28 3 11 1 2 3 2 4 2 3 1 1 2 3 1 1 2 3 2 4 2 3 1 1 1 2 3 2 4 2 3 2 4 2 3 2 4 2 3 2 4 2 3 2 2 3 2 2 3 2 2 3 2 2 3 2 2 3 2 4 2 3 2 4 2 3 2 3 2 4 2 3 2 3 2 4 2 3 2 3 2 4 2 3 2 3 2 4 2 3 2 3 2 4 4 2 3 2 3 2 3 2 4 4 2 3 2 3 2 3 2 4 4 2 3 2 3 2 3 2 4 3 2 3 3 2 3 3 2 4 3 2 3 3 3 3 3 4 3 2 3 3 3 3 3 1 1 2 3 3 3 3 3 1 1 2 3 3 3 3 3 1 1 1 2 3 3 3 3 1 1 2 3 3 3 3 1 1 1 2 3 3 3 3 1 1 1 2 3 3 3 3 1 1 2 3 3 3 1 1 2 3 3 3 3 1 1 2 3 3 3 1 1 3 3 3 3 3 1 1 3 3 3 3 3 3 3 3 3 3 3 3 3
Manhatten Newton Oberlin Osawatomie Osborne Ottawa Phillipsburg Pratt Russell Salina Scott City Sharon Spgs. Syracuse Wellington Winfield	15 31 36 33 24 17 26 44 30 18 32 40 0 31 21 29 33 35 SOUTH CENTRA 1 VHF 30 UHF	11 3 2 5 2 10 2 18 2 5 21 2 1 1 7 10	TEXAS 12 V Alpine Amarillo Brownsville Dallas Ft. Worth Houston Jasper Laredo Palestine San Angelo San Angelo San Antonio Wichita Falls Abilene Beaumont- Port Arthur Corpus Christi El Paso Lubbock	PHF 8 V-UHF 111 12 2 4 5 7 4 5 9 (4 8) 12 2 (5) 10 (2) 8 11 13 9 3 8 7 2 6 (4 5) 7 9 12 3 6 9 2.4 4 6 26 33 39 6 10 31 33 2 4 5 7 9 12 3 6 10 31 33 2 4 5 7 9 12 3 6 10 31 33 2 4 5 7 9 12 3 2 4 5 7 9 12 3 2 10 31 33 2 4 5 7 9 12 3 2 10 31 33 2 4 5	4 53 22 377 208 510 39 12 26 319 45 27 139 71	Shamrock Sequin Sherman Seymour Sierra Blanca Snyder Sonora Spur Stanford Stephenville Stephenville Stephenville Stephenville Stuphur Spring Taylor Temple Terrell Texarkana (see A Tyler Uvalde Van Horn	21 41 14 34 32 22 15 44 20 40 29 16 26 23 37 38 Arkansas) 45 14 18	7 17 3 1 4 3 2 5 5 1 7 8 5 9 2 7 1 9 2 7 1 9 2 7 1	Soda Springs Wallace Weiser WYOMING 4 Casper Cheyenne Riverton Sheridan Basin Buffalo Cody Douglas Evanston Gillette Green River Hanna Jackson Kemmerer Lander Laramie	37 39 27 29 V-UHF 25 UF 3 6 8 24 11 13 14 16 10 18 20 9 11 13 15 17 38 22 23 25 36 36 30 41 15 44 23 16 19 21	IF 18 28 3 11 2 3 2 4 2 3 1 1 2 3 1 1 2 3 1 1
Manhatten Newton Oberlin Osawatomie Osborne Ottawa Phillipsburg Pratt Russell Salina Scott City Sharon Spgs. Syracuse Wellington Winfield WEST ARKANSAS Little Rock	15 31 36 33 24 17 26 44 30 18 32 40 31 21 29 33 35 SOUTH CENTRA 1 VHF 30 UHF 2 5 7 11	11 3 2 5 2 10 2 1 2 1 2 1 2 1 2 1 2 1 2 1 2 1 2	TEXAS 12 V Alpine Amarillo Brownsville Dallas Ft. Worth Houston Jasper Laredo Palestine San Angelo San Antonio Wichita Falls Abilene Beaumont- Port Arthur Corpus Christi El Paso	PHF 8 V-UHF 11 12 2 4 5 7 10 4 5 9 (4 8) 12 2 (5) 10 (2) 8 1 12 2 (5) 10 (2) 8 11 13 9 3 8 7 2 6 (4 5) 7 9 12 3 6 9 2 4 6 26 33 39 6 10 31 33 2 4 5 7 9 41 44 11 13 33 35 4 19 7 21	4 53 22 377 208 510 3 39 12 266 319 45 27 139 71 116 32 4 10	Shamrock Sequin Sherman Seymour Sierra Blanca Snyder Sonora Spur Stanford Stephenville Sterling City Sulphur Spring Taylor Temple Terrell Texarkana (see Yaler Uvalde Van Horn Vernon Victoria Waco Wacahachie	21 41 14 34 32 22 15 44 20 40 29 16 23 37 38 Arkansas) 45 14 18 38 18 16 18 31	7 17 3 4 3 2 5 5 1 7 8 5 1 5 1 9 2 8 7 1 9 12	Soda Springs Wallace Weiser WYOMING 4 Casper Cheyenne Riverton Sheridan Basin Buffalo Cody Douglas Evanston Gillette Green River Hanna Jackson Kemmerer Lander Laramie Lusk	37 39 27 29 V-UHF 25 UF 3 6 8 24 11 13 14 16 10 18 20 9 11 13 15 17 38 22 23 25 36 36 30 41 15 44 23 16	IF 18 28 3 11 1 2 3 2 4 2 3 1 1 2 3 1 1 2 3 1 1 1 2 3 2 4 2 3 1 1 1 2 3 2 4 2 3 1 1 1 2 3 2 4 2 3 2 4 2 3 2 4 2 3 2 4 2 3 2 4 2 3 2 3 2 4 4 2 3 2 3 2 4 4 2 3 2 3 2 4 4 2 3 2 3 2 4 4 2 3 2 3 2 4 4 2 3 2 3 2 3 2 4 4 2 3 2 3 2 3 2 3 2 3 2 3 2 3 2 3 1 1 1 2 3 2 3 2 3 1 1 1 2 3 2 3 3 1 1 1 2 3 2 3 3 1 1 1 2 3 2 3 1 1 1 2 3 2 3 1 1 1 2 3 2 3 1 1 1 2 3 2 3 1 1 1 2 3 1 1 2 3 1 1 2 3 1 1 2 3 3 1 1 2 3 1 1 2 3 1 1 2 3 1 1 2 3 1 1 2 3 1 1 2 3 1 1 2 3 1 1 2 3 1 1 2 1 1 2 1 1 2 1 1 2 1 1 1 2 1 1 2 1 1 1 2 1 1 1 2 1 1 1 2 1 1 1 1 2 1 1 1 1 1 2 1 1 1 1 1 2 1 1 1 1 1 1 1 1 1 1 1 1 1
Manhatten Newton Norton Oberlin Osawatomie Osborne Ottawa Phillipsburg Pratt Russell Salina Scott City Sharon Spgs. Syracuse Wellington Winfield WEST ARKANSAS Little Rock Arkadelphia	15 31 36 33 24 17 26 44 30 18 32 40 31 21 29 33 35 SOUTH CENTRA 1 VHF 30 UHF 2 5 7 11 15	11 3 2 5 2 10 2 18 2 5 21 2 1 2 1 1 7 10 L	TEXAS 12 V Alpine Amarillo Brownsville Dallas Ft. Worth Houston Jasper Laredo Palestine San Angelo San Angelo San Angelo San Antonio Wichita Falls Abilene Beaumont- Port Arthur Corpus Christi El Paso Lubbock Monahans Odessa Sweetwater	PHF 8 V-UHF 111 12 2 4 5 7 10 4 5 9 (4 8) 12 2 (5) 10 (2) 8 1 13 9 3 8 7 2 6 (4 5) 7 9 12 3 6 9 24 4 6 26 33 39 6 10 31 33 2 4 5 7 9 41 44 11 13 33 35 4 19 7 21 12 14 32	4 53 22 377 208 510 3 39 12 26 319 45 27 139 71 116 32 4 4 10 10	Shamrock Sequin Sherman Seymour Sierra Blanca Snyder Sonora Spur Stanford Stephenville Stephenville Stephenville Stephenville Stuphur Spring Taylor Temple Terrell Texarkana (see A Tyler Uvalde Van Horn Vernon Victoria Waco	21 41 14 34 32 22 15 44 20 40 29 16 26 23 37 38 Arkansas) 45 14 18 38 18 16 18	7 17 3 1 4 3 2 5 5 1 7 8 5 9 2 7 1 9 2 7 1 9 2 7 1	Soda Springs Wallace Weiser WYOMING 4 Casper Cheyenne Riverton Sheridan Basin Buffalo Cody Douglas Evanston Gillette Green River Hanna Jackson Kemmerer Lander Laramie Lusk Midwest Newcastle	37 39 27 29 V-UHF 25 UF 3 6 8 24 11 13 14 16 10 18 20 9 11 13 15 17 38 22 23 25 36 36 30 41 15 44 23 16 19 21 26 32 34 23	IF 18 28 3 11 1 2 3 2 4 2 3 1 1 2 3 1 1 2 3 1 1 1 2 3 1 1 1 2 3 1 1 1 2 3 1 1 1 2 3 1 1 1 2 3 2 4 2 3 1 1 1 2 3 2 4 2 3 1 1 1 2 3 2 4 2 3 1 1 1 2 3 2 4 2 3 1 1 1 2 3 2 4 2 3 1 1 1 2 3 2 4 2 3 1 1 1 2 3 1 1 2 3 1 1 2 3 1 1 2 3 1 1 2 3 1 1 2 3 1 1 2 3 1 1 2 3 1 1 2 3 1 1 2 3 1 1 2 3 1 1 2 3 1 1 2 3 1 1 2 3 1 1 2 3 1 1 2 3 1 1 2 3 1 1 2 3 1 1 2 2 3 1 1 2 3 1 1 2 3 1 1 2 3 1 1 2 3 1 1 2 3 1 1 2 3 1 1 2 2 3 1 1 2 2 1 1 2 2 1 1 2 2 1 1 2 2 1 1 2 2 1 1 2 2 1 1 2 2 1 1 2 2 1 1 2 2 1 1 2 2 1 2 2 1 2 1 2 2 1 2 2 1 2 2 2 2 2 2 2 2 2 2 2 2 2
Manhatten Newton Oberlin Osawatomie Osborne Ottawa Phillipsburg Pratt Russell Salina Scott City Sharon Spgs: Syracuse Wellington Winfield WEST ARKANSAS Little Rock Arkadelphia Batesvile	15 31 36 33 24 17 26 44 30 18 32 40 31 21 29 33 35 SOUTH CENTRA 1 VHF 30 UHF 2 5 7 11	11 3 2 5 2 10 2 1 2 1 2 1 2 1 2 1 2 1 2 1 7 10 2 1 2 1 2 10 2 2 1 2 10 2 2 1 2 10 2 5 2 10 2 5 2 10 2 5 2 10 2 5 2 10 2 5 5 2 10 2 5 5 2 10 2 5 5 2 10 2 5 5 2 10 2 5 5 2 10 2 5 5 2 10 2 5 5 2 10 2 5 5 2 10 2 5 5 2 10 2 5 5 2 10 2 5 5 2 10 2 5 5 2 10 2 10	TEXAS 12 V Alpine Amarillo Brownsville Dallas Ft. Worth Houston Jasper Laredo Palestine San Angelo San Angelo San Antonio Wichita Falls Abilene Beaumont- Port Arthur Corpus Christi El Paso Lubbock Monahans Odessa Sweetwater Alice	PHF 8 V-UHF 111 12 2 4 5 7 2 4 5 7 10 4 5 9 (4 8) 12 2 (5) 10 (2) 8 11 13 9 8 7 2 6 (4 5) 7 9 12 3 6 9 24 4 6 26 33 39 6 10 31 33 2 4 5 7 9 41 44 11 13 33 35 4 19 7 21 12 14 32 19	4 53 22 377 208 510 3 39 12 26 319 45 27 139 71 116 32 4 100 108	Shamrock Sequin Sherman Sierra Blanca Snyder Sonora Spur Stanford Stephenville Stephenville Stephenville Stephenville Stulphur Spring Taylor Temple Terrell Texarkana (see Van Horn Vernon Victoria Waco Wacahachie Weslaco	21 41 14 34 32 22 15 44 20 40 29 16 26 23 37 38 Arkansas) 45 14 18 38 18 16 18 31 42	7 17 3 1 4 3 2 5 5 1 7 8 5 9 2 7 1 9 2 7 1 9 2 7 1	Soda Springs Wallace Weiser WYOMING 4 Casper Cheyenne Riverton Sheridan Basin Buffalo Cody Douglas Evanston Gillette Green River Hanna Jackson Kemmerer Lander Laramie Lusk Midwest Newcastle Pinedale	37 39 27 29 V-UHF 25 UF 3 6 8 24 11 13 14 16 10 18 20 9 11 13 15 17 38 22 23 25 36 30 41 15 44 23 16 19 21 26 32 34 23 14	IF 18 28 3 11 2 3 2 4 2 3 11 2 3 11 2 3 11 2 3 11 2 3 11 2 3 11 2 3 11 2 3 11 2 3 11 2 3 11 2 3 11 2 3 11 2 3 2 4 2 3 11 2 3 2 4 2 3 11 2 3 2 4 2 3 1 1 2 3 2 4 2 3 1 1 2 3 2 4 2 3 1 1 2 3 2 4 2 3 1 1 2 3 3 1 1 2 3 3 1 1 2 3 3 1 1 2 3 3 1 1 2 3 3 1 1 2 3 3 1 1 2 3 3 1 1 2 3 3 1 1 2 3 3 1 1 2 3 3 1 1 2 3 3 1 2 3 3 1 2 3 3 3 3 3 3 3 3 3 3 3 3 3
Manhatten Newton Norton Oberlin Osawatomie Osborne Ottawa Phillipsburg Pratt Russell Salina Scott City Sharon Spgs. Syracuse Wellington Winfield WEST ARKANSAS Little Rock Arkadelphia	15 31 36 33 24 17 26 44 30 18 32 40 31 21 29 33 35 SOUTH CENTRA 1 VHF 30 UHF 2 5 7 11 15 20 44 42	11 32 52 10 22 18 25 21 21 21 1 7 10 L 127 5 5 11 9	TEXAS 12 V Alpine Amarillo Brownsville Dallas Ft. Worth Houston Jasper Laredo Palestine San Angelo San Antonio Wichita Falls Abilene Beaumont- Port Arthur Corpus Christi El Paso Lubbock Monahans Odessa Sweetwater Alice Athens	PHF 8 V-UHF 111 12 2 4 5 7 10 4 5 9 (4 8) 12 2 (5) 10 (2) 8 1 13 9 3 8 7 2 6 (4 5) 7 9 12 3 6 9 24 4 6 26 33 39 6 10 31 33 2 4 5 7 9 41 44 11 13 33 35 4 19 7 21 12 14 32	4 53 22 377 208 510 3 39 12 26 319 45 27 139 71 116 32 4 4 10 10	Shamrock Sequin Sherman Seymour Sierra Blanca Snyder Sonora Spur Stanford Stephenville Stephenville Stephenville Stephenville Stulphur Spring Taylor Temple Terrell Texarkana (see Van Horn Vernon Victoria Waco Wacahachie Weslaco	21 41 14 34 32 22 15 44 20 40 29 16 26 23 37 38 Arkansas) 45 14 18 38 18 16 18 31 42 OUNTAIN	7 17 3 1 4 3 2 5 5 1 7 8 5 1 9 7 1 9 7	Soda Springs Wallace Weiser Weiser WYOMING 4 Casper Cheyenne Riverton Sheridan Basin Buffalo Cody Douglas Evanston Gillette Green River Hanna Jackson Kemmerer Larder Laramie Lusk Midwest Newcastle Pinedale Powell	37 39 27 29 V-UHF 25 UH 3 6 8 24 11 13 14 16 10 18 20 9 11 13 15 17 38 22 23 25 36 36 36 36 36 36 30 41 15 44 23 16 19 21 26 32 34 23 14 27	IF 18 28 3 11 1 2 3 2 4 4 2 3 1 1 2 3 1 1 2 3 1 1 2 3 1 1 2 1 2 1
Manhatten Newton Norton Oberlin Osawatomie Osborne Ottawa Phillipsburg Pratt Russell Salina Scott City Sharon Spgs: Syracuse Wellington Winfield WEST ARKANSAS Little Rock Arkadelphia Batesville Blytheville Camden Conway	15 31 36 33 24 17 26 44 30 18 32 40 31 21 29 33 35 SOUTH CENTRA 1 VHF 30 UHF 2 5 7 11 15 20 44 42 24	11 3 5 2 10 2 18 2 5 21 1 1 1 7 10 L 127 5 5 11 9 6	TEXAS 12 V Alpine Amarillo Brownsville Dallas Ft. Worth Houston Jasper Laredo Palestine San Angelo San Angelo	PHF 8 V-UHF 111 12 2 4 5 7 10 4 5 9 (4 8) 12 2 (5) 10 (2) 8 12 2 (5) 10 (2) 8 11 13 9 3 8 7 2 6 (4 5) 7 9 12 3 6 9 24 4 6 26 33 39 6 10 31 33 2 4 5 7 9 41 4 3 3 35 4 19 3 3 5 4 19 7 2 1 1 12 14 32 19 41 26 28 30 36 6 36 36 36 36 36 36 36 36 36 36 36 36 36 36 36 36 3	4 53 22 377 208 510 3 9 22 6 319 45 27 71 116 32 4 100 100 8 5 106 4 4	Shamrock Sequin Sherman Seymour Sierra Blanca Snyder Sonora Spur Stanford Stephenville Sterling City Sulphur Spring Taylor Terrell Texarkana (see Van Horn Vernon Victoria Waco Wacahachie Weslaco	21 41 14 34 32 22 15 44 20 40 29 16 26 23 37 38 Arkansas) 45 14 18 38 18 16 18 31 42 OUNTAIN 1 VHF 6 V-UHF 45	7 17 3 1 4 3 2 5 5 1 7 8 15 19 28 7 1 9 7 12 7 1 9 7	Soda Springs Wallace Weiser WYOMING 4 Casper Cheyenne Riverton Sheridan Basin Buffalo Cody Douglas Evanston Gillette Green River Hanna Jackson Kemmerer Lander Laramie Lusk Midwest Newcastle Pinedale	37 39 27 29 V-UHF 25 UF 3 6 8 24 11 13 14 16 10 18 20 9 11 13 15 17 38 22 23 25 36 36 30 41 15 44 23 16 19 21 26 32 34 23 14 27 17 25	IF 18 28 3 11 2 3 2 4 2 3 1 1 2 3 1 1 2 3 1 1 2 3 3 1 1 2 2 6 6 2 6 10
Manhatten Newton Norton Oberlin Osawatomie Osborne Ottawa Phillipsburg Pratt Russell Salina Scott City Sharon Spgs. Syracuse Welington Winfield WEST Little Rock Arkadelphia Batesvile Blytheville Camden Conway Crossett	15 31 36 33 24 17 26 44 30 18 32 40 31 21 29 33 35 SOUTH CENTRA 1 VHF 30 UHF 2 5 7 11 15 20 44 42 24 26	11 3 2 5 2 10 2 18 2 5 21 1 1 7 10 L 127 5 5 11 9 6 5	TEXAS 12 V Alpine Amarillo Brownsville Dallas Ft. Worth Houston Jasper Laredo Palestine San Angelo San Antonio Wichita Falls Abilene Beaumont- Port Arthur Corpus Christi El Paso Lubbock Monahans Odessa Sweetwater Alice Athens Austin Ballinger Bay City	THE 8 V-UHE 112 2 4 5 7 10 4 5 9 (4 8) 12 2 (5) 10 (2) 8 11 13 9 3 8 7 2 6 (4 5) 7 9 12 3 6 (4 5) 7 9 12 3 6 (4 5) 7 9 12 3 6 9 24 4 6 26 33 39 6 10 31 33 2 4 5 7 9 41 44 11 13 35 4 19 7 21 12 14 32 19 41 26 28 30 36 16 40	4 53 222 377 208 510 3 9 126 319 45 27 139 71 116 32 4 4 100 10 8 5 106 4 7	Shamrock Sequin Sherman Seymour Sierra Blanca Snyder Sonora Spur Stanford Stephenville Sterling City Sulphur Spring Taylor Temple Terrell Texarkana (see Tyler Uvalde Van Horn Vernon Victoria Wacahachie Weslaco MONTANA	21 41 14 34 32 22 15 44 20 40 29 16 26 23 37 38 Arkansas) 45 14 18 38 18 18 31 42 OUNTAIN 1 VHF 6 V-UHF 45 U 10 12	7 17 3 1 4 3 2 5 5 1 7 8 15 19 28 7 1 9 7 12 7 1 9 7 7 15	Soda Springs Wallace Weiser WYOMING 4 Casper Cheyenne Riverton Sheridan Basin Buffalo Cody Douglas Evanston Gillette Green River Hanna Jackson Kemmerer Lander Laramie Lusk Midwest Newcastle Pinedale Powell Rawlins Rock Springs Sudance	37 39 27 29 V-UHF 25 UH 3 6 8 24 11 13 14 16 10 18 20 9 11 13 15 17 38 22 23 25 36 36 36 36 36 30 41 15 44 23 16 19 21 26 32 34 23 14 27 17 25 25	IF 18 28 3 11 1 2 3 2 4 4 2 3 1 1 2 3 1 1 2 3 1 1 2 3 2 4 4 2 3 1 1 2 3 2 4 4 2 3 2 4 4 2 3 2 4 4 2 3 2 4 4 2 3 2 4 4 2 3 2 4 4 2 3 2 2 4 4 2 3 2 2 4 4 2 3 2 2 4 4 2 3 3 2 4 4 2 3 2 2 4 4 2 3 3 2 4 4 2 3 3 2 4 4 2 3 3 1 1 2 3 3 2 4 4 2 3 3 1 1 2 3 3 1 1 2 3 3 1 1 2 3 3 1 1 2 3 3 1 1 2 3 3 1 1 2 3 3 1 1 2 3 3 1 1 2 3 3 1 1 2 3 3 1 1 2 3 3 1 1 2 2 3 3 1 1 2 3 3 1 1 2 3 3 1 1 2 3 3 1 1 2 2 6 6 6 6 6 7 6 7 8 8 8 8 8 8 8 8 8 8 8 8 8
Manhatten Newton Norton Oberlin Osawatomie Osborne Ottawa Phillipsburg Pratt Russell Salina Scott City Sharon Spgs: Syracuse Wellington Winfield WEST ARKANSAS Little Rock Arkadelphia Batesville Blytheville Camden Conway	15 31 36 33 24 17 26 44 30 18 32 40 31 21 29 33 35 SOUTH CENTRA 1 VHF 30 UHF 2 5 7 11 15 20 44 42 24	11 3 5 2 10 2 18 2 5 21 1 1 1 7 10 L 127 5 5 11 9 6	TEXAS 12 V Alpine Amarillo Brownsville Dallas Ft. Worth Houston Jasper Laredo Palestine San Angelo San Antonio Wichita Falls Abilene Beaumont- Port Arthur Corpus Christi El Paso Lubbock Monahans Odessa Sweetwater Alice Athens Austin Ballinger Bay City Beeville	PHF 8 V-UHF 111 12 2 4 5 7 10 4 5 9 (4 8) 12 2 (5) 10 (2) 8 1 12 2 (5) 10 (2) 8 11 13 9 3 8 7 2 6 (4 5) 7 9 12 3 6 9 24 4 6 26 33 39 6 10 31 33 2 4 5 7 9 41 44 11 13 33 35 4 19 7 21 12 14 32 19 41 26 28 30 36 16 40 25 5	4 53 222 377 208 510 3 39 12 266 319 45 27 139 71 116 322 4 4 100 100 8 5 106 4 7 7	Shamrock Sequin Sherman Seymour Sierra Blanca Snyder Sonora Spur Stanford Stephenville Sterling City Sulphur Spring Taylor Temple Terrell Texarkana (see Van Horn Vernon Victoria Waco Wacahachie Weslaco	21 41 14 34 32 22 15 44 20 40 29 16 26 23 37 38 Arkansas) 45 14 18 38 18 16 18 31 42 OUNTAIN 1 VHF 6 V-UHF 45	7 17 3 1 4 3 2 5 5 1 7 8 5 5 1 7 8 5 5 1 7 8 5 5 1 7 8 5 5 1 7 8 5 5 1 7 8 7 7 9 7 7 9 7 9 7 9 7 9 7 9 7 9 7 9	Soda Springs Wallace Weiser WyOMING 4 Casper Cheyenne Riverton Sheridan Basin Buffalo Cody Douglas Evanston Gillette Green River Hanna Jackson Kemmerer Lander Laramie Lusk Midwest Newcastle Pinedale Powell Rawlins Rock Springs Sudance Superior	37 39 27 29 V-UHF 25 UH 3 6 8 24 11 13 14 16 10 18 20 9 11 13 15 17 38 22 23 25 36 36 30 41 15 44 23 16 19 21 26 32 34 23 14 27 17 25 25 25 29	IF 18 28 3 11 1 2 3 2 4 2 3 1 1 2 3 1 1 2 3 1 1 2 3 1 1 2 3 1 1 1 2 3 2 4 2 3 1 1 1 2 3 2 4 2 3 1 1 1 2 3 2 4 2 3 1 1 1 2 3 2 4 2 3 1 1 1 2 3 2 4 2 3 1 1 1 2 3 2 4 2 3 1 1 1 2 3 2 4 2 3 1 1 1 2 3 2 4 2 3 1 1 1 2 3 1 1 1 2 3 1 1 1 2 3 1 1 1 2 3 1 1 1 2 3 1 1 2 3 1 1 2 1 1 2 2 3 1 1 2 2 3 1 1 2 2 3 1 1 2 2 3 1 1 2 2 3 1 1 2 2 3 1 1 2 2 3 1 1 2 2 3 1 1 2 2 3 1 1 2 2 0.66 2 6 2 6 2 6 2 6 2 6 2 6 2 6 2 6 2 6 2 6 2 6 7 7 1 1 2 1 1 2 1 1 2 1 1 2 1 1 2 1 1 2 1 1 2 1 1 2 1 1 1 2 1 1 2 1 1 2 1 1 2 1 1 1 2 1 1 1 2 1 1 1 1 2 1 1 1 1 2 1 1 1 1 2 1 1 1 1 1 1 2 1 1 1 1 1 1 1 1 1 1 1 1 1
Manhatten Newton Norton Oberlin Osawatomie Osborne Ottawa Phillipsburg Pratt Russell Salina Scott City Sharon Spgs. Syracuse Welington Winfield WEST ARKANSAS Little Rock Arkadelphia Batesvile Blytheville Camden Conway Crossett El Dorado Fayetteville Forrest City	15 31 36 33 24 17 26 44 30 18 32 40 0 31 21 29 33 35 SOUTH CENTRA 1 VHF 30 UHF 2 5 7 11 15 20 44 42 24 24 26 34 31 16	11 32 52 10 21 12 12 10 21 10 21 10 21 10 21 10 21 10 21 10 21 10 21 10 21 10 21 10 21 10 21 21 10 21 21 10 21 21 21 20 21 20 21 20 21 20 21 20 21 20 21 20 21 20 21 20 21 20 21 20 21 20 21 20 21 20 21 20 21 20 21 20 20 21 20 20 21 20 20 20 20 20 20 20 20 20 20 20 20 20	TEXAS 12 V Alpine Amarillo Brownsville Dallas Ft. Worth Houston Jasper Laredo Palestine San Angelo San Antonio Wichita Falls Abilene Beaumont- Port Arthur Corpus Christi El Paso Lubbock Monahans Odessa Sweetwater Alice Athens Austin Ballinger Bay City	PHF 8 V-UHF 111 12 2 4 5 7 10 4 5 9 (4 8) 12 2 (5) 10 (2 8 1 13 9 3 8 7 2 6 (4 5) 7 9 12 3 6 9 24 4 6 26 33 39 6 10 31 33 2 4 5 7 9 41 4 11 13 33 35 4 19 7 21 12 14 32 19 41 26 28 30 36 16 40 25 25 15 15 15 15 15 15 15 15 15 15 15 15 15 15 15 15 15 15 12 14 12 14 12 14 12	4 53 222 377 208 510 3 39 122 26 319 45 27 71 139 71 116 322 4 100 100 8 5 106 4 7 7 7 133 10	Shamrock Sequin Sherman Seymour Sierra Blanca Snyder Sonora Spur Stanford Stephenville Sterling City Sulphur Spring Taylor Temple Terrell Texarkana (see Tyler Uvalde Van Horn Vernon Victoria Wacahachie Weslaco MONTANA	21 41 14 34 32 22 15 44 20 40 29 16 26 23 37 Arkansas) 45 14 18 38 Arkansas) 45 14 18 38 18 31 42 OUNTAIN 1 VHF 6 V-UHF 45 1 10 12 2 4 5 7 19 21 2 4 5 7 33 40 3 6 8 26 28	7 17 3 1 4 3 2 5 5 1 7 8 7 1 9 7 JHF 15 237 30	Soda Springs Wallace Weiser WyOMING 4 Casper Cheyenne Riverton Sheridan Basin Buffalo Cody Douglas Evanston Gillette Green River Hanna Jackson Kemmerer Laramie Lusk Midwest Newcastle Pinedale Powell Rawlins Rock Springs Sudance Superior Thermopolis	37 39 27 29 V-UHF 25 UH 3 6 8 24 11 13 14 16 10 18 20 9 11 13 15 17 38 22 23 25 36 36 36 36 36 36 36 36 36 31 15 44 23 16 19 21 26 23 24 23 14 23 14 25 25	IF 18 28 3 11 1 2 3 2 4 2 3 2 4 2 3 1 1 2 3 1 1 2 3 2 4 2 3 2 4 2 3 2 4 2 3 2 4 2 3 2 4 2 3 2 4 2 3 2 4 2 3 2 4 2 3 2 4 2 3 2 4 4 2 3 2 3 2 4 4 2 3 2 4 4 2 3 2 4 4 2 3 2 4 4 2 3 2 4 4 2 3 2 4 4 2 3 2 4 4 2 3 2 4 4 2 3 2 4 4 2 3 2 4 4 2 3 1 1 2 3 2 4 4 2 3 1 1 2 3 2 4 4 2 3 1 1 2 3 2 4 4 2 3 1 1 2 2 0.66 1 1 2 2 0.66 1 1 2 2 0.66 1 1 2 2 0.66 1 1 2 2 0.66 1 1 2 2 0.66 1 1 2 2 0.66 1 1 2 2 0.66 1 1 2 2 0.7 1 2 2 2 2 2 2 2 2 2 2 2 2 2
Manhatten Newton Norton Oberlin Osawatomie Osborne Ottawa Phillipsburg Pratt Russell Salina Scott City Sharon Spgs. Syracuse Wellington Winfield WEST ARKANSAS Little Rock Arkadelphia Batesville Blytheville Camden Conway Crossett El Dorado Fayetteville Forrest City Fort Smith	15 31 36 33 24 17 26 44 30 18 32 40 31 21 29 33 35 SOUTH CENTRA 1 VHF 30 UHF 2 5 7 11 15 20 44 42 24 24 24 24 33 35 SOUTH CENTRA 1 5 20 40 31 21 29 33 35 SOUTH CENTRA 1 8 3 2 4 0 3 1 21 29 3 3 3 5 SOUTH CENTRA 1 8 3 2 4 0 3 1 21 29 3 3 5 SOUTH CENTRA 1 8 3 2 4 0 3 1 21 29 3 3 5 SOUTH CENTRA 1 8 3 2 4 0 3 1 1 1 5 2 0 4 4 3 1 1 1 5 2 0 3 4 1 1 1 5 2 0 3 4 1 1 1 5 1 1 1 5 2 0 3 4 1 1 1 5 1 1 1 5 2 0 3 4 1 1 1 5 1 1 1 5 1 1 1 5 2 1 1 1 5 1 1 1 1 5 1 1 1 1 5 1 1 1 1 5 1 1 1 1 5 1 1 1 1 1 1 1 1 1 1	11 32 52 10 21 127 55 11 9 65 16 8 6 37	TEXAS 12 V Alpine Amarillo Brownsville Dallas Ft. Worth Houston Jasper Laredo Palestine San Angelo San Antonio Wichita Falls Abilene Beaumont- Port Arthur Corpus Christi El Paso Lubbock Monahans Odessa Sweetwater Alice Athens Austin Ballinger Bay City Beeville Big Spring Borger Brackittville	PHF 8 V-UHF 111 12 2 4 5 7 10 4 5 9 (4 8) 12 2 (5) 10 (2) 8 1 12 2 (5) 10 (2) 8 11 13 9 3 8 7 2 6 (4 5) 7 9 12 3 6 9 24 4 6 26 33 39 6 10 31 33 2 4 5 7 9 11 13 33 35 4 19 7 21 12 14 32 19 41 26 28 30 36 16 40 25 25 25 15 29 9 9 14 15 13 14 14 13 14 14 14 14 16 26 28 30 36	4 53 222 377 208 510 3 39 12 26 319 45 27 139 71 116 32 4 4 100 100 8 5 106 4 7 7 7 133 106 106 100 100 100 100 100 100 100 100	Shamrock Sequin Sherman Seymour Sierra Blanca Snyder Sonora Spur Stanford Stephenville Sterling City Sulphur Spring Taylor Temple Terrell Texarkana (see Tyler Uvalde Van Horn Vernon Victoria Waco Wacahachie Weslaco MONTANA Helena Billings Butte Great Falls Havre	21 41 14 34 32 22 15 44 20 40 29 16 26 23 37 38 Arkansas) 45 14 18 38 18 16 18 31 42 OUNTAIN 1 VHF 6 V-UHF 45 U 10 12 2 4 5 7 19 21 2 4 5 7 19 21 2 4 5 7 33 40 3 6 8 26 28 9 11 19 21 23	7 17 3 1 4 3 2 5 5 1 7 8 15 2 8 7 1 9 7 7 1 7 7 7 7 7 7 7 7 7 7 7 7 7 7	Soda Springs Wallace Weiser WyOMING 4 Casper Cheyenne Riverton Sheridan Basin Buffalo Cody Douglas Evanston Gillette Green River Hanna Jackson Kemmerer Lander Laramie Lusk Midwest Newcastle Pinedale Powell Rawlins Rock Springs Sudance Superior	37 39 27 29 V-UHF 25 UF 3 6 8 24 11 13 14 16 10 18 20 9 11 13 15 17 38 22 23 25 36 36 30 41 15 44 23 16 19 21 26 23 23 25 36 32 34 23 14 27 17 25 25 25 29 45 44 28 30	IF 18 28 3 11 1 2 3 2 4 4 2 3 3 1 1 1 2 3 4 4 2 3 3 1 1 1 2 3 1 1 1 2 1 2 0.6 0.7 1 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2
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Worth Houston Jasper Laredo Palestine San Angelo San Antonio Wichita Falls Abilene Beaumont- Port Arthur Corpus Christi El Paso Lubbock Monahans Odessa Sweetwater Alice Athens Austin Ballinger Bay City Beeville Big Spring Borger Brackittville Brady Breckenridge Brenham Brownfield Brownfield Brownod Bryan Cameron Cameron Candian Canyon Center Childress Clarendon Cleburne Coleman Colorado City Corulla Crockett	PHF 8 V-UHF 11 12 2 4 5 7 10 4 5 9 (4 8) 12 2 (5) 10 (2) 8 11 13 9 3 8 7 2 6 (4 5) 7 9 12 3 6 9 2 4 4 6 26 33 39 6 10 31 33 2 4 5 7 9 12 3 6 9 24 4 6 26 33 39 6 10 31 33 2 4 5 7 9 11 4 11 13 33 35 4 19 7 21 12 14 32 19 17 19 37 21 12 14 32 28 32 40 19 37 21 14 32 <td>4 53 222 377 208 510 3 39 2 26 319 4 5 27 139 71 116 32 4 10 8 5 106 4 4 7 7 7 13 100 3 3 5 6 6 6 4 4 13 12 22 7 10 10 10 32 5 10 10 10 10 10 10 10 10 10 10 10 10 10</td> <td>Shamrock Sequin Sherman Seymour Sierra Blanca Snyder Sonora Spur Stanford Stephenville Sterling City Sulphur Spring Taylor Temple Terrell Texarkana (see Tyler Uvalde Van Horn Vernon Victoria Waco Wacahachie Weslaco MONTANA Helena Billings Butte Great Falls Havre Miles City Missoula Anaconda Baker Big Timber Bozeman Broadus Chester Chinook Chouteau Circle Cut Bank Dillion Ekalaka Forsyth Fort Benton Glasgow Glendive Hamilton</td> <td>21 41 14 34 32 22 15 44 20 40 29 16 26 23 37 38 Arkansos) 45 14 18 38 18 16 18 31 42 OUNTAIN 1 VHF 6 V-UHF 45 10 12 2 4 5 7 19 21 2 4 5 7 19 21 2 4 5 7 33 40 3 6 8 26 28 9 11 19 21 23 3 6 10 14 16 24 11 13 17 19 35 37 19 24 14 16 29 30 36 38 18 20 22 21 44 18 20 22 21 44 18 20 22 21 44 18 20 22 21 44 22 24 24 25 18 28 28 28 29 30 36 38 18 20 22 21 24 24 24 25 25 18 28 28 28 29 30 25 26 23 27 26 27 26 27 27 26 27 27 26 27 27 26 27 27 26 27 27 27 26 27 27 27 27 27 28 24 27 27 27 28 24 27 27 27 27 27 27 27 27 27 27</td> <td>77314325517859 192797 HF5370678112965217337222452 0.7337222452</td> <td>Soda Springs Wallace Weiser Weiser WYOMING 4 Casper Cheyenne Riverton Sheridan Basin Buffalo Cody Douglas Evanston Gillette Green River Hanna Jackson Kemmerer Lander Laramie Lusk Midwest Newcastle Pinedale Powell Rawlins Rock Springs Sudance Superior Thermopolis Torington Wheatland Worland COLORADO 42 L Denver Pueblo Alamosa Boulder Burlington Canon City Cheyenne Wells Colorado Spgs. Cortez Craig Del Norte Delta Durango Ft. 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Cortez Craig Del Norte Delta Durango Ft. 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Worth Houston Jasper Laredo Palestine San Angelo San Angelo San Antonio Wichita Falls Abilene Beaumont- Port Arthur Corpus Christi El Paso Lubbock Monahans Odessa Sweetwater Alice Athens Austin Ballinger Bay City Beeville Big Spring Borger Brackitville Brady Breckenridge Brenham Brownfield Brownwood Bryan Cameton Canadian Cangon Center Childress Clarendon City Corulla Crockett Crystal City Cuero Dalhart	PHF 8 V-UHF 111 12 2 4 5 7 4 5 9 (4 8) 12 2 (5) 10 (2) 8 11 13 9 3 8 7 2 6 (4 5) 7 9 12 36 7 2 6 (4 5) 7 9 12 3 6 9 24 4 6 26 33 39 6 10 31 33 2 4 5 7 9 41 44 11 13 33 35 4 19 7 21 12 14 32 19 11 14 32 19 16 40 25 25 15 29 19 17 19 37 21 14 32 28 32 40 19 26 44 43 18 32 22 24 20 22 24 20 22 24 20 <td>4 53 222 377 208 510 3 39 12 26 319 45 27 139 106 4 77 13 100 10 8 5 106 4 77 77 13 103 35 6 6 4 13 12 23 33 6 6 4 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5</td> <td>Shamrock Sequin Sherman Seymour Sierra Blanca Snyder Sonora Spur Stanford Stephenville Stephenville Stephenville Stephenville Stephenville Stephenville Stephenville Stephenville Stephenville Stephenville Terrell Texarkana (see Tyler Uvalde Van Horn Vernon Victoria Waco Wacahachie Weslaco Maco Montana Helena Billings Butte Great Falls Havre Milss City Missoula Anaconda Baker Big Timber Bozeman Broadus Chester Chinook Chouteau Circle Cut Bank Dillion Ekalaka Forsyth Fort Benton Glasgow Glendive Hamilton</td> <td>$\begin{array}{c} 21 \\ 41 \\ 14 \\ 34 \\ 32 \\ 22 \\ 15 \\ 44 \\ 20 \\ 40 \\ 29 \\ 16 \\ 23 \\ 37 \\ 38 \\ 45 \\ 14 \\ 18 \\ 38 \\ 18 \\ 16 \\ 18 \\ 38 \\ 18 \\ 16 \\ 18 \\ 31 \\ 42 \end{array}$</td> <td>77 17 14 32 55 17 85 9 27 19 27 97 HF 53 70 67 81 12 96 65 21 73 33 67 81 12 96 65 21 73 22 24 52 22 24 52 22 22 22 23 23 23 23 23 23 2</td> <td>Soda Springs Wallace Weiser Weiser WyOMING 4 Casper Cheyenne Riverton Sheridan Basin Buffalo Cody Douglas Evanston Gillette Green River Hanna Jackson Kemmerer Lander Laramie Lusk Midwest Newcastle Pinedale Powell Rawlins Rock Springs Sudance Superior Thermopolis Torington Wheatland Worland COLORADO 42 L Denver Pueblo Alamosa Boulder Burlington Canon City Cheyenne Wells Colorado Spgs. 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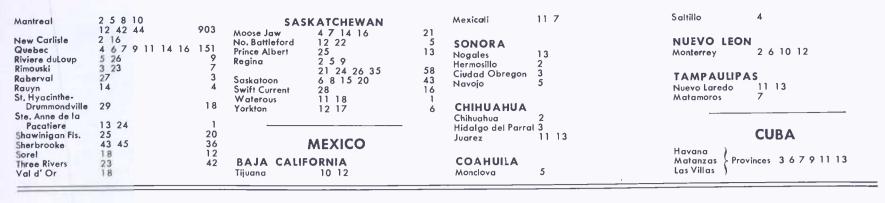
August 1949-formerly FM, and FM RADIO-ELECTRONICS

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Hugo La Junta Lenar Leadville Limon Longmont Los Animas Loveland Meeker Montrose Oak Creek Ouray Pagosa Spg Rocky Ford Saguache	36 16 19 32 22 45 14 27 42 27 34 38 s. 16 42 40		 Fillmore Green River Heber Hurricane Hyrum Kanab Lehi Logan Logan Milford Monticello Nephi Panguitch Parowan 	37 43 16 21 20 44 45 30 32 32 20 23 18 42 15	0. 0. 1 0.	3 Newport 2 Ontario 2 Pendleton 1 Pineville 3 Redmond 4 Reedsport 2 Roseburg 1 Salem 1 Sprague River 7 The Dalles	22 29 42 20 24 30 45 18 31 33 32 34 41 43 27 19 21 37	5249221 316638	Mayaguez San Juan VI	PUERTO RICO 2 4 7 9 11 13 RGIN ISLANDS 3 Alian ISLANDS 2 4 7 9 11 13 2 4 7 9 11 13 2 4 7 9 11 13 3 8 10 12 3 8 10 12	50 169 25 23 179 4 7
Salida San Luis Silvertown Springfield Steamboat S Sterling Trinidad Walden Walden Walsenburg Wray Yuma	44 23 29 25 39 34 18 21 37 26 38 17	(5 Provo 1 Richfield 1 St. George 1 Salina 2 Tooele 7 Vernal 3 6 NEVADA 6 Elko 2 Ely Las Vegas	21 24 22 38 35 27 33 4 V-UHF 23 1 10 15 17 14 3 6 14 16 2 8 10 12 14 16 41 45	9 4	CALIFORNIA 8 2 Los Angeles 2 San Francisco- 0akland Yreka 8 Bakersfield Chico Fresno Sacramento	A 3 VHF 5 V-U UHF 2 (4 5 7 9 11 13) 2 (4 5 7) 9 11 11 13 10 14 16 12 36 8 12 15 17 6 10 38 40	HF 2,904 1,428 29 98 159	Calgary Lacombe Lethbridge Medicine Hat Red Deer	CANADA ALBERTA 2 4 10 12 14 16 18 27 8 29 7 20 24 5 15 17 25 ISH COLUMBIA 12 38	80 2 15 11 3
	(ICO 1 VHF ₂ 6 V-U 2 UHF 2 (4) 5 7 10 22 24 12 14 16 3 10 17 19 3 6 8 34 36 9 11 13 30 32 12 18 19 21 26 28 22 24 20		Reno Austin Battle Mounta Boulder City Caliente Carson City Eureka Carson City Gerloch Gerloch Goldfield Henderson Lovelock AcDermitt	3 13 14 16 29	21 0.5 0.8 3 1 2 0.6 2 0.1 0.6 7 0.1 0.6 7 0.1	San Diego Alturas Arcata Arroyo Grande Banning Barstow Blythe Brawley Bridgeport Calipatria Calexico Coalinga	3 6 (8) 14 16 24 30 32 23 25 26 20 43 28 22 41 39	256 2 1 4 2 12 12 0.4 5 5	Cranbrook Fernie Kamloops Kelowna Nelson Port Alberni Prince Rupert Trail Vancouver-New Westminster Vernon Victoria	12 38 17 21 4 42 13 36 6 38 18 42 3 7 11 14 6 8 10 15 17 29 40 44 2 42 2 27 36	4 3 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5
Carrizoza Chama Clayton Dawson Deming Farmington Ft, Sumner Hachita Hobbs Hot Springs Laguna Lordsburg Los Alamos	42 43 27 41 23 25 21 43 37 15 17 31 33 28 43 45 34	0.	 McGill Mina Mountain City Overton Palisade Pioche Sparks Tonopah Wells Winnemucca 	23 25 39 34 34 36 45 24 26 37 18 21 41 18 21 23	0.2 3 0.4 0.9 1 0.1 5 2 0.8 2 1	Corona Crescent City	35 45 38 29 18 41 14 16 28 28 24 19 19 20 31	109154 10517336842	Brandon Portage la Prairi Winnipeg-St. Boniface NEV Cambellton Edmundton Fredericton Moncton	MANITOBA 5 9 11 37 40	44 17 222 7 7 10 23
Las Cruces Las Vegas Lovington Magdalena Park View Portales Raton Roy San Rita Santa Rosa Socorro Taos Tucumcari	27 29 17 30 35 36 18 20 35 37 44 20 25 14 16 15 29 31	0.	 WASHINGT 32 32	PACIFIC ON 2 VHF 2 UHF 2 4 5 7 9 13 4 (5) 7 _g 11 1 6 8 10 38 22 21 23 39 41 24 28 45	141 156	Independence Inyokern Laguna Beach Lakeport Lancaster Lodi Lompoc Merced Modèsto Mojave Monterey Mt. Shasta Napa	33 43 33 33 45 21 42 24 26 20 18 23 29	0.3 5 4 12 11 10 16 20 28	Amherst Antigonish Bridgewater Hallfax Kentville	38 4 6 26 28 22 8 19 40 DVA SCOTIA 36 9 16 10 33 3 5 12 27 29 31 39 15	4 52 32 4 9 2 3 70 4
Vaughn Willard	45 39 5 V-UHF 30 UHF 9 11 14 16 6 29 35 2 4 (5) 8 12 15 17 3 6 7 10 14 16 9 13 30 32 34 19 21	0.3 121 37 5 1	Colfax Ellensburg Ephrata Everett Goldendale Grand Coulee Kennewick Longview Metaline Falls	42 42 17 43 45 29 27 26 40 29 44 19 18	2 3 6 1 30 2 4 2 12 0.5 0.3 4 13	Needles Occeanside Oroville Oxnard Placerville Pacific Grove Palm Springs Paso Robles Petaluma Porterville Portola Red Bluff Red Bluff Redding	24 27 22 34 45 44 25 23 31 41 25 18 42	4549363386240	Belleville Brantford-Simcoe Brockville Chatham Cornwall Ft. Frances	45 19 36 5 28	28 10 3 8 16 38 11 17 14 6
Buckeye Casa Grande Clarkdale Clifton Coolidge Douglas Ft. Huachuca Granada Granada Grand Canyon Globe Halbrook Hayden Jerome	39 24 43 45 30 35 37 15 17 38 15 40 22 27 29 28 44 36	1 3 2 9 1 0.6 6 1 2 2	Omak Oroville Pasco Port Angeles Pullman Puyallup Republic Ritzville Sheldon Sunnyside Vancouver Waterville Wenatchee	25 32 19 32 34 30 20 40 23 30 15 38 35 35 37	3 1 4 9 4 8 0.9 2 4 2 19 0.9 12	Redlands Riverside Salinas San Bernardino San Luis Obispo San Jose Santa Barbara Santa Cruz Santa Cruz Santa Maria Santa Paula Santa Roula Santa Roula	29 19 21 30 15 17 21 35 37 39 24 26 14 16 44 18 17 37	14 31 12 44 9 129 35 17 9 13 13	Guelph-Kitchener- Galt Haileybury Hamilton Kenora Kingston Kirkland Lake London-St. Thomas North Bay Oshawa Orillia Jnc. Ottawa-Hull Owen Sound	37 21 6 29 15 9 19 26 3 16	74 2 166 8 30 20 95 16 29 20 155 14
Mesa Miami Morenci McNary Nogales Parker Prescott Safford St, Johns San Simon Superior Tombstone	31 33 26 32 34 23 25 38 23 25 36 38 40 42 29	2 7 5 3 2 5 1 6 2 1 0.7 4 0.8	Yakima OREGON 1 La Grande Klamath Falls Medford Portland Albany Ashland Astoria Baker	31 33 VHF 3 V-UHF 3 13 2 4 32 34 5 7 15 17 (3) 6 8 10 12 25 19 21 26 16	27 33 UHF 8 16 11 17 406 6 5 10 9	Stockton Susanville Taft Trona Turlock Ukiah Ventura Victorville Visalia Wasco	32 42 44 22 36 40 23 28 20 30 37 27 34 22	8 3 13 9 5	Pembrooke Peterborough Port Arthur- Ft, William St, Catherine- Niagara Falls Sarnia Sault Ste, Marie Stratford Sudbury Timmons Tonto Windsor	4 31 38 2 4 19 22 24	11 25 24 51 19 26 *17 32 29 667 105
Price Salt Lake City Cedar City Ogden Beaver Brigham	41 30 18 20 2 V-UHF 27 UHF 11 13 2 (4 5) 7 9 5 17 12 34 38 40 19 42	1 3 5 204 5 44 2 6	Bend Burns Canyon City Coquille Condon Corvallis Enterprise Eugene Gold Beach Grants Pass Heppner Hood River	28 35 21 42 14 24 26 22 23 40 14 16 40 36 38 41 43 36	10 3 0.3 3 1 8 2 21 0.5 6 1 3	Westwood Willits 2 Willows 3 Yuba City 1 U. S. TE Anchorage 2	39 45 43 31 55 ERRITORIES LASKA 2 7 11 13	0.7 5 2 5 5	Wingham Woodstock PRINCE E Charlottetown Summerside (Amos Chicoutimi	33 26 DWARD ISLAND 13 14 11 21 DUEBEC 20 212 20	2 12 15 5 3 16
Castle Dale Duchesne Ephraim Escalante	14 31 28 25	1 1 2 1	Kinzua Lakeview McMinnville Madras	18 20 27 29 44 29	0.8 2 4 0.4	Juneau 3 Ketchikan 2	2 4 7 9 11 13 3 8 10 2 4 9 5 9	5	Ionquiere	27 14 16 22 14	14 33 14 5

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FM and TELEVISION



CHANNELS 2: LIST OF THE CITIES PROPOSED FOR EACH ONE

the FCC proposal was rearranged in or-In considering the channels assigned der to list each channel number with the to a specific area, it is necessary to areas to which that channel has been know where the same channel or channels have been assigned also. Therefore, assigned.

Calais, Me. Boston, Mass. N, Y, City Buffialo, N. Y. Baltimore, Md. Greensboro, N. C. Charleston, S. C. Atlanta, Ga. Jacksonville, Fla Mia ni, Fla Hamilton, Ohio Chicago, Ill. Detroit, Mich. Nashville, fenn Macon, Ga. Minneapolis, Minn. Iowa City, Iowa De Sota, Mo. Kansas City, Iowa De Sota, Mo. Kansas City, Iowa De Sota, Mo. Kansas City, No. Dickin on, N. D. Grand Forks, N. D. North Platte, Neb. Little Rock, Ark. New Orleans, La. Tulsa, Okla. Amarillo, Tex. El Paso, Tex. Ft. Worth, Tex. Houston, Tex. Butto Mart. Butte, Mont. Boise, Idaho Boise, Idaho Denver, Colo. Albuquerque, N. M. Phoenix, Ariz. Salt Lake City, Utah Spokane, Wash. Klamath Falls, Ore. Los Angeles, Cal. San Francisco, Cal.

CHANNEL 2 (42)

CHANNEL 3 (40)

CHANNEL 3 (Montpelier, Vt. Syracuse, N. Y. Philadelphia, Pa Pittsburgh, Pa. Richmond Va Charlotte, N. C. Savannah, Ga Tampa, Fla. Columbus, Ohio Tell City, Ind Springfield, III. Katamazoo Mich. Marquette, Mich. Milwaukee, Wis. Duluth, Wis. Chattanooga, Tent Duluth, Wis. Chattanooga, Tenn. Eufaula, Ala. Jackson, Miss. Decorah, Iowa Springfield, Mo. Minot, N. D. Aberdeen, S. D. Omaha, Neb. Wichita, Kans. Wichita, Kuis. Shreveport, La. Laredo, Tex. Wichita Fals, Tex. Great Falls, Mont. Miles City, Mon Idaho Falls, Idaho Casper, Wyo. Pueblo Colo. Gallup, N. M. Roswell, N. M. Roswell, N. M. Tucson, Ariz. Ely, Nev. Reno, Nev. La Grande, Ore. Portland, Ore. San Diego, Cal.

CHANNEL 4 (49) CHANNEL 4 (49) Boston, Mass. N. Y. City Albany-Schenectady-Troy, N. Y. Buffalo, N. Y. Lancaster, Pa. Washington, D. C. Norfolk, W. Va. Beckley, W. Va. Columbia, S. C. Jacksonville, Fla. Miami, Zla. Cincinnati, Ohio Cleveland, Ohio Chicago III. Moline, III. Moline, III. Moline, III. Cheboygan, Mich. Detroit, Mich. Memphis, Tenn. Nashville Tenn. Birmingham, Ala. Minneapolis, Minn. Minneapolis, Minn. Ames, Iowa Kansas City, Mo. St. Louis, Mo. Dickinson, N. D. Grand Forks, N. D. Mitchell, S. D. Hastings, Neb. New Orleans, La. Okla. City, Okla. Amarillo, Tex. Brownsville, Tex. Dallas, Tex. Brownsville, Tex. Dallas, Tex. El Paso, Tex. Monahans, Tex. San Antonio, Tex. Billings, Mont. Billings, Mont. Butte, Mont. Boise, Idaho Denver, Colo. Albuquerque, N. M. Phoenix, Ariz. Salt Lake City, Utah Seattle, Wash. Spokane, Wash. Klamath Falls, Ore. Los Angeles, Cal. San Francisco, Cal. CHANNEL 5 (4 Bangor, Me. Boston, Mass. N. Y. City Rochester, N. Y. Washington, D. C. Huntington, W. Va. Wilmington N. C. Atlanta, Ga. Jacksonville, Fla. Miami, Fla. Cleveland, Ohio Dayton, Ohio Chicago, Ill. Marquette, Mich. Louisville, Ky. Lexington, Tenn. Mobile, Ala. Minneapolis, Minn. CHANNEL 5 (45)

Mobile, Ala. Minneapolis, Minn. Sioux City, Iowa Kansas City, Mo. St. ouis, Mo. Bismarck, N. D.

No. P atte, Neb. Great Bend, Kans Little Rock, Ark. Alexandria, La. Amarillo, Tex. Brownsville, Tex.

El Paso, Tex. Ft. Worth, Tex. San Antonio, Tex. Billings, Mont.

Butte, Mont. Boise, Idaho Denver, Colo. Albuquerque, N. M. Phoenix, Ariz. Cedar City, Utah Salt Lake City, Utah Salt Lake City, Utah Spokane, Wash. Medford, Ore. Los Angeles, Cal. San Francisco, Cal. CHANNEL 6 (42) Portland, Me. New Haven, Conn. Johnston, Pa. Philadelphia, Pa. Richmond, Va. Richmond, Va. Winston-Salem, N. C. Augusta, Ga. Cairo, Ga. Augusta, Ga. Cairo, Ga. Tampa, Fla. Columbus, Ohio Indianapolis, Ind. Peoria, III. Lansing, Mich. Milwaukee, Wis. Duluth, Wis. Knoxville, Tenn. Memphis, Tenn. Birmingham, Ala. Jefferson City, Mo. Fargo, N. D. Minot, N. D. Pierre, S. D. Omaha, Neb. New Orleans, La. Tulsa, Okla. Beaumont, Tex. Corpus Christi, Tex. San Angelo, Tex. Corpus Christi, Tex. San Angelo, Tex. Wichita Falls, Tex. Great Falls, Mont. Miles City, Mont. Idaho Falls, Idaho Casper, Wyo. Pueblo, Colo. Roswell, N. M. Kingman, Ariz. Tucson, Ariz. Ely, Nev. Walla Wala, Wash. Portland, Ore. Portland, Ore. Sacramento, Cal. San Diego, Cal. CHANNEL 7 (43 Calais, Me. Boston, Mass. N. Y. City Bu falo, N. Y. Wilmington, Dela. Washington, D. C. Roanoke, Va. Wheeling, W. Va. Columbia, S. C. Tampa, Fla. Cincinnati, Ohio Chicago, Ill. Detroit, Mich. Iron Mtn. Mich. CHANNEL 7 (43)

Odessa, Tex. Palestine, Tex. San Antonio, Tex. Billings, Mont. Butte, Mont. Boise, Idaho Boise, Idaho Denver, Colo. Albuquerque, N. M. Tuscon, Ariz. Salt Lake City, Utah Seattle, Wash. Spokane, Wash. Medford, Ore. Los Angeles, Cal. San Francisco, Cal.

CHANNEL 8 (37) Augusta, Me. Ft. Kent, Me.

Augusta, Me. Ft. Kent, Me. Syracuse, N. Y. Charleston, W. Va. Charleston, S. C. Atlanta, Ga. Jacksonville, Fla. Miami, Fla. Cleveland, Ohio Indianapolis, Ind. St. Ste. Marie, Mich. Milwaukse, Wis. Duluth, Wis. Memphis, Tenn. Mobile, Ala. Des Moines, Iowa Grcnd Forks, N. D. Williston, N. D. Mitchell, S. D. McCook, Neb. Junction City, Kans. Muskogee, Okla. Dallas, Tex. Houston, Tex. Great Falls, Mont. Pocatello, Idaho Carper, Wyo Pocatello, Idaho Casper, Wyo. Pueblo, Colo. Roswell, N. M. Roswell, N. M. Phoenix, Ariz. Las Vegas, Nev. Walla Walla, Wash. Portland, Ore. Fresno, Cal. San Diego, Cal. **CHANNEL 9 (39)**

Manchester, N. H. N. Y. City Pittsburgh, Pa. Washington, D. C. Charlotte, N. C. Bajabridge Charlotte, N. C. Bainbridge, Ga. Savannah, Ga. Tampa, Fla. Chicago, III. Iron Mtn., Mich. Louisville, Ky. Cha tanooga, Tenn. Jackson, Miss. Minneapolis. Minn. Jackson, Miss. Minneapolis, Minn. Cedar Rapids, Iowa Sioux City, Iowa Kansas City, Mo. St. Louis, Mo. Dickinson, N. D. Abardeon S. D. Aberdeen, S. D. Garden City, Kans. Okla. City, Okla. Abilene, Tex. Brownsville, Tex. El Paso, Tex. Jasper, Tex. San Antonio, Tex. Havre, Mont. Coeur D'Alene, Idahó Nampa, Idaho

Denver, Col. Sheridan, Wyo. Santa Fe, N. M. Flagst_ff, Ariz. Yuma, Ariz. Salt Lake City, Utah Takoma, Wash. Los Angeles, Cal. San Francisco, Cal. **CHANNEL 10 (45)** Augusta, Me. Syracuse, N. Y. Philadelphia, Pa

Syracuse, N. T. Philadelphia, Pa Norfolk, Va. Roanoke, Va. Columbia, S. C. Jacksonville, Fla. Miami, Fla. Columbus, Ohio Bloomington, Ind. Carthage, Ill. S. St. Marie, Mich. Milwaukee, Wis. Duluth, Wis. Knoxville, Tern. Memphis, Tenn. Montgomery, Ala. Algona, Iowa Springfield, Mo. Fargo, N. D. Minot, N. D. Pierre, S. D. Lincoln, Neb. Wichita, Kans. New Orleans, La. Shreveport, La. Amarillo, Tex. Corpus Christi, Tex. Ft. Worth, Tex. Helena, Mont. Miles City, Mont. Pocatello, Idaho Biverton Wuo Pocatello, Idaho Riverton, Wyo. Pueblo, Colo. Carlsbad, N. M. Gallup, N. M. Tucson, Ariz. Elxo, Nev. Las Vegas, Nev. Walla Walla, Wash. Portland, Ore. Bakersfield, Cal. Sacramento, Cal.

Denver, Col.

CHANNEL 11 (36) Providence, R. I. N. Y. City N. Y. City Baltimore, Md. Charlotte, N. C. Atlanta, Ga. Savannah, Ga. Tampa, Fla. Cincinnati, Ohio Columbus, Ohio Chicago, III. Marquette, M:ch. Nashville. Tenn. Mobile, Ala. Mobile, Ala. Minneapolis, Minn. Des Moines, Iowa St. Louis, Mo. Williston, N. D, Sioux Falls, S. D. Garden City, Kans. Topeka, Kans. Little Rock, Ark. Little Rock, Ark. Alexandria, La. Tulsa, Okla. Houston, Tex. Lubbock, Tex. Havre, Mont. Missoula, Mont. Twin Falls, Idaho Cheyenne, Wyo.

Here, again, it is advisable to transfer the data to a map, particularly for studying possible co-channel and adjacentchannel interference.

Sheridan, Wyo. Santa Fe, N. M. Flagstaff, Ariz. Price, Utah Seattle, Wash. Los Angeles, Cal. San Francisco, Cal. Yreka, Cal.

CHANNEL 12 (38) CHANNEL 12 (3 Bangor, Me. Binghampton, N. Y. Erie, Pa. Norfolk, Va. Charleston, W. Va. Augusta, Ga. Miami, Fla. Tallahassee, Fla. Indianapolis, Ind. Peoria, III. Grand Rapids, III. Duluth, Wis. Paducah, Ky. Duluth, Wis. Paducah, Ky. Chattanooga, Tenn. Jackson, Miss. Charles City, Iowa Bismarck, N. D. Rapid City, S. D. Lincoln, Neb. Wichita, Kans. Alpine, Tex. Dallas, Tex. San Antonio, Tex. San Antonio, Tex. Sweetwater, Tex. Helena, Mont. Coeur D'Alene, Idaho Nampa, Idaho Alamosa, Colo. Clovis, N. M. Silver City, N. M. Phoenix, Ariz. Ogden, Utah La Vegas, Nev. Portland, Ore. Chico, Cal. San Antonio, Tex Chico, Cal. Fresno. Cal CHANNEL 13 (42) Portland, Me. Utica, N. Y. Newark, N. J. Johnstown, Pa. Johnstown, Pa. Baltimore, Md. Lynchburg, Va. Asheville, N. C. Winston-Salem, N. C. Charleston, S. C. Cordele, Ga. Tampa, Fla. Dayton, Ohio Toledo, Ohio Toledo, Ohio Chicago, III. Gladstone, Mich. Knoxville, Tenn. Memphis, Tenn. Birmingham, Ala. Mobile, Ala. Mobile, Ala. Minneapolis, Minn. Des Moines, Iowa St. Louis, Mo. Fargo, N. D. Sioux Falls, S. D. McCook, Neb. Topeka, Kans. Shreveport, La. Alexandria, La. Enid. Okla. Enid, Okla. Enid, Okia. Houston, Tex. Lubbock, Tex. Missoula, Mont. Twin Falls, Idaho Cheyenne, Wyo. Sheridan, Wyo. Santa Fe, N. M. Yuma Ariz Yuma, Ariz. Price, Utah

Reno, Nev. Tacoma, Wash. LaGrande, Ore. Los Angeles, Cat. Yreka, Cal.

CHANNEL 14 (66) Calais, Me. Biddeford, Me. Bridgeport, Conn. Elmira, N. Y. Elmira, N. Y. Baltimore, Md. Richmond, Va. Bluefield, W. Va. Wilmington, N. C. Macon, Ga. Gainsville, Fla. Panama City, Fla. W. Palm Beach, Fla. Dayton, Ohio Youngstown, Ohio Vincennes, Ind. Fiint, Mich. Iron River, Mich. Iron River, Mich. S. Ste. Marie, Mich. 5. Ste. Marie, Mich. Madison, Wis. Murfreesboro, Tenn. Demopolis, Ala. International Falls, Minn. Northfield, Minn. Ft. Madison, Iowa Fr. Madison, sowo Salem, Mo. Fargo, N. D. Stanton, N. D. Sioux Falls, S. D. Gothenburg, Neb. Nebraska City, Neb. Great Bend, Kans. Helena, Ark. Hammond, La. Hammond, La. Minden, La. Bartlesvile, Okla. Elk City, Okla. Elk City, Okla. Bryan, Tex. Ft. Davis, Tex. Harlingen, Tex. Sweetwater, Tex. Ilvalde Tex Sweetwater, Tex. Uvalde, Tex. Bozeman, Mont. Miles City, Mont. Shelby, Mont. Sheby, Mont. Shoshone, Idaho Cheyenne, Wyo. Pinedale, Wyo. Durango, Colo. Los Animas, Colo. Clovis, N. M. Socorro, N. M. Socorro, N. M. Flagstaff, Ariz. Flagstaff, Ariz. Tucson, Ariz. Castle Dale, Utah Ely, Nev. Las Vegas, Nev. Reno, Nev. Seattle, Wash. Canyon City, Ore. Eugene, Ore. Bakersfield, Cal. Eureka, Cal. San Diego, Cal. Santa Cruz, Cal. CHANNEL 15 (55)

Ft. Kent, Me. Burlington, Vt. Burlington, Vt. Providence, R. . Trenton, N. J. Altoona, Pa. Bennettsville, S. C. Gainsville, Ga. Moultrie, Ga. Melbourne, Fla. Zanesville, Ohio Cairo III Cairo, III.

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Iron Mtn. Mich. Nashville, Tenn. Montgomery, Ala. Minneapolis, Minn. Cedar Rapids, Iowa St. Louis, Mo. Bismarck, N. D. Rapid City, S. C. Omaha, Neb. Little Rock, Ark. New Orleans, La. Okla. City, Okla. Amarillo Tex. El Paso, Tex.

El Paso, Tex.

Iron Mtn. Mich.

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Champaign, Kalamazoo, III. Champaign, Kalamazoo, III. Manistee, Mich. Medford, Mich. Frankfort Wis. Brew, Ky. Abeton, Ala. Wilrdeen, Miss. Mimar, Minn. Carshalltown, Ia. Columbia, Mo. New Rockford, N. D. Miller, S. D. Alliance, Neb. Norfolk, Neb. Manhatten, Kans. Arkadelphia, Ark. Opelousas, La. Enid, Okla. Borger, Tex. Graham, Tex. Granam, Tex. Gonzales, Tex. Jacksonville, Tex. Sonora, Tex. Kalpellis, Mont. Stanford, Mont. Preston, Idaho Salmon, Idaho Preston, İdaho Salmon, Idaho Hanna, Wyo. Sheridan, Wyo. Burlington, Colo. Grand Jnc., Colo. Hobbs, N. M. Taos, N. M. Douglas, Ariz. Granado, Ariz. Phoenix, Ariz. Parowan, Utah Elko. Nev. Parowan, Utah Elko, Nev. Sunnyside, Wash. Medford, Ore. Fresno, Cal. San Bernardino, Cal. Yuba City, Cal.

CHANNEL 16 (64) Calais, Me. Biddeford, Me. Bridgeport, Conn. E mira, N. Y. Baltimore, Md. Baitimore, Ma. Lynchburg, Va. Wilmington, N. C. Macon, Ga. Gainsville, Fla. Panama City, Fla. W. Palm Beach, Fla. W. Palm Beach, Fla. Dayton, Ohio Youngstown, Ohio Evansville, Ind. Kewanee, Ill. Flint, Mich. Hancock, Mich. S. Ste. Marie Mich. Oshkosh, Wis. Fayettesville, Tenn. Johnson City, Tenn. Laurel, Miss. Jonnson City, tenn. Laurel, Miss. Austin, Minn. International Falls, Minn. Shenandoah, Iowa Fargo, N. D. Minot, N. D. Minot, N. D. Custer, S. D. Sioux Falls, S. D. Broken Bow, Neb. El Dorado, Kans. Forrest City, Ark. Ft. Smith, Ark. Ft. Smith, Ark. Ruston, La. A tus, Okla. Bay City, Tex Eagle Pass, Tex. Presido, Tex. Sterling City, Tex. Waco, Tex. Bozeman, Mont. Miles City, Mont. Shelby, Mont. Shelby, Mont. Kellogg Wardner, Id. Twin Falls, Idaho Cheyenne, Wyo. Twin Falls, Idaho Cheyenne, Wyo. Lander, Wyo. La Junta, Colo. Pagasa Springs, Colo. Clovis, N. M. Socorro, N. M. Flagstaff, Ariz. Turcon Ariz Tucson, Ariz. Tucson, Ariz. Heber, Utah Ely, Nev. Las Vegas, Nev. Reno, Nev. Reno, Nev. Seattle, Wash. Baker, Ore. Eugene, Ore. Bakersfield, Cal. Eureka, Cal. San Diego, Cal. Santa Cruz, Cal.

CHANNEL 17 (56) Ft. Kent, Me. Burlington, Vt. Providence, R. I. Jamestown, N. Y. Trenton, N. J. Richmond, Va.

Clarksburg, W. Va. Winston-Salem, N. C. Augusta, Ga. Valdosta, Ga. Sebring, Fla. Sandusky, Ohio Seymour, Ind. Springfield, III. Muskegon, Mich. Sparta, Wis. Mayfield, Ky. Horriman, Tenn. Horriman, Tenn. Alexander City, Ala. Grenada, Miss. St Claud, Minn. Grenada, Miss. St Claud, Minn. Ft Dodge, Iawa Marshall, Mo. Carrington, N. D. Dupree, S. D. Neligh, Neb. Orbores Karr Dupree, S. D. Neligh, Neb. Osborne, Kans. Morrilton, Ark. Crowley, La. Stillwater, Okla. Breckenridge, Tex. Huntsville, Tex. Kingsville, Tex. Yampa, Tex. Lewistown, Mont. Missoula, Mont. Sidney, Mont. Preston, Idaho Rawlins, Wyo. Sheridan, Wyo. Grand Jnc., Colo. Yuma, Colo. Gallup, N. M. Hobbs, N. M. Las Vegas, N. M. Las Vegas, N. M. Douglas, Ariz. Phoenix, Ariz. Cedar City, Utah Elko, Nev. Elko, Nev. Ephrata, Wash. Medford, Ore. Portland, Ore. Fresno, Cal. San Bernardino, Cal.

Santa Rosa, Cal. CHANNEL 18 (59) Calais, Me. Brattlebora, Vt. Auburn, N. Y. York, Pa. Asheville, N. C. Asheville, N. C. Henderson, N. C. Georgetown, S. C. Macon, Ga. Crestview, Fla. W. Palm Beach, Fla. Portsmouth, Ohio Youngstown, Ohio Evansville, Ind. Marion, Ind. Quincy, III. Marquette, Mich. Saginaw, Mich. Beloit, Wis. Winchester, Tenn. Brookshaven, Miss Ely, Minn. Red Wing, Minn. Fargo, N. D. Minot, N. D. Sioux Falls, S. D. Lexington, Neb. Scatts Bluff, Neb. Atchison, Kans. Ft. Smith, Ark. Paragould, Ark. Lawton, Okla. Colo. City, Tex. Del Rio, Tex. Orange, Tex. Brookshaven, Miss. Del Rio, Tex. Orange, Tex. Van Horn Tex. Victoria, Tex. Waco, Tex. Chouteau, Mont. Glasgow, Mont. Cascade, Idaho St. Maries, Idaho Riverton, Wyo. Cortez, Colo. Trinidad, Colo. Portales, N. M. Silver City, N. M. Winslow, Ariz. Nephi, Utah Nephi, Utah Boulder City, Nev. Tonopah, Nev. Winnemucca, Nev. Olympia, Wash. Kinzva, Ore. Reedsport, Ore. El Centro, Cal. Monterey, Cal. Redding, Cal. Santa Paula, Cal.

CHANNEL 19 (55) Augusta, Me. Ft Kent, Me. Fall River, Mass. Olean, N. Y. Tupper Lake, N. Y. Easton, Pa.

Richmond, Va. Weston, W. Va. Kannapolis, N. C. Cedartown, Ga. Statesboro, Ga. Deland, Fla. Key West, Flo. Quincy, Fla. Danville, III. Vanville, III. Muskegan, III. Merrill, Wis. Lexington, Ky. Paris, Tenn. Kosciuska, Miss. St. Cloud, Minn. Webster City, Iowa Joplin, Mo. Webster City, low Joplin, Mo. Washington, Mo. Devils Lake, N. D. Gettysburg, S. D. York, Neb. Oakdale, La. Alice Tox Alice, Tex. Brady, Tex. Brenham, Tex. Childress, Tex. Monahans, Tex. Paris, Tex. Baker, Mont. Billings, Mont. Havre, Mont. Missoula, Mont. Idaho Falls, Idaho Missoira, moment Idaho Falls, Idaho Laramie, Wyo. Gunnison, Colo. Lamar, Colo. Alamogordo, N. M. Gallup, N. M. Ajo, Ariz. Bisbee, Ariz. Beaver, Utah Elko, Nev. Mt. Vernon, Wash. Pasco, Wash. Ashland, Ore. Grass Valley, Cal. Hanford, Cal.. Riverside, Cal

CHANNEL 20 (53) Montpelier, Vt. New Haven, Conn. Oswego, N. Y. York, Pa. Roanoke, Va. Belhaven, N. C. Headergowille, N. C. Hendersonville, N. C Americus, Ga. Pensacola, Fla. Portsmouth, Ohia Evansville, Ind. Elgin, III. Elgin, III. Ishpeming, Mich. Jackson, Mich. Whitehall, Wis. Jasper, Ala. McComb, Miss. Jasper, Ala. McComb, Miss. Crookston, Minn. Marshall, Minn. Ottumwa, Iowa Clinton, Mo. Bismarck, N. D. Belle Fourche, S. D. O'Neill, Neb. Scotts Bluff, Neb. Hutchinson, Kans. Batesville, Ark. Magnolia, Ark. Ada, Okla. Guymon, Okla. Cuero, Tex. Marfa, Tex. Rock Springs, Tex. Stanford, Tex. Glasgow, Mont. White Sul. Spgs., Mont. San Rita, N. M. Portales, N. M. San Rita, N. M. Winslow, Ariz. Hyrum, Utah Mach. Utah Hyrum, Utah Maab, Utah Ely, Nev. Puyallup, Wash. Lakeview, Ore. Dakeview, Ord On ario, Ore. Brawley, Cal. Hollister, Cal. Mojave, Cal. Ukiah, Cal.

CHANNEL 21 (61) Augusta, Me. Ft. Kent, Me. Fall River, Mass. Massena, N. Y. Easton, Pa. Johnstown, Pa. Petersburg, Va. Salisbury, N. C. Athens, Ga. Waycross, Ga. Waycross, Ga. Key West, Fla. Orlando, Fla. Mansfield, Ohio

Logansport, Ohio Gailsburg, III. Saginaw, Mich. Fond du Lac, Wis. Richmond, Ky. Richmond, Ky. Columbia, Tenn. Troy, Ala. Greenwood, Miss. Gulfport, Miss. Faribault, Minn. Virginia, Minn. Virginia, Minn. Crestan, Iawa Poplar Bluff, Ma. Rugby, N. D. White River, S. D. Kearney, Neb. Emparia, Kans. Sharon Spgs., Kans. Russelville, Ark. Pinaville, La Russelville, Ark. Pineville, La. Brownwood, Tex. Edinburg, Tex. Galveston, Tex. Mineola, Tex. Odessa, Tex. Shamrock, Tex. Billings, Mont. Glendive, Mont. Havre, Mont. Idaho Falls, Idaho Moscow, Idaho Laramie, Wyo. Trinidad, Colo. Alamogordo, N. M. Farmington, N. M. Ajo, Ariz. Bisbee, Ariz. Hurricane, Utah Provo, Utah Tonopah, Nev. Winnemucca, Nev. Bellingham, Wash. Ashland, Ore. Burns, Ore. Moscow, Idaho Ashiana, Ore. Burns, Ore. Tillamook, Ore. Lodi, Cal. Riverside, Cal. San Luis, Ob., Cal.

CHANNEL 22 (52)

Montpelier, Vt. New Haven, Conn. Rochester, N. Y. Harrisburg, Pa. Roanoke, Va. Jacksonville, N. C. Jacksonville, N. C. Spartanburg, S. C. La Grange, Ga. Pensacola, Fla. Perry, Fla. W. Palm Bch., Fla. Cincinnati, Ohio Cincinnati, Ohio Steubenville, O. Metropolis, III. Urbana, III. Jackson, Mich. Antigo, Wis. McComb, Miss. Tupelo, Miss. Bemidji, Minn. Cedar Falls, Iowa Joplin, Mo. Mexico, Mo. Bismark, N. D. Watertown, S. D. Crawford, Neb. Stanton, Neb. Hays, Kans. Hope, Ark. El Reno, Okla. Crockett, Tex. Dalhart, Tex. Fredericksb¹g, Tex. Snyder Tex Fredericksb g, le Snyder, Tex. Glasgow, Mont. Whitehall, Mont. Gooding, Idaho Sandpoint, Idaho Buffalo, Wyo. Limon, Colo. Belen, N. M. Carlsbad, N. M. Globe, Ariz. Richfield, Utah Boulder City, Nev. Aberdeen, Wash. Boulder City, Nev Aberdeen, Wash. Condon, Ore. Marshfield, Ore. Calexico, Cal. Ocnard, Cal. Susanville, Cal. Watsonville, Cal.

CHANNEL 23 (56)

CHANNEL 23 Augusta, Me. Fall River, Mass. Binghamtan, N. Y. Atlantic City, N. J. Suffolk, Va. Elkins, W. Va. High Point, N. C. Athens, Ga. Waycross, Ga. Orlando, Fla. Mansfield, Ohio Kokomo. Ind. Kokomo, Ind. Jacksonville, III. Cadillac, Mich. Madison, Wis.

Hermitage, Ma. Rolla, N. D. Willistan, N. D. Chamberlin, S. C. Kearney, Neb. Janesbaro, Ark. Bastron La Janesbaro, Ark. Bastrop, La. Lake Charles, La. Alva, Okia. Alva, Okla. Muskagee, Okla. Falfurrias, Tex. Henrietta, Tex. Plainview, Tex. Sanderson, Tex. Taylor, Tex. Havre, Mont. Havre, Mont. Nampa, Idaho Cody, Wyo. Kemmerer, Wyo. Newcastle, Wyo. San Luis, Colo. Deming, N. M. Deming, N. M. Nogales, Ariz. Prescott, Ariz. Monticello, Utah McGill, Nev. Yerington, Nev. Bellingham, Wash. Ritzville, Wash. Carvallis, Ore. Banning, Cal. Mt. Shasta, Cal. Petaluma, Cal. Tulare, Cal. CHANNEL 24 (53) St. Albans, Vt. Waterbury, Conn. Pittsburgh, Pa. Pittsburgh, Pa. Lebanon, Pa. Hinton, W. Va. Rocky Mount, N. C. Spartanburg, S. C. La Grange, Ga. Cross City, Fla. Palm Beach, Fla. Palm Beach, ria. Pensacola, Fla. Cincinnati, Ohio Centralia, III. Joliet, III. Detroit, Mich. Stevens Pt., Wis. Jackson, Tenn. Canton, Miss. Albert Lea, Minn. Thief Run Falls, Minn. Fairfield, Iowa McIntosh, S. D. Watertown, S. D. Watertown, S. D. Ogallala, Neb. Seward, Neb. Dodge City, Kans. Osawatomie, Kans. Conway, Ark. Houma, La. Natchitoches, La. Guthrie, Okla. Abilene, Tex. Greenville, Tex. Greenville, Tex. Greenville, Tex. Big Timber, Mont. Miles City, Mont. Burley, Idaho Casper, Wyo. Colo. Springs, Calo. Belen, N. M. Carlsbad, N. M. Casa Grande, Ariz. Casa Grande, Ar Provo, Utah Pioche, Nev. Centralia, Wash. Coquille, Ore. Pendleton, Ore. Alturas, Cal. Ft. Bragg, Cal. Merced, Cal. Needles, Cal. Santa Barbara, Cal.

Rice Lake, Wis.

Rice Lake, Wis. Hazard, Ky. Springfield, Tenn. Tuscaloosa, Ala. Gulfport, Miss. Warthingtan, Minn. Clarinda, Iawa Harmitage Ma

CHANNEL 25 (56)

CHANNEL 25 (Houlton, Me. Lawrence, Mass. Binghamton, N. Y. Atlantic City, N. J. Norfolk, Va. Winchester, Va. Huntington, W. Va. High Point, N. C. Barnwell, S. C. Dawson, Ga Dawson, Ga. Dolton, Ga. Orlando, Fla. Akron, Ohio Ft. Wayne, Ind. Escanaba, Mich. Tawas City, Mich. Madison, Wis. Madisonville, Ky. Columbus, Miss. Natchez, Miss. Little Falls, Minn.

Boone, Iowa Carthage, Mo. Hannibal Mo. Jamestown, N. D. Willistan, N. D. Yanktan, S. D. Haldridge, Neb. Janesbaro, Ark, Texarkana, Ark, Habart, Okla, Beeville, Tex. Big Sprina, Tex. Hillsbora, Tex. Marfa, Tex. Chinaak, Mont, Thampson Falls, Mant. Nampa, Idaha Cody, Wyo, Rock Springs, Wya. Sudance, Wyo, Delta, Colo. Ft. Morgan, Colo. Springfield, Colo. Deming, N. M. Springfield, Colo. Deming, N. M. Santa Rosa, N. M. Nogales, Ariz. Prescott, Ariz. Escalante, Utah Lovelock, Nev. McGill, Nev. Omak, Wash. Albany. Ore Albany, Ore. Barstow, Cal Paso Robles, Cal. Red Bluff, Cal. CHANNEL 26 (5 Berlin, N. H. Waterbury, Conn. Lancaster, Pa. Pittsburgh, Pa. Goldsboro, N. C. Milledgeville, Ga. Belle-Glade, Fla. Lake City, Fla. Springfield, Ohio Bloomington, III. Holland, Mich. Stevens Pt., Wis. Bristol, Tenn. Andalusia, Ala. Huntsville, Ala. Fairmount, Minn. Grand Rapids, Minn. Centerville, Iowa Sikeston, Mo. CHANNEL 26 (50) Sikeston Mo. Grafton N. D. Aberdeen S. D. Columbus Neb. Colby, Kans. Ottawa, Kans. Crossett, Ark. Harrison, Ark. Bogalusa, La. Austin, Tex. Beaumont, Tex. Clarendon, Tex. McAllen, Tex. Sulphur Springs, Tex. Ekalaka, Mont. Great Falls, Mont. Challis, Idaho Colby, Kans. Great Falls, Mont. Challis, Idaho Montpelier, Idaho Lusk, Wyo Craig, Colo. Walsenburg, Colo. Artesia, N. M. Miami, Ariz. McDermitt, Nev. Pioche, Nev. Kennewick, Wash. Astoria, Ore. Coquille, Ore. Blythe, Cal. Modesto, Cal. Modesto, Cal. Santa Barbara, Cal. CHANNEL 27 (54) Houlton, Me. Lawrence, Mass. Buffalo, N. Y. Buttalo, N. Y. Oneonta, N. Y. Atlantic City, N. J. Emporia, Va. Emporia, Va. Martinsburg, W. Va. Florence, S. C. Fitzgerald, Ga. Toccoa, Ga. Leesburg, Fla. Gallipolis, Ohio Anderson Ind Anderson, Ind. Mt. Vernon, III. Rockford, III. Detroit. Mich. Houghton, Mich. Manistee, Mich, Eau Clair, Wis. Lebanon, Tenn. Clanton, Ala. Natchez, Miss. Natchez, Miss. Det. Lakes, Minn. Lebanon, Mo. Napoleon, N. D. Williston, N. D. Lake Andes, S. C. Lead, S. D. Belleville, Kans.

W. Helena Ark Frederick Okla. Ponca City, Okla. Junction Tex Pecas Tex Rabstown Tex Dillion Mont. Dilian Mant. Malta Mont. Palsan Mant. Weiser Idaha Pawell Wya Mantrase Cala. Laveland Colo. Laveland, Colo. Claytan, N. M. Las Cruces, N. M. Halbroak, Ariz Taoele, Utah Hendersan, Nev. G'nd Caulee, Wash. Lakeview, Occ Lakeview Ore. The Dalles, Ore. Oceanside, Cal. Oroville, Cal. Visalia, Cal.

CHANNEL 28 (47)

Lewiston, Me. Pittsfield, Mass. Lancaster, Pa. Wheeling, W. Va Raleigh, N. C. Charleston, S. C. Lakeworth, Fla. Tallahassee, Fla. Lima, Ohio Terre Haute, Ind. Midland, Mich. Appleton, Wis. Van Cleve, Ky. Union City, Tenn. Pascagoula, Miss. Starkville, Miss. Starkville, Miss. New Ulm, Minn. Burlington, Iowa Glenwood, Iowa Gooperstown, N. D. Valentine, Neb. Goodland, Kans. McPherson, Kans. Malvern, Ark. Abbeville, La Okmulgee, Okla. Austin, Tex. Canadian, Tex. Hamlin, Tex. Nacogdoches, Tex. Circle, Mant. Arco, Idaho Arco, Idaho Wheatland, Wyo. Canon City, Colo. Artesia, N. M. Laguna, N. M. Hayden, Ariz. Ephraim, Utah Caliente, Nev. Caliente, Nev. Gerloch, Nev. Chehalis, Wash. Colfax, Wash. Bend, Ore. Calipatria, Cal. Fillmore, Cal. Turlock, Cal.

CHANNEL 29 (56)

Houlton, Me. Manchester, N. H. Williamsport, Pa. Williamsport, r Covington, Va. Norfolk, Va. Rockhill, S. C. Griffin, Ga. Sanford, Fla. Newark, Ohia Litchfield, III, Packford, III Litchfield, III. Rackford, III. Battle Creek, Mic Petoskey, Mich. Eau Clair, Wis. Louisville, Ky. Lewisburg, Tenn. Clarksdale, Miss. Calumbia, Mins. Mich Alexandria, Minn Newton, Iowa Sedalia, Mo. Fort Yates, N. D. Buffalo. S. D. Yankton, S. D. Superior, Neb. Syracuse, Kans. DeRidder, La. Alexandria, Minn DeRidder, La. Hugo, Okla. Okeene, Okla. Brackittville, Tex. Eagle Lake, Tex. Midland, Tex. Rio Grande, Tex. Stephenville, Tex. Broadus, Mont. Philipsburg Mont. Plentywood, Mont. Red Lodge, Mant. Weiser, Idaho Superior, Wyo. Superior, Wyo. Greely, Colo. Silvertown, Colo. Las Cruces, N. M. Tucumcari, N. M.

FM and TELEVISION

Texarkana, Ark.

of 1 kw. Antenna gain is expressed as the ratio in db of the maximum radiation from the antenna to the radiation in the equatorial plane of a half-wave dipole, with equal power input.

Classes of Stations & Power:

Channels 46 to 55 are for community stations only in those communities which are not part of a metropolitan district, and to which, except for special cases, no assignment has been made in the allocations table. Effective radiated peak power of not less than 7 db (5 kw.) and not more than 13 db (20 kw.) will be authorized, with an antenna 500 ft. above average terrain, as prescribed in the Engineering Standards. Co-channel assignments will not be less than 140 miles apart, and adjacent-channel assignments not less than 60 miles apart.

Metropolitan stations are intended primarily to render service to a single metropolitan district or a principal city and to the surrounding rural area. Except for wide-coverage stations located at high elevations, metropolitan stations will be authorized to use effective radiated peak power as set forth below, with an antenna 500 ft. above average terrain. CHAN. MIN. POWER MAX. POWER 2-6 10 db (10 kw.) 20 db (100 kw.) 7-13 10 db (10 kw.) 20 db (100 kw.) 14-55 10 db (10 kw.) 23 db (200 kw.)

Notes on Antennas:

Antennas higher than 500 ft. should be used if available, but a reduction in effective radiated peak power will be required so that interference caused to Grade A service on the same and adjacent channels will not be increased by the height above 500 ft. Where a height of 500 ft. is not available, a lower antenna will be authorized, but power will be limited in accordance with the preceding table.

The Commission intends, from time to time, to consider horizontal power increases for all community and metropolitan stations.

Directional Antennas:

No provision has been made in the allocations for the use of directional antennas, with the exception of WGAL-TV on channel 4 in Lancaster, Pa., and WDEL-TV on channel 7 in Wilmington, Del., where it is planned to authorize the use of directional antennas to permit the use of increased power. The Commission does not propose to make changes in the plan based on the use of such antennas. However, the Commission does recognize that a directional antenna may be useful in certain situations, and their use will be permitted in appropriate cases. The best available information, according to the Commission, indicates that nulls deeper than -10 db, as compared to the maximum radiation in any direction, may not be practical because of reflecting surfaces which may be in the vicinity of the transmitter.

6: COVERAGE TRANSMITTING RANGE & CHANNEL SEPARATION

Co-CHANNEL SEPARATION, MILES

A very thorough study of service radii and separation of co-channel and adjacent-channel alocations has been made by the Ad Hoc Committee. On the basis of their findings the FCC has worked out the tables presented here for frequencies of 63, 195, and 600 mc.

In working out estimates of field intensities required at the antenna of a television receiver, it was considered that half-wave dipoles, connected to the set by 50 ft. of RG59U cable, would be typical for 63 and 195 mc. A small rhombic, with a 300-ohm line as the lead-in, was assumed to be typical for the 600mc, frequency range.

A MC T	RANSMISSI	N
	10 db	
SERVICE	(10 kw.)	(100 kw.)
SERVICE]	Radii, in Mili	cs
A	12	20
В	16	27
С	43	57
CO-CHANNEL	SEPARATION,	Miles
A	148	215
В	134	205
С	252	328
ADJCHANNEL	SEPARATION,	MILES
A	50	75
В	50	78
С	105	141
195-MC. 7	TRANSMISSI	ON
GRADE OF	10 db	20 db
SERVICE	(10 kw.)	(100 kw.)
	RADII, IN MILI	
Λ	13	21
В	17	29
С	36	46

00.						
Α		111		172		
В		108		162		
С		164		232		
Adj.	-Channel	Sepai	RATION,	Miles		
Α		50		73		
В		51		78		
С		84		109		
6	600-MC. TRANSMISSION					
	GRADE	OF SE	ERVICE			
$7 ext{ db}$	$10 \mathrm{~db}$	1	3 db	23 db		
(5 kw.)	(10 kw.)	(20	kw.)	(200 kw.)		
	Service R	ADII,	IN MILE	s		
А	7	10	12	21		
В	12	14	17	29		
С	24	27	31	43		
Co-(CHANNEL S	SEPAR.	ation, I	Miles		
Α	92	103	125	172		
B	92	99	108	162		
С	115	125	141	212		
Adj.	-CHANNEL	Sepai	RATION,	Miles		
Α	36	43	49	73		
В	33	40	46	78		
С	58	62	75	102		

The service radii at 600 mc. apply to relatively smooth terrain. For relatively rough terrain, as in the vicinity of Washington, D. C., and New York City, an increase in power of about 10 db may be required to provide the same grades of service and radii indicated in the table.

It should be noted that these are conservative figures, and are based on the use of conventional receiving antennas. At any given point, reception may be considerably better or worse than indicated by the tables. Signal strength level will be more consistent near a transmitter, tending to fluctuate more widely from hour to hour, day to day, and month to month, as the fringe of the service area is approached. Also, at the fringe, co-channel and adjacent-channel interference will vary more noticeably with the time of day and the time of year.

Undoubtedly types of antennas will be developed which, by offering greater gain and directional selection, will offset variations in propagation effects. Knowledge of receiving conditions is still theoretical, but there is every reason to expect that improvement will be made as practical experience is gained in the UHF band.

Summary:

Altogether, The FCC plan is a real challenge to the industry. By the time the new plan is finalized, the Commission and the Ad Hoc Committee will have spent nearly a year and a half on the frequency allocations. Then, the engineering of equipment and the construction of new stations will be only in the initial stages.

There's no use thinking back and wishing that the TV allocations had been settled sooner. The truth is that research had not progressed far enough. Basic data was not available. Many problems are still unanswered. But the answers will come. The whole story of radio progress is a record of doing tomorrow what seems impossible today.

August 1949-formerly FM, and FM RADIO-ELECTRONICS

SPOT NEWS NOTES NOTES AND COMMENTS ABOUT SIGNIFI-CANT ACTIVITIES OF PEOPLE & COMPANIES

Even Worse by Radio:

"Have a good lunch?" "Yes, indeed, it was just packed with delicious, flavorsome goodness, and every bite was chockfull of wholesome nourishment, too, including energy minerals, vitamins, and protein, the food elements so vital to robust good health." If anyone talked like this, you'd consider him a grade-A bore. At least that's what advertising agency Young & Rubicam states in a recent piece of advertising. "You can't always ignore a boring acquaintance," the copy continues. "But most people can, and do, ignore boring advertising." Now, there's a glimmer of progress. Can we hope that agencies will some day learn that that sort of drivel sounds still worse by radio, and that people can, and do, ignore it by switching off their sets?

Newspaper Program Schedules:

Since newspapers and broadcast stations compete for advertising dollars, publishers have generally begrudged and some have refused space required for carrying program schedules. DuMont station WDTV Pittsburgh has found a smart way to win the goodwill of the newspapers. Each night, before the station signs off, the announcer concludes with: "The program schedule for WDTV can be found in the following newspapers. ..." Then he names 25 papers published in Pittsburgh and the surrounding area.

J. Clifford Durr:

Former FCC Commissioner was principal speaker at the recent Bill of Rights Congress in New York. Sponsors of this Communist-front sound-off on the FBI included Vito Marcantonio, Henry Wallace, Beanie Baldwin, and Harry Bridges.

TV Interference on 27 Mc.:

Complaints of TV interference, addressed to the FCC, have brought to light the fact that some sets are using an IF frequency of 27 mc., disregarding FCC allocations which provide for the use of 27.12 mc. by type-approved or certified diathermy and industrial heating equipment. Looks as if the most practical way to lick this trouble is for manufacturers to use a different IF frequency.

Price Reductions:

Announced by Westinghouse on 16 audio receivers, including 2 FM-AM table models, 1 FM-AM console, and 7 FM-AM phono combinations. Cuts on these models range from \$20 to \$200.

Stamps Show Microphones:

We learn from philatelist S. N. Shure, president of Shure Brothers, Inc., 225 W.



"An American, Excellency, a Mr. Coy, seeks advice on amicable cohabitation of divers elements of a common identity."

Huron Street, Chicago, that his company's model 55 mike appears on three anniversary and commemorative stamps just issued by the Philippines. He might send you a set if you ask him.

Frequency Range Extended:

We have been advised by Howard Carlson, author of "Portable FM Equipment" which appeared last month, that the frequency range of the Doolittle model PJZ-11 has been extended to cover 152 to 174 mc.

16-in. TV at New Low Price:

Lowest price tag we've seen on a 16-in. TV set is \$279, carried by Meck's new table model.

Railroad Radio Conference:

Annual meeting of the Communications Section of the Association of American Railroads will be held at Portsmouth, N. H., from September 27 to 29. Details can be obtained from secretary A. H. Grothmann, 30 Vesey Street, New York 7, N. Y.

New TV Set Line:

Sylvania will market a full line of 10and $12\frac{1}{2}$ -in. TV sets this fall. Models will include table and console cabinets, with FM and automatic phonographs. They will be made in the Colonial plant.

South Africa Tests FM:

Concerning FM tests being conducted by the South African Broadcasting Company, the *Johannesburg Star* reports: "This is of first-class importance in South Africa, which suffers from worse electric storms than any other country in the world. . . . If and when FM transmitters are provided for general use, our people will enjoy much truer reception than ever before."

Better Business Bureau:

Complains irregular practices are being used to promote TV set sales. Among examples cited were "\$200 trade allowance" which was an authorized price reduction, and which could be obtained without a trade-in, mis-description of cabinet woods, misleading terms, and exaggerated tube counts.

Railroad Radio:

Motorola president Paul Galvin reports that the use of 2-way FM at the Union Pacific's North Platte terminal has raised the 70% record of delivery promises to 98%. Moreover, cost of the radio system in that yard was amortized in six months.

Survey of Chicago FM Listeners:

FM Broadcasters of Chicagoland is making a coincidental telephone survey to determine percentage of FM homes in Chicago service area, and amount of FM listening time. Also, monthly surveys will be made on increase in number of sets and hours of listening. Participating stations are WEFM, WMOR, WOAK, WILA, WJIZ, WXRT, WRGK, and WEAW.

Numbers on C-R Tubes:

All Sylvania picture tubes and their respective cartons now carry serial numbers. Purpose is to enable jobbers and dealers to keep sales records for warranty purposes.

Mobile FM for Signal Corps:

A contract for FM ground and vehicular equipment, amounting to more than \$1.8 million, has been awarded to Federal Telephone & Radio Corporation.

NAB Says "Audio-Video"

Under a newly-planned reorganization, NAB will set up an Audio Department and a Video Department. The former will be devoted to matters concerned with FM and AM broadcasting, and the latter with television broadcasting. We're relieved that they didn't call them the Radio and Television departments.

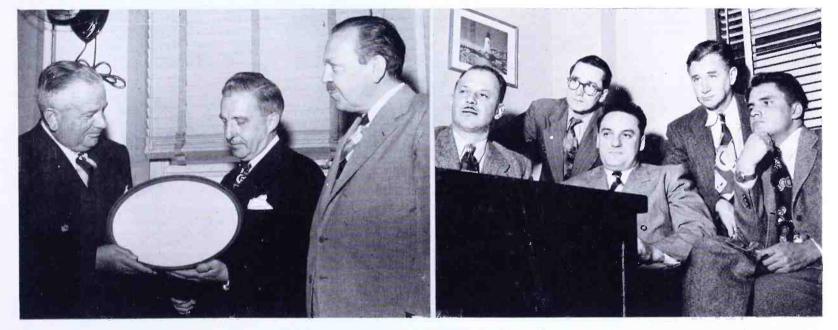
More FM Interest:

Item from WBEN-FM tells that, "because of added interest in FM in the Buffalo area," four hours have been added to the station's daily schedule. Now WBEN-FM operates on 106.5 mc. from 1:00 P. M. to midnight.



NEWS PICTURES

TOP: Installation at WGN-TV's studio A. In the foreground is the G. E. program control console, with film camera console beyond. Sponsor's room is at left. Twelve of the notables who attended RCA's Carfone demonstration of adjacent-channel operation, are left to right: W. E. Darnell, Daniel H. Arnold, W. S. Grenfell, Jeremiah Courtney, Ray E. Simonds, Franklin Smith, William Rothman, Frank DeBrouse, R. W. Malcolm, H. Gwilym, J. C. Fields, and R. Welsh. CENTER: This 16-in. cathode-ray tube is the one-millionth produced by RCA. Here it is being examined admiringly by RCA president Frank Folsom, left, L. W. Teegarden, vice president in charge of technical products, and J. G. Wilson, executive vice-president in charge of the



RCA Victor division, at the right.

Organizers of Chicagoland FM Association, formed to promote the sale of sets and time, are, left to right: Walter F. Myers, chief engineer of WFMF and WJJD; Ralph J. Wood, Jr., WMOR; Bernard Jacobs, WOAK; Ted Leitzell, WEFM; and Ed Wheeler of WEAW. BOTTOM: Here's a window used by W. Wendell Budrow, manager of WBEC-FM, to promote his station at Pittsfield, Mass., by promoting Zenith's high-sen-

sitivity receivers.

General Electric has started deliveries on this \$49.95 FM-AM set, using the Armstrong limiter-discriminator circuit for FM. The set has six tubes and a selenium rectifier.



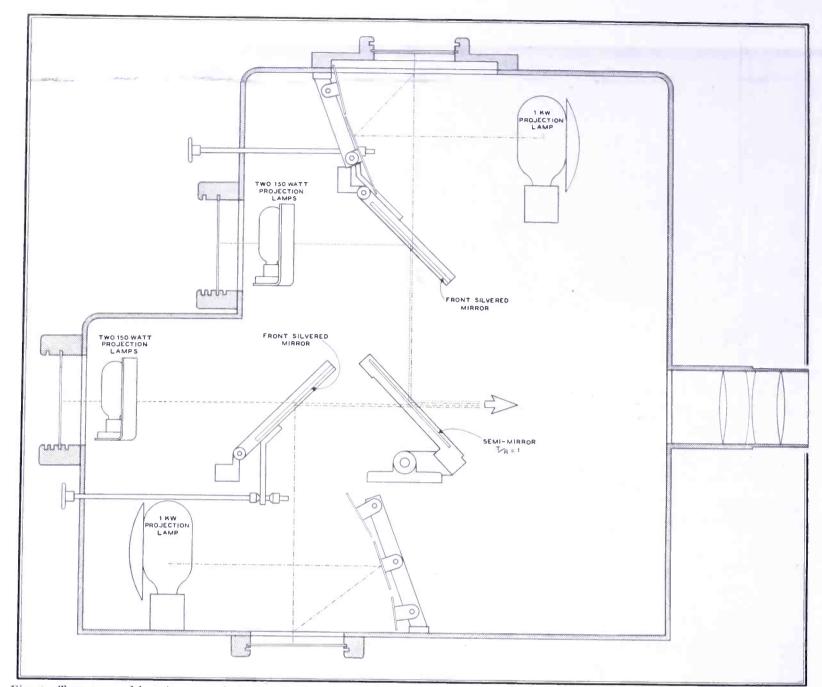


Fig. 1. Two moveable mirrors and the semi-mirror, or optical mixer, permit unlimited combinations of effects from four slides

LOCAL TV COMMERCIALS

A VERSATILE OPTICAL SYSTEM, CARRYING FOUR SLIDES, PROVIDES CONTINUOUS ANIMATION AND ATTENTION-COMPELLING EFFECTS — \mathcal{B}_y CHESTER A. SNOW*

T ELEVISION stations are rapidly learning that while it's easy to sell local advertisers the idea of using television, the high cost of producing effective commercials is a serious stumbling block.

A national advertiser can afford the expense of trick movie shots and animated cartoons for, once produced, a large number of copies brings the cost per showing to a very reasonable figure. The local advertiser, on the other hand, must charge the entire cost of a commercial against a showing over only one station. And he's very liable to balk when he finds that the preparation runs up to perhaps as much, or more, than the cost of the time he would like to buy. Also, because national advertisers have set high standard of eyecatching ingenuity in devising their commercials, something as over-simplified as a plain, lettered card or an inanimate slide picture has little chance to compete for audience attention.

The Gray Telop was developed as a means for making highly effective use of inexpensive commercial copy. Credit for initiating this project is due to Howard Chinn's engineering group at CBS. Essentially, it is a versatile, 4-channel optical system with such flexibility of control that it can produce an unlimited variety of effects with the simplest copy forms.

Moreover, the focal length of the Telop lens is great enough to permit its use with a diplexer, so that only one TV camera is needed when the Telop is added to an installation of two film projectors. At the smaller stations, programmed largely from film, and equipped with only one film projector, the Telop is the least expensive means of producing added revenue.

Animating Still Pictures:

The accompanying photographs show the general design of the machine, while the drawing in Fig. 1 discloses the details of the optical system. Openings at the top, rear, and bottom permit as many as four slides to be set up at one time.

Efforts to produce commercials for local sponsors at a price reasonably related to the cost of time have shown that their inadequacy is not necessarily due to limitations of simple slides. Rather, they are ineffective because, lacking animation, they fail to make use of the very feature that makes television such a po-

^{*}Project Engineer, Gray Research and Development Company, Inc., 16 Arbor Street, Hartford 1, Conn.



Fig. 2. Top and bottom slide-holders can be seen in this view of the projector

tentially powerful advertising medium. Therein lies the importance of the Telop's optical system. That is, it provides animated effects from the simplest and least expensive slides. The only limit to the use of this device is the imagination of the individual who plans the commercials and sets up the sequence of operations for the controls. There are 5 basic adjustments;

1. The use of 1 to 4 different slides in any setup.

2. Variable brilliance for any 2 of the 4 light sources.

3. Reversing switches on the light controls.

4. Settings and changes of the two adjustable mirrors.

5. The use of the semi-mirror as an optical mixer.

Details of Design:

As Fig. 1 shows, up to 4 slides can be inserted at one time. The mounting at the top can be turned on a vertical axis, if desired. This can be seen in Fig. 2. The opening at the bottom accommodates small objects such as a watch, package of cigarettes or pills, or a piece of jewelry. Special slots in both rear positions are intended to take American Optical Company slide holders.

All the light controls are located at convenient height on the panel at the left, Fig. 2. There are two large handles to operate separate 2-kw. faders. They can be switched to control any 2 of the 4 light sources.

In addition, there are reversing switch-

es for the faders, so that the lights under control can be dimmed by pushing the related handle either up or down. If, for example, one lamp is to be dimmed while the other is turned up, the reversing switches enable operator to accomplish that result with one hand, since the handles can be moved together, in the same direction, and the transition can be accomplished smoothly.

The selection of slides in their proper sequence is a function of the mirror settings as well as the light controls. Each mirror is positioned accurately to assure perfect register and focus. Rather than leave the precise setting of the mirrors to the operator, small permanent magnets are used to take each mirror to the final position of travel.

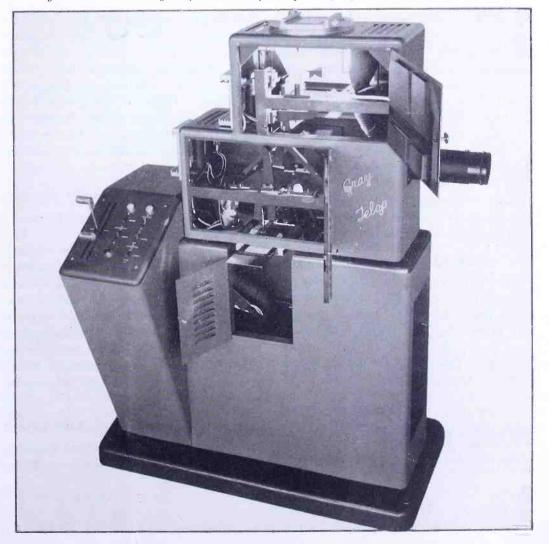
Optical mixing is accomplished with the semi-mirror. This reflects light from one side, projecting images from the top or upper rear slides into the lens, but it is transparent to images from the lower rear and bottom locations. Thus, either upper slide can be combined with either lower slide.

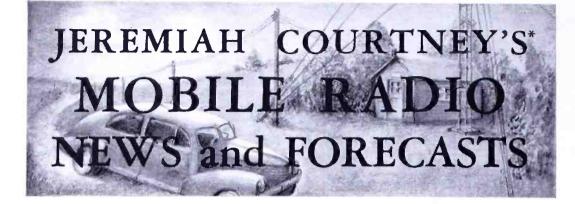
The use of the controls is explained most readily by typical examples of setups for commercial announcements.

EXAMPLE A. No. 1: A slide showing a house is faded in from the top position. No. 2: The words "Any way you look at it" are faded in from the lower rear position and superimposed on the house while the slide of the house is turned upside down and back again. No. 3: Those words are switched off and, from the upper rear slide, the words "It's cheaper to buy than rent" are faded in on the picture of the house. No. 4: Those words are switched off, and finally, from the bottom position, the name and phone number of a real estate office are faded in as the house picture is faded out.

(Continued on page 29)

Fig. 3. Three doors give free access for replacing lights and cleaning mirrors





C AUGHT in the middle between opposing a Senate bill that would give the Interstate Commerce Commission power to order railroads to install radio equipment for safety purposes, and at the same time asking the FCC for more frequencies, the Association of American Railroads and six individual roads withdrew their petition for a hearing and reconsideration of an FCC action which reduced the number of channels assigned to railroad radio service.

At the same time, the FCC denied a petition for reconsideration and rehearing filed by Aeronautical Radio, Inc. They wanted 12 pairs of channels below 500 mc. for public correspondence with aircraft. Interference considerations required exclusive frequency assignments for this purpose, which the FCC found impossible to grant. These were the only two petitions filed against the new land mobile radio service rules. Withdrawal of one and denial of other now permits all new land mobile freqency assignments to become fully effective.

The FCC staff promptly began grinding out new authorizations, badly backlogged while railroad and airline petitions hung fire. The current transitional period is also marked by no little confusion. Many problems found the staff torn between requiring immediate conformance with the new Rules, in the long-range interest of new services, and not imposing hasty frequency changes on particular applicants. It would seem that, in the absence of special circumstances, frequency modifications should be voluntarily assumed by all applicants, to accord with new Rules.

National Coordination Plans:

Power, petroleum and forest products services have filed their suggested national plans for frequency assignments with FCC. Coordinating frequency selections by applicants with industry area committees should reduce the possibility of future interference.

Taxicab Systems:

Taxi applications were being granted on

all four channels without any showing of area frequency-coordination wherever there was no possibility of interference to telephone companies still using channels now assigned to taxi service. Taxi operators are still worrying about adjacent 60-kc. channels in the same area. As one taxi leader said in commenting on the subject: "We pass from Experiment No. 1 to Experiment No. 2."

Motorola's recent Chicago demonstration of 60-kc. adjacent channel operation to a lay group, with vice-president D. E. Noble explaining the highly technical aspects of the problem, produced this press relations gem:

"All representatives were in a position upon returning home to explain the various problems attendant to adjacentchannel systems operation."

Another sector of confusion in the taxi field is the base-station power limitation of 120 watts input. Taxi stations can continue to use greater power than that, if previously authorized, until the present experimental licenses expire November 1, 1949. But when they apply for regular licenses prior to that date, as required, a showing must be made that the power has been reduced to conform to the new rules. Otherwise, regular license applications will be returned or delayed in processing. Object of the power limitation is to reduce unnecessary interference to other distant stations, and to minimize adjacent-channel interference to stations of lower power.

Maritime Mobile Service:

There are still no definitive Rules for maritime mobile radio service. Frequency allocations have been finalized, but the use of particular frequencies is still not resolved. Proposed Rules should be out soon, and probably will be final by November 1. That's target date, at least, for all experimental authorizations expire then. To be on the safe side, renewals of experimental maritime mobile licenses should be filed sixty days in advance of November 1.

Rules and Allocations:

The May 6th issue of Federal Register, containing all land mobile service Rules,

is now exhausted.¹ However, separate copies of the Rules can be obtained from Superintendent of Documents, Government Printing Office (not from the FCC).

Common Carriers:

The recent formation of a national association by the limited common carriers, known as the National Mobile Radio System, should be a boon to intercity truckers. Cost of erecting and operating private intercity systems is so great that most long-distance truckers will look to common carriers for their mobile communication needs. The national association should facilitate a satisfactory solution to the truckers' coverage requirements in different cities.

Existing limited common carrier licensees and permittees must file applications for modification of their permits or licenses in order to operate in regular service. Applications must be supported by current balance sheets and descriptions of technical qualifications.

Applicants entering this field must file new construction permit applications. All experimental applications pending when the new Rules were adopted were dismissed July 1, without prejudice. Refilings in regular service are now in order, although no regular grants will be made before September 1.

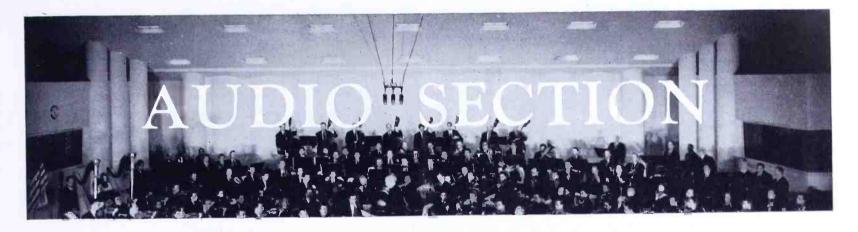
The American Telephone and Telegraph Company has objected to the priority categories which the FCC proposes to establish for rendering mobile communications service to present subscribers and new applicants. The priorities proposed would require the Company to drop lower-priority subscribers in favor of higher-priority applicants. A T & T objected to this proposal on the ground that it would cause inconvenience and expense to existing subscribers as well as particular hardship to those who had modified their methods of doing business as a result of having mobile telephone service. A T & T indicated that same results could be obtained through voluntary discontinuance of existing services and the normal growth of facilities. Their petition indicated that the discontinuance rate of mobile telephone service in congested areas is approximately 30% per annum.

Forecast:

Long-range: compulsory radio for railroads within next five years. Shortrange: some changes in present 72- to 76-me. fixed-circuit limitations that will redeem this present desert area of the radio spectrum.

^{*}Courtney, Krieger, and Jorgensen, Washington 6, District of Columbia.

¹ Complete tables of frequency allocations with footnote references, and a resume of technical requirements for common carriers and safety services were presented in FM-TV for June and July. Industrial and transportation services will be covered in September and October.



NEW NOTES ON CORNER SPEAKERS

FURTHER REFINEMENTS HAVE ADDED TO THE RANGE OF REPRODUCTION, AND IMPROVED THE APPEARANCE OF THIS FAMOUS DESIGN— B_y PAUL W. KLIPSCH*

CONTINUING effort has brought the corner-speaker system of sound reproduction to a high degree of development. In its present state, it offers a longer wavelength-handling capacity than any other contemporary type, and from 2 to 4 times the wavelength capacity per unit of occupied space than any other system. Various stages in the development have been reported in FM-TV, the Journal of the Acoustical Society of America, and Electronics.

The first experimental design, predicated on a selection of major dimensions that would permit the woofer to go through an average dwelling door, delivered a range from 80 to 250 cycles. This range was subsequently increased to 55 to 400 cycles at full efficiency, with usable efficiency down to 40 cycles.

Since 1946, further research has led to the design of the K-3-B, C, and D series, the latest models offering full efficiency down to 36 cycles and a considerably improved remaining efficiency at the 32.7cycle low-C note of the pipe organ.

Some special woofer horn designs have been completed. Most noteworthy of these is the T-6, a tentative design which has been under study for a couple of years. This unit, owned by Dr. Brickenkamp of St. Louis, is a scale-up of the X-3 with altered taper and throat to accommodate an 18-in. driver. A comparison between this T-6 and the standard K-3-C indicates that the standard model offers all the performance of the scaledup model, with about half the total bulk.

Experiments with Woofer Horns:

The latest development has been in drivers for the woofer horn. Preservation of full bass range of the woofer with improved efficiency in the middle- and high-frequency woofer range has been brought about by some very ingenious

* Klipsch and Associates, Hope, Ark.

technology on the part of the Stephens Manufacturing Company.

The Brickenkamp T-6 woofer was developed especially for the electric organ. Experiments on placement and drivers were continued until it offered appreciable efficiency down to 24 cycles per second. Consideration was given to making this a standard for organ tone generation and reproduction, but meanwhile the K-3-C was developed to the point that it offered full efficiency down to D above low-C with relatively little loss at the lowest organ note. A direct comparison was made with the T-6 in one corner and the K-3-C in an adjacent corner, both operating from the same output amplifier. The most skeptical of the critics observed that there was only a slight difference in efficiency, within limits capable of equalization. As this test was conducted before introduction of the latest woofer driving motor, it would appear that the test favored the standard K-3-C on an absolute basis, and that the performance-per-cubic-foot and per-dollar is definitely in favor of the standard model over the special T-6.

Another special design is the Owendorff speaker. This consists of a woofer scaled up approximately 10% from the X-3 and using the Bostwick middle- and high-range components as a 3-way system. The taper was kept about the same as the X-3, but the larger size permitted performance down to an estimated 40 or 50. This writer heard the unit in Mr. Owendorff's New Jersey home in 1946 and noted the improvement over the X-3 performance, but no comparison has been conducted between it and a late model of the production series.

The T-12 and T-13 designs were developed for very large power handling capacity, such as organ-tone generation in large churches and auditoria. The size of these designs approximately trebled the bulk of the K-3-C. They were built by a group which has been experimenting with electric organ-tone generation. It can be said that these special units offer the extra output capacity that several additional 15-in. drivers afford, since the power output is of the same order as the output of large pipe organs. Their high efficiency and low distortion are typical of all the writer's horn-loaded woofers. and the amplifier capacity need be only a fraction of that required for direct radiators of similar rated output. Their application would be limited to large installations, the smaller standard designs sufficing in power rating for medium auditoria and living rooms.

In other words, the standard model now offers full bass range, and any redesign would result in a considerable cost increase with, at best, only marginal or subliminal improvement in performance.

Experiments on Drivers:

An improvement in bass response, afforded by a treatment of driver cone rims, was reported in FM AND TELEVISION, November, 1948. Even as that article was going to press, it began to appear that this advance was not an unmixed blessing. The plasticizer was suspected of increasing the dissipation, which suspicion was confirmed as a result of work with a group in St. Louis. Still, the extended bass range was considered to be of sufficient importance as to justify the small sacrifice in middle-range efficiency. It was recognized, however, that recovery of this efficiency loss would be desirable.

Through the very cooperative efforts of the Stephens Manufacturing Corporation and the personal efforts of Mr. Howard Souther, a new driver was developed which offers the same high compliance as the treated drivers, the same full extension of the bass range without the edge dissipation, and a higher average efficiency. In addition, the new driver is wound to optimum impedance for use in the late model horns.

Dissipation in a cone can be detected by impedance measurement of the driver in free space. The old driver, untreated, exhibited an impedance of approximately 30 times the DC resistance at 43 cycles. Treated, it showed a resonant frequency of 28 cycles and an impedance of 13 times the resistance. As the resistive component is lower at the lower frequency, and since the relation of resistive to reactive load would dictate a higher resonant impedance, it is evident that dissipation existed. The new driver exhibits 120 times the DC resistance at 29 cycles, indicating that the dissipation is lower even than the old cone untreated,

One series of tests was conducted involving 6 drivers of 4 types from 3 manufacturers, all mounted in identical horns in the 4 corners of the same room, alternating the drivers in the various horns. Instantaneous switching between units was provided. Drivers ranged in net price from \$48 to \$90. Observers were the writer, an assistant, and numerous members of the lay public. The treated drivers were unanimously acknowledged to exhibit the greatest range in the extreme bass, but they lacked a triffe in efficiency at the middle range.

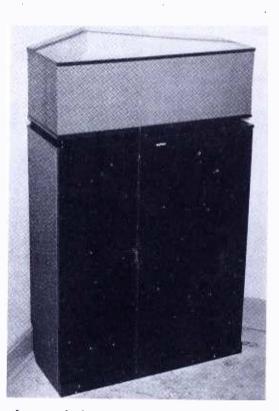
Later, a similar test between the new type driver and the treated drivers was conducted, with the finding that the new driver was equal to the treated driver in the extreme bass range, and even better in middle-range efficiency than the best of the other drivers tested. A highly gratifying finding, this, in view of the fact that this best driver is by no means the most expensive.

An impedance run of the new driver in the K-3-C and D series of horns shows that the trough efficiency at around 60 cycles is approximately 57%, compared to about 30% for the treated driver. The higher efficiency measured in the new driver is more valid than the lower efficiency of the treated driver, because the efficiency measurement is representative of the electro-mechanical transfer, and cannot recognize losses due to dissipation. A determination of relative efficiency by inserting enough loss in the more efficient driver with a calibrated attenuator indicates about 2 to 3 db better output with the new driver.

Built-in Installations:

From time to time, the writer has received inquiries as to feasibility of building the bass speaker into the construction of a new house, instead of installing it as a physically independent unit. It is recognized that this is possible, if the work is carried out by workers skilled in both architecture and acoustics, particularly in acoustics as related to the speaker system. But even then it would appear that the results would not offer advantages over the existing production models, and would be expensive. The problem of transferring technical knowledge resulting from many years of acoustical experience to the mind and hand of the architect would also be formidable.

However, many acoustical improvements available in architectural design are applicable to sound reproduction in general, and to the use of the corner speaker in particular. These relate to desirable room proportions, provision of at least one unbroken corner, design with respect to reverberation, limitation



Latest designs are attractively styled

of abrupt breaks in columns, non-parallel walls, and certain irregularity of wall surfaces.

Room size and proportion bear more relation to the resultant sound in the room than is generally realized. A room less than about 16 ft. long reduces sound pressure at the ear in the frequency range below 50, cycles. An L-shaped room with one leg about 8 ft. width and 14 ft. long was found to be particularly poor for organ reproduction. With the speaker at the angle of the L, deemed necessary for high frequency coverage, there was substantially no bass below 60 cycles, yet the speaker had been tested with good results clear down to the 32.7 bottom of the pipe organ in another location.

The writer's living room (actually 2 rooms joined by a 7-ft. square opening) offers an effective width of 13 ft. and length of about 28 ft. The lowest organ notes produce standing waves, with best listening at the far corner opposite the speaker. Opening the kitchen door at the end remote from the speaker tends to reduce the standing waves.

The Brickenkamp T-6 is installed in a living room about 25 ft. wide, 40 ft. long, and 13 ft. high, with acoustic side chambers represented by large doors to the main hall and dining room. Standing waves exist here but not as bad as in the writer's living room. Organ notes tend to "pile up" in the corners, but observers agree that any part in the room is a good place to listen.

The Seifert installation is in a room about 30 ft. long, 18 ft. wide, and 9 ft. high, with doors at the ends. The end of the room opposite the speaker is lined with record albums except for about 10% area occupied by a window. Ceiling beams 9 ins. deep and spaced 2 ft. apart cross the room transverse to the direction of sound propagation. This room has less standing waves than any room of corresponding size that this writer has observed. The ceiling beams and the sound absorption at the back of the room appear to be responsible for this.

The Fairchild living room is probably the best this writer has ever observed. It was designed with acoustic performance definitely in mind. The ceiling consists of zig-zag surfaces concealed above acoustically transparent cloth. The north wall is glass, the west wall hardwood against brick, the east wall a sort of pressed fiber coarser than Celotex, and the south wall of glass at an angle to the north wall, and with about a third of the area opening into a hallway. Standing waves are not noticeable. Reverberation appears to be optimum. In spite of having to add a portion of a wall to produce a corner for the speaker, the corner horn system renders an excellent account of itself in this room. Details of this room were presented in FM and TELEVISION for October, 1944.

This discussion of room acoustics has necessarily been qualitative. The final test of any audio system must necessarily be referred to the ear.

Functional Cabinet Design:

The prototype of the K-3-C and D woofers was the T-3-B-1 reported in the September, 1947 issue of FM AND TELE-VISION. That was standardized as the K-3-B, built of $\frac{3}{8}$ -in. fir plywood. The C and D series are built of $\frac{1}{2}$ -in. hardwood plywood, with all other dimensions substantially unchanged. Yet the new model offers full efficiency down to 36 cycles compared to 42 cycles for the T-3-B-1. Much armchair philosophy has been expended trying to explain this improvement. The best opinion appears to be that the increased rigidity of the ma-

(Continued on page 28)

You Have Three Choices When You Buy a

FREQUENCY METER

For Checking Mobile Radio Communications Transmitters

1: You can take a chance that your Radio Inspector won't know how much your frequency meter has drifted. But he probably will find out.

2: You can send your frequency meter back to the factory for checking every six months. But that is a nuisance.

3: Or you can buy a BROWN-ING frequency meter—the make generally preferred by communications supervisors for more than ten years.

With the changing seasons, all meters tend to drift beyond the limits set by the FCC. However, you can keep a BROWNING right on the nose at all times without ever sending it back to the factory. You see, it is so designed that you can check it ourself directly against WWV standard frequency transmissions.



Model S-4 and S-7 Frequency Meters

Can't that be done with any make of meter? No, indeed. To check a meter directly against WWV, the crystal must be a submultiple of a WWV frequency. That the secret. That's the reason why every BROWNING meter, regardless of the calibration points, uses a 100-kc. crystal. Add to this extra, and necessary, degree of precision the ease and speed of using a BROWNING frequency meter (it operates on both AC and DC) and you can see why this make is preferred by supervisors and maintenance men.

Still, a BROWNING frequency Meter is very reasonable in price. Model S-4 can be furnished with calibrations at 1 to 5 points in the band from 1.0 to 70 mc., accurate to .0025%, or model S-7 at 1 or 2 points between 72 to 76 and/or 152 to 162 mc., accurate to .0025%. The model S-5, with temperature-controlled crystal, can be calibrated at 1, 2, or 3 points from 30 to 500 mc., accurate to .0025%.

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 S-4 Frequency Meter S-5 Frequency Meter 	 S-7 Frequency Meter WWV Frequency Calibrator 				
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August 1949—formerly FM, and FM RADIO—ELECTRONICS

FM signal generator

MODEL 202-B FREQUENCY RANGE 54 to 216 MEGACYCLES

The model 202-B is specifically designed to meet the needs of television and FM engineers working in the frequency range from 54-216 mc. Following are some of the outstanding features of this instrument:

- RF RANGES 54-108, 108-216 mc. ± 0.5% accuracy. Also covers 0.1 mc. to 25 mc. with accessory 203-B Univerter.
- VERNIER DIAL → 24:1 gear ratio with main frequency dial.

FREQUENCY DEVIATION RANGES - 0-24 kc., 0-80 kc., 0-240 kc.

AMPLITUDE MODULATION — Continuously variable 0-50%; calibrated at 30% and 50% points.

MODULATING OSCILLATOR—Eight internal modulating frequencies from 50 cycles to 15 kc. Available for FM or AM.



RF OUTPUT VOLTAGE — 0.2 volt to 0.1 microvolt. Output impedance 26.5 ohms.
 FM DISTORTION—Less than 2% at 75 kc deviation.
 SPURIOUS RF OUTPUT—All spurious RF voltages 30 db or more below fundamental.

Write for Catalog F



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For the most informative reporting of the many changes and new developments slated for the radio industry in the months ahead, you mustn't miss a single issue of FM-TV. The coming issues will give you exclusive, and authoritative articles on new types of FM receivers, TV equipment, mobile radio and point-to-point systems, and important refinements in audio reproduction.

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CORNER SPEAKERS

(Continued from page 26)

terial permits less acoustic absorption, but this explanation is far from satisfactory. The fact remains that there is a difference, even transferring identical drivers from one horn to the other.

This difference in the two horns, representing a mere 6 cycles at the extreme bass end, may appear to be marginal. But on certain pipe organ records there is a difference of 3 or 4 bass notes at the bottom of the pedal range, and this turns out to be more than marginal. The new design offers full efficiency at D above low-C, whereas the old unit begins to droop below F. These low notes are felt as much as heard, and the pressure against the chest is definitely lacking in the old model.

It was pointed out in earlier articles that the woofer horn structure must be air tight. Violation of this requirement in home-constructed woofers has resulted in very poor performance.

Air tightness is measured by using an imperforate motor board and special door. The door is fitted with 2 tubes, one of which is connected to a water manometer and the other to a mouthpiece. The pressure is blown up to 2 ins. of water pressure and held while the time required for the pressure to drop to one inch is observed. This time exceeds 6 seconds, representing a timeconstant of around 9 seconds. Such a long time-constant may not be strictly necessary, but it is felt that no relaxation of standards of quality can be permitted.

Early models were built starting with one of the inner members, the front going on last. Inverting the assembly or der has permitted the front to remain unbroken by any visible fastenings, whereby finishes can be applied directly to the woofer front.

The top housing of the styled models is made up of the same material as the corresponding woofer front. The top housing has been aimed at functional design for several reasons: shadowing of the high frequency horn mouth must be avoided, and rigidity and absence of vibration and rattles is paramount.

Studies in functional styling have been in progress since production started. Several styles regarded as attractive on paper have been discarded as being too bulky in appearance. Other styles which seem hardly worth taking past the drawing board stage have proved attractive and apparently less bulky even though the actual occupied space was reduced a mere 2%.

In a system as expensive as the corner 2-horn system, long life expectancy is important, as well as low obsolescene of styling. In this 20-second spot, continuous animation is supplied by the projector, but the preparation calls only for 4 simple slides. To obtain variation, the slogan and the picture of the house can be changed from time to time.

EXAMPLE B. No. 1: The words "It's later than you think" are faded in from the top. No. 2: The face of a clock, fitted in the bottom position, is faded in as the letters are faded out. No. 3: The words "Tomorrow is the last bargain day at —" are faded in and held while the clock face is faded out.

Only two slides are required for this spot, but the commercial is animated for the entire 20-second period.

EXAMPLE C. No. 1: A sketch of a boy is faded in from the top. No. 2: While

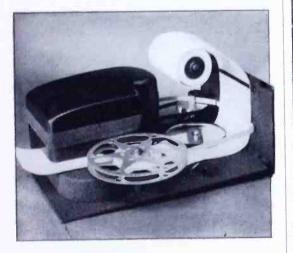


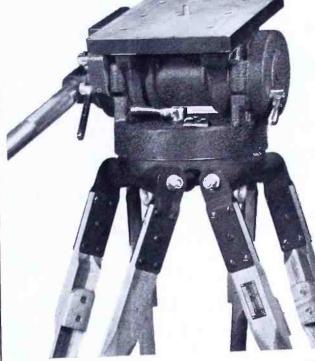
Fig. 4. Stage No. 1 fits the slide-holders

that is held, the word "Mother," enclosed in a balloon, is faded in from the bottom. No. 3: Those slides are switched off and the words "School starts September 7," are switched on from the upper rear. No. 4: As that slide is faded out, the words "— has a complete line of school supplies on hand now" are faded in.

This indicates a method of holding one slide while it is supplemented by another.

The foregoing examples illustrated indicate the endless possibilities of the Telop. But the machine is not limited to the use of slides. A special unit, called Stage No. 1, can be used at one of the rear positions. This device, Fig. 3, provides 3 kinds of animation: 1) lettering on the roll of paper can be fed down continuously by the motor drive, 2) news, announcements, and weather reports on tape can be drawn across the opening from the reel, and 3) small objects can be revolved slowly on the turntable disc. These functions can be combined with slides in the other three positions, if desired. For example, tape announcements from Stage No. 1, at the lower rear position can be shown with a test pattern inserted at the top.

Floating Action! for all TV Cameras "BALANCED"



Complete 360° pan without ragged or jerky movement is accomplished with effortless control. It is impossible to get anything but perfectly smooth pan and tilt action with the "BALANCED" TV Tripod.

Quick-release pan handle adjustment locks into position desired by operator with no "play" between pan handle and tripod head. Tripod head mechanism is rustproof, completely enclosed, never requires adjustments, cleaning or lubrication. Built-in spirit level. Telescoping extension pan handle.

Write for further particulars

* AMERA

Structural Design:

Fig. 2 shows the high degree of accessibility to the optical system. This is essential because the mirrors and reflectors must be cleaned from time to time. The bottom section contains two blower systems which maintain a constant flow of air to carry off heat from the lamps. Interlocking switches permit the lamps to be turned on only if the blowers are operating.

COUPTIEN

Extremely rigid construction is used to prevent vibration when the switching controls are shifted, or when the operator walks around the machine. This is essential for, otherwise, the slides would appear to wiggle at the receiving sets just as they do when slides are changed in the portable projectors used for lectures. A heavy cast iron base plate brings the total weight up to 600 lbs.

TV TRIPOD

Pat. Pending

This tripod was engl-

neered and designed ex-

pressly to meet all video

Previous concepts of

gyro and friction type de-

sign have been discarded

to achieve absolute bal-

ance, effortless operation, super-smooth tilt and pan action, dependability, ruggedness & efficiency.

Below: 3-wheel portable dolly with balanced TV Tripod mounted.

camera requirements.

The f/5 lens, 4 ins. in diameter, has a focal length of 18 ins. and an optical throw of 33 ins. Light intensity projected on the mosaic of the television camera is 12 to 15 foot-candles.

Operation of the machine calls for a reasonable amount of ingenious thinking, a little manual skill at the controls, and 3 kw. of power from a 115-volt, 60-cycle source.



THE products listed here are described in new catalogs and bulletins now available. Unless otherwise noted, they will be sent on request, without charge.

BROADCAST EQUIPMENT

Slide & Tape Projector:

Compact, low-cost projector handles wide paper roll, narrow tape, or one slide. Mounts on stand or table. INS-INP Television Dept., 235 E. 45th St., New York 17.

HOME RECEIVERS

TV Tube Sizes:

Sets will not be listed in this section unless the diameter of the picture-tube is given. Rating of tube in square inches is not considered adequately descriptive.

TV Receivers:

Four new models are 121/2-inch Rumson table model, 15-inch Sussex console, 121/2-inch Sheffield console, and Bradford set with the Du Mont new 19-inch short-neck tube. Laboratories, Inc., 654 Madison Ave., N.Y.

Two 16-Inch Consoles:

Two cabinet designs, both listing at \$479.50, have 29 tubes, and high-fidelity audio system with 12-inch speaker. Freed Radio Corp., 200 Hudson St., New York 13.

Portable TV Receiver:

Model weighing 38 lbs. has 7-inch tube, cabinet antenna, tunes all VIIF channels. Priced at \$179.50. Model 9-425. Crosley Division, Avco Mfg. Corp., Cincinnati.

GENERAL COMPONENTS

High-Voltage Resistors:

Molded resistors, intended as voltage dividers. are rated at 4 watts, 100 to 100,000 megohms, at 10,000 volts DC with 75°F. temperature and 50% relative humidity. Tolerance plus and minus 10%. Length 7% inches, diameter 5/16 inch. Type 80X. S. S. White, 10 E. 40th St., New York 16.

Small Relays:

Aircraft-type relays 21/4 inches high, 21/16 inches wide, 1 1/8 inches deep have contact combinations up to 4-pole, double-throw For operation up to 230 volts, 60 cycles AC or 115 volts DC. Type DO. Amer. Relay & Controls, Inc., 4925 W. Flourney St., Chicago 44.

Saturable-Core Reactors:

Two types are available, built to customer specifications, for control circuits to provide automatic line-voltage regulation and for DC power supplies. Sorenson & Co., Inc., Stamford, Conn.

Plugs, Jacks, Switches:

Catalog of 12 pages gives specifications and mechanical drawings of plugs, jacks, and switches of many types for low-power circuits. Catalog S49. Switchcraft, Inc., 1328 N. Halstead St., Chicago 22.

Dust Caps for Connectors:

Screw-on caps protect male or female con-

nectors when open, excluding dust, dirt, moisture, and mechanical damage. Available for all AN connectors. Amer. Phenolic Corp., Chicago 50.

Video-Circuit Trap:

A permeability-tuned, 4.5-mc. trap comprising a coil and shunt capacitor. Operates in the first video amplifier, attenuating the 4.5-mc. beat which exists in IF stages handling both picture and sound IF carriers. Type 203L5. RCA Victor Div., Harrison, N.J.

Heat-Dissipating Connectors:

To make connections to plate and grid terminals of Eimac tubes. Their use aids in keeping seal temperatures at safe values, and increases effectiveness of forced-air cooling, Eitel-McCullogh, Inc., San Bruno, Calif.

Blocking & Stabilizing Coil:

A horizontal-blocking oscillator coil and shock-excited frequency-stabilizing coil for use in TV receivers employing the 6SN7-GT as a combination horizontal blocking-oscillator and sync-control tube. Type 203R2. RCA Victor Div., Harrison, N. J.

COMMUNICATIONS EQUIPMENT

25- to 50-Mc. Mobile Units:

Circuits are designed for 20- or 40-kc. The former is intended modulation band. to permit adjacent-channel operation. Mobile transmitters have 30 or 50 watts output; associated fixed transmitters are rated at 50 and 250 watts. General Electric Co., Communications Section, Electronics Park, Syracuse, N. Y.

Bench Power Supply:

For bench-testing mobile radio equipment. Operates from 115 volts AC. DC output is variable from 0 to 8 volts. Can be used to deliver 10 amps. continuously, 30 amps. intermittently. P. R. Mallory & Co., 3029 E. Washington St., Indianapolis 6.

7-Channel Carrier Equipment:

Units designed for rack mounting provide up to 7 talking circuits with associated ringdown or dial-signaling channels from a 2way radio link. Spectrum of 0 to 35 kc. is utilized. Lenkurt Electric Co., 1126 County Rd., San Carlos, Calif.

TEST & MEASURING INSTRUMENTS

Transmission Measuring Set:

Moderately-priced unit on rack panel for checking frequency response, impedance matching, and gain measurements. Accuracy plus or minus 1%, 20 to 20,000 cycles, attenuation to 111 db in .I-db steps. Model 11A. Daven Co., 191 Central Ave., Newark 4, N. J.

VHF Analyzer:

Oscilloscope with coaxial, wide-band mixer operates on 30 to 500 mc. Signals can be studied within a 30-mc. range at one time. High sensitivity permits use of signals down to 100 microvolts. Price \$895. Kay Electric Co., Pine Brook, N. J.

Measuring Instruments

Three new instruments include null detector and vacuum-tube voltmeter for AC bridge measurements; universal bridge for measuring inductors and capacitors; AC power supply with continuously variable output. Freed Transformer Co., 1718-36 Weirfield St., Brooklyn 27.

Ultrasonic Analyzer:

Panoramic type of oscilloscope shows presence of all frequencies between 2 kc. and 300 kc. at one time. For analyzing ultrasonic vibrations from any source, Full scale deflection from 1 millivolt input. Panoramic Radio Products, Inc., 10 S. 2nd Ave., Mt. Vernon, N, Y

Microwave Test Equipment:

Units for 2,700 to 3,200 mc. include a transition for coaxial cable to wave-guide, variable attenuator, standing-wave dector, and a termination. Varian Assoc., 81 Washington St., San Carlos, Calif.

VACUUM TUBES

19-Inch Short-Neck Tube:

New 19-inch cathode-ray tube is 211/2 inches long. Designed to reduce cabinet depth of receivers. Shorter beam throw is described as giving sharper picture. Du Mont Laboratories, Inc., Passaic, N. J.

Transmitter Triode:

Type 304TL is a low-mu power triode for use as an amplifier, oscillator, or modulator. Plate dissipation is 300 watts. Operates at maximum ratings at frequencies up to 40 mc. Eitel-McCullough, Inc., San Bruno, Calif.

3-Inch Cathode-Ray Tube:

Type 3KP11 is intended for oscillograph use. Blue radiation, of short duration, is highly actinic and suitable for moving-film recording. High deflection sensitivity, with electrostatic deflection and focus. RCA Victor Div., Harrison, N. J.

ANTENNAS

VHF TV Antennas:

Combination high-band and low-band design. with separate orientation, is pre-assembled to reduce working time for installation. Ward Products Corp., 1523 E. 45th St., Cleveland.

Antenna Data:

Performance curves and field patterns of TV and FM antennas show results to be expected from each type of antenna. Catalog 30. Technical Appl. Co., Sherburne, N. Y.

BOOKS

Papers on UHF:

RADIO AT ULTRA-HIGH FREQUENCIES, Vol. 2, 1940-1947, a compilation of papers written by RCA engineers, 485 pages, 6 by 9 inches, cloth bound. Papers are grouped as follows: antennas and transmission lines, propagation, reception, relays, micro-waves, measurements and components, aids to navigation. Included in each section are summaries of related papers. A bibliography lists 330 papers on UHF by RCA authors, published from 1925 to 1940. Price \$2.50. RCA Laboratories Division, Princeton, N. J.

Television Simplified:

UNDERSTANDING TELEVISION, by Orrin E. Dunlap, Jr., RCA vice-president in charge of advertising and publicity, 128 pages, $5\frac{1}{2}$ by 8 inches, cloth bound. A non-technical explanation of television in which the text is supplemented by the generous use of interesting photographs and drawings, and a glossary of terms. An excellent book for those who want to acquire a general knowledge of television without going into technical details. Price \$2.50. Published by Green-burg, 201 E. 57th St., New York 22.

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New stainless steel clamp for plug-in units subject to vibration.

Materials and finishes comply with Armed Forces specifications.

Recommended for use in military electronic equipment.

Please state in your inquiry the type of tube or component to which the retainer is to be applied, or supply sample or outline drawings with pertinent dimensions.

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- Call letters
- Frequency
- Name of licensee
- Network
- AM and TV affiliates
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This reference book has been compiled from data furnished by the stations themselves and is the most accurate such list now available. For maximum convenience and usefulness, it is arranged both geographically by location alphabetically by call letters. and

68 pages, $5\frac{1}{2}$ by $8\frac{1}{2}$, sturdily bound. \$2.00 per copy. Order direct from the publishers: FM - TV, Great Barrington, Mass.

It's Alden - for ... facsimile dispatching equipment

designed for your specific purposes. It may be for wire or for radio circuit. A pilot operation — or in quantity production

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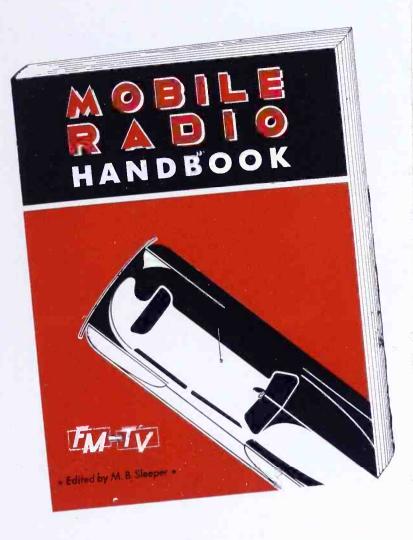
To solve that facsimile or impulse recording problem — write now to

ALDEN PRODUCTS CO. Brockton 64FD, Massachusetts

August 1949-formerly FM, and FM RADIO-ELECTRONICS



FM and TELEVISION



AT LAST!

A COMPLETE AUTHORATATIVE UP-TO-DATE HANDBOOK ON MOBILE RADIO & POINT-TO-POINT COMMUNICATIONS

COVERS ALL THE NEW SERVICES

EVERYONE concerned with mobile radio communications and associated point-to-point systems will find the MOBILE RADIO HANDBOOK an invaluable reference guide — the sort of a book that is kept at hand to give accurate and specific answers to the increasing complications of this field.

The HANDBOOK has been in course of preparation for more than a year, but it could not be completed until after the FCC released the new frequency allocations and rules last May.

Now, thanks to the efforts of 17 engineering specialists who have cooperated in preparing the text, the MOBILE RADIO HANDBOOK presents complete and completely up-to-date information.

Written as a working text, this book contains practical, straightforward answers to problems encountered in all phases of mobile radio planning and operation. It is intended for use by company executives and public officials concerned with the use of mobile radio, as well as for engineers, systems supervisors, operators, and maintenance men.

It is a big book, 8³/₄ by 11¹/₂ ins., with easy-to-read type, profusely illustrated with photographs and drawings, and handsomely printed on fine paper.

CONTENTS

1. THEORY: A non-mathematical explanation of FM transmission and reception and the advantages of FM over AM.

2. MOBILE INSTALLATIONS: Details of the newest transmitters; standard and adjacent-channel receivers; portables; railroad equipment; methods of installation; power supplies; charging generators.

3. FIXED INSTALLATIONS: Transmitters; receivers; remote controls; typical systems plans; operation.

4. ANTENNAS AND TOWERS: Transmitting and receiving antennas; directional and special antennas; erection of a typical tower.

5. POINT-TO-POINT SYSTEMS: Types of systems and applications; transmitters, receivers, antennas; multiplex operation.

6. OPERATION: Operator requirements; maintenance and testing.

7. FCC REGULATIONS: Quick-reference information on common carrier, safety, industrial, and transportation services, showing qualifications, frequencies, and technical requirements.

FM-TV

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Norelco PROTELGRAM now offers



From this tiny 2¹/₂-inch tube

Many of America's important manufacturers of TV receivers will presently announce to your customers a wider variety of screen sizes in PROTELGRAM-equipped receivers.

These manufacturers have already introduced to the trade their sets featuring the popular 192-square-inch picture ($16'' \times 12''$, 20'' diagonal, square corners).

Look to them for early news about these two companion sizes—130 square inches with 16" diagonal and rounded corners, and 234 square inches with 20" diagonal and rounded corners.

And the latest version of PROTELGRAM for the projection of a giant $3' \times 4'$ picture on a home-movie type screen is now available from several well-known makers, with others soon to be announced.

Television

MORE

... in a choice of picture sizes!

PROTELGRAM is the result of nearly *fifteen years* of development by the world's greatest electronic laboratories. It is an entirely new conception of quality television picture reproduction—a big *life-size*, more *life-like* image free from glare and easier on the eyes—at the lowest cost per square inch of viewing area.

PROTELGRAM has been adopted by leading TV manufacturers because it is the perfect answer to your customers' demand for bigger, better, more true-to-life television. It is your best bet for bigger television profits in 1949. Get the facts today on the profit-making opportunities in PROTELGRAM-equipped receivers. North American Philips Company, Inc., Dept. PC-8, 100 East 42nd Street, New York 17, N. Y.



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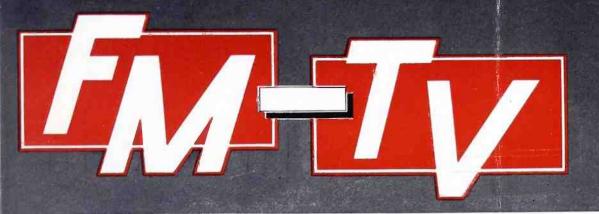


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* Edited by * Milton B. Sleeper

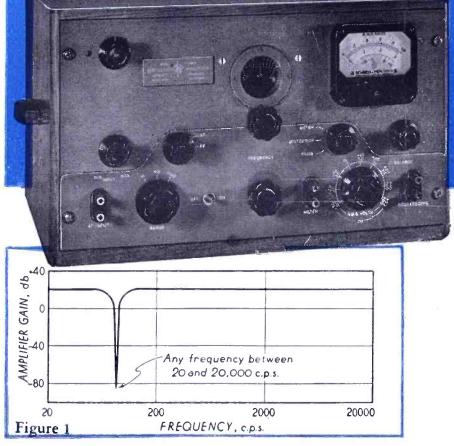
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TV ANTENNA

9th Year of Service to Management and Engineering

MEASURE TOTAL DISTORTION Between 20 cps and 20 kc





CHECK THESE SEVEN IMPORTANT FUNCTIONS:

- 1. Measures total audio distortion.
- 2. Checks distortion of modulated r-f carrier.
- 3. Determines voltage level, power output.
- 4. Measures amplifier gain and response.
- 5. Directly measures audio noise and hum.
- 6. Determines unknown audio frequencies.
- 7. Serves as high-gain, wideband stabilized amplifier.

This fast, versatile -*bp*-330B Analyzer measures distortion at *any* frequency from 20 cps to 20 kc. Measurements are made by eliminating the fundamental and comparing the ratio of the original wave with the total of remaining harmonic components. This comparison is made with a built-in vacuum tube voltmeter.

The unique -bp- resistance-tuned vircuit used in this instrument is adapted from the famous -bp- 200 series oscillators. It provides almost infinite attenuation at one chosen frequency. All other frequencies are passed at the normal 20 db gain of the amplifier. Figure 1 shows how attenuation of approximately 80 db is achieved at any pre-selected point between 20 cps and 20 kc. Rejection is so sharp that second and higher harmonics are attenuated less than 10%.

Full-Fledged Voltmeter

As a high-impedance, wide-range, high-sensitivity vacuum tube voltmeter, this -hp- 330B gives precision response flat at any frequency from 10 cps to 100 kc. Nine full-scale ranges are provided: .03, .1, .3, 1.0, 3.0, 10, 30, 100 and 300. Calibration from +2 to -12 db is provided, and ranges are related in 10 db steps.

The amplifier of the instrument can be used in cascade with the vacuum tube voltmeter to increase its sensitivity 100 times for noise and hum measurements.

Accuracy throughout is approximately $\pm 3\%$ and is unaffected by changing of tubes or line voltage variations. Output of the voltmeter has terminals for connection to an oscilloscope, to permit visual presentation of wave under measurement.

Measures Direct From R-F Carrier

The -bp- 330B incorporates a linear r-f detector to rectify the transmitted carrier, and input circuits are continuously variable from 500 kc to 60 mc in 6 bands.

Ease of operation, universal applicability, great stability and light weight of this unique -*bp*- 330B Analyzer make it ideal for almost any audio measurement in laboratory, broadcast or production line work. Full details are immediately available. Write or wire for them-today Hewlett-Packard Company, 1437F Page Mill Road, Palo Alto, Calif.



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Frequency Meters Vacuum Tube Voltmeters ars Attenuators Electronic Tachometers

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Choose Du Mont transmitters for years of rugged, trouble-free performance at lower initial investment and lower operating costs.

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Based on such facts, the Du Mont completely air-cooled transmitter leads in all factors that spell practical operation with the finest picture transmission.

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OPERATION CH

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TUBE LIFE

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DU MC

DU MONT TRANSMITTER

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Convenience and ease of operation.

The advantages of the complete Du Mont Transmitter Control Console housing all control and monitoring equipment for the transmitter.

These advantages, along with countless others, offer you the finest in telecasting operation with a minimum of operating expense.

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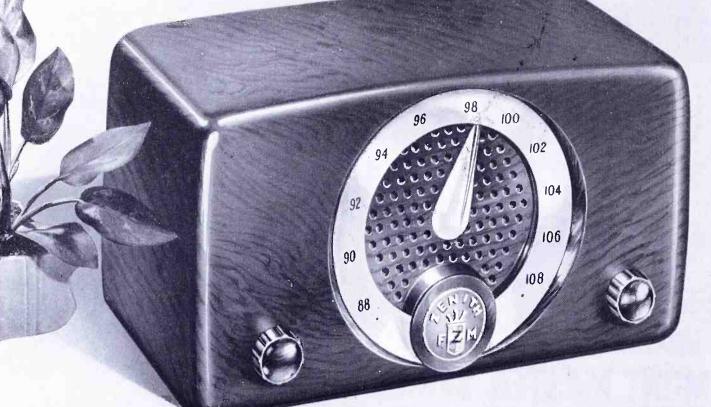
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September 1949-formerly FM, and FM RADIO-ELECTRONICS

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The Most Sensitive FM Radio Ever Built

FOR THE PUBLIC



ONLY ZENITH GIVES YOU THIS

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on signals too weak for ordinary sets to catch.

This all-new Zenith Model is the climax of years of acknowledged leadership in genuine Zenith-Armstrong FM-that hundreds of thousands know as true FM-the FM radio that leading FM stations over the nation rely upon to monitor and test their own broadcasts-truly the FM of the Experts! Now, in a new Super-Sensitive circuit that gives perfected performance even

So we say - hear, compare! Be prepared to hear the most sensitive FM receiver you have ever listened to-

a genuine Zenith-Armstrong receiver at a sensation-

Most Sensitive Performance

ally low price.

Superb reception even on weak signals. Longer Distance

Because of high sensitivity, brings in stations in fringe areas others miss.

No whistles, no overlap, no cross-talk, no background hiss.

No Interference

Even in the worst storms. Only rich, glorious tone.

No Special

just plug in and play,

Antenna With Zenith's patented Power-Line Antenna,

Whatever has been your experience with FM-whatever FM radio you have ever heard-Zenith[†] now asks

The Super-Sensitive "MAJOR"

No Static

The lowest price ever for genuine Zenith-Armstrong FM!...only





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Formerly, FM MAGAZINE and FM RADIO-ELECTRONICS

NO. 9 VOL. 9 SEPTEMBER, 1949

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MILTON B. SLEEPER, Editor and Publisher

CHARLES FOWLER, Business Manager LILLIAN BENDROSS, Circulation Manager SOPHIE FORTY, Production Manager Published by: FM COMPANY

Publication Office: 264 Main St., Gt. Barrington, Mass. Tel. Gt. Barrington 500 FM-TV Magazine is issued on the 10th of each month.

Single copies 25c—Subscription rate: \$6.00 for three years, \$3.00 for one year in the U. S. A.—Canada, add 50c per year postage—foreign, add \$1.00 per year postage.

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(below)



Now Raytheon Radiophone offers dependable 2-way communication systems in both 25-50 megacycle and 152-162 megacycle. Whatever your needs, you can be sure that there is a Raytheon Radiophone to meet your requirements exactlymanufactured to Raytheon's high standard of excellence in electronics.

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VM 30-1 (25-50 mega-cycles)—30 watt. Compact Mobile Station.

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(not illustrated)

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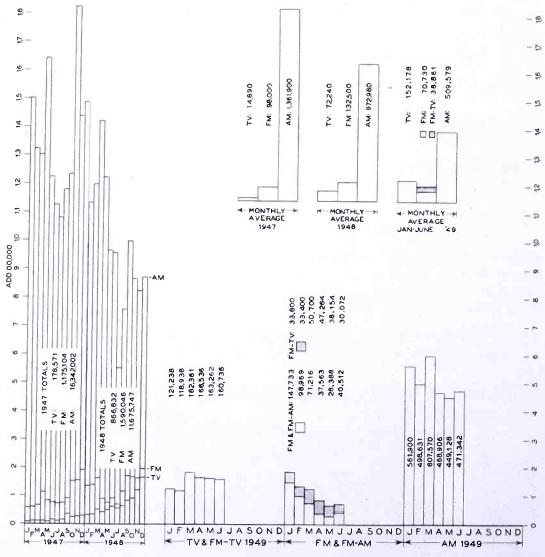


HE only important change in June production was a reversal of the fivemonth drop in FM sets. It's hard to tell how fast FM will bounce up from the low in May. However, the industry has been watching closely Zenith's success with the \$39.95 Major model. It so far exceeds the capability of any low-priced AM set in delivering radio entertainment that there just isn't any comparison. If you haven't heard the Major, you have a surprise coming. You may have trouble getting one. Although Zenith is struggling to step up production, the demand is building up a backlog of orders which belies the statement that FM is dead.

In the AM category, RMA figures for the first six months of '49 show home sets trailing other types. Only 1,220,098 table models, consoles, and phono combinations, including export types, were shipped in that period. The balance comprised 1,150,905 auto sets and 686,-474 portables, making the 6-month total 3,057,477 AM units. This represents a drop of 56% below AM production in the same period of '48 when 6,817,621 sets were produced. On the basis of last year's figures, it can be expected that less than 5 million AM sets will be manufactured this year. That is a drop of almost 60% in number of AM sets, but a loss of dollar volume to the industry of more nearly 80%, because '48 production included many expensive phonograph combinations,

One lesson to be drawn from experience this year is that the day of radio furniture is virtually over. Even television sets reflect the new attitude of our American public, for '49 production figures show 591,482 TV table models, against 321,589 consoles, with current console demand dropping steadily.

Next step in the trend toward functional design will be the introduction of TV and FM sets in plain metal cabinets, complete except for the speaker, carried separately in an equally plain enclosure of wood.



TV, FM, and AM Set Production Barometer, prepared from RMA figures

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CARRYING hundreds of telephone calls, coaxial cable runs through many lonely miles. Far from towns and people, master amplifying stations stand guard with a new automatic alarm system developed by Bell Telephone Laboratorics.

12

13

14

A

At a city terminal, the man on duty makes a check by laying a transparent log sheet over a glass window, and dialing a master station hundreds of miles away. At once the station begins to give an account of itself, lighting lamps under the log sheet to report any abnormal operating condition before it becomes an emergency.

D

But when something happens that threatens serious trouble, the apparatus acts at once – maybe by switching in a spare coaxial – and calls a distant test board by ringing a bell. Sometimes he can take further steps by remote control; if not, he knows exactly how to brief the nearest repair crew.

With this new alarm system, maintenance men need not be stationed at isolated points, just waiting for something to happen. Instead, they live in their home communities. This makes for better work ... and better telephone service.

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BELL TELEPHONE LABORATORIES PIONEERS IN THE RESEARCH OF FM RADIO AND TELEVISION, AND ACTIVE IN DEVELOPING IMPROVEMENTS IN BOTH FIELDS TODAY



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C

Things You Should Know About:

TV: The most complete analysis of the FCC's new proposal for revising TV rules and allocations appeared in the August issue of FM-TV. Prepared for the use of broadcasters and equipment manufacturers, it includes a breakdown of potential audiences and markets. This analysis is presented in such convenient form that you will refer to it again and again. Copies of the August issue are still available.

FM: The most-discussed audio receiver is the little super-sensitive Zenith Major, an FM-only model that sells for \$39.95 and delivers finer entertainment than any AM-only set at that price. If you are interested in the details of this receiver, you'll find them in the April issue of FM-TV, in an article by G. E. Gustafson, Zenith's vice president in charge of engineering. April copies are still available.

AUDIENCES: Receivers represent audiences. If you want to know the trends in TV, FM, and AM audiences, how they are growing or shrinking, watch the Set Production Barometer on page 4 of every issue of FM-TV. You can plot what's ahead by watching the monthly figures against the background of 1947 and '48 sales.

MOBILE RADIO: The October issue of FM-TV will carry detailed specifications of all mobile radio transmitters and receivers, and associated fixed-station equipment. It is the only compilation of such data, enabling you to check every feature right down to tube types and current drain. Also, October will contain the 4th and final part of the data on mobile radio rules and allocations. This will be on the transportation services.

AUDIO: Feature articles in the October issue will be devoted to audio developments related to broadcast transmission and reception, and recording. These will be timed with the AES Convention in New York City, October 27th to 29th. Watch for papers of outstanding interest, written by some of the leading authorities in this field.

FM-TV MAGAZINE GREAT BARRINGTON, MASS.

THIS MONTH'S COVER

One of the most useful, new service instruments is the antenna compass shown in use on this month's front cover. It's a dual-range meter that can be connected to the receiver by an extension cord as long as is necessary. As the antenna is turned around, the meter shows the strength of the signal received. This is faster and more accurate than talking the antenna into position, with someone at the set to shout up or report by telephone. There are other specific advantages in working by direct meter indication, as explained on page 13.



WHAT'S NEW THIS MONTH

A CRITICISM OF THE FCC'S TELEVISION PROPOSAL

THE FCC's plan for allocations has not been received favorably by the radio industry. Expressed in terms which can be published, opinions of executives and engineers were summarized accurately when we said last month: "From any angle of approach, it is easy to find many faults in the plan. If, however, it is examined in the light of its intended purpose, *viz.*, to give the best service possible to the greatest number of people, there is little to criticize except that from a commercial point of view, the allocations are unrealistic."

Comments we have heard in New York, Philadelphia, Washington, and Boston, and over the telephone from points west, were much less moderate but no more specific.

Putting them all together, it seems that the manufacturers and broadcasters are in a very unhappy mood, and the FCC plan just rubs them the wrong way at a time when, with certain notable exceptions, video business is not showing a profit, and has knocked the props from under audio business.

The TV allocations shed no rav of light and hope on this situation, and it's hard to see how any plan could. The proposed addition of 42 six-megacycle UHF channels for which no equipment has been developed, an allocations table listing channels for hundreds of areas that cannot support TV stations, and the invitation to discuss color even before anyone has found the formula for blackand-white profits are just new irritants to an industry that is in the throes of the worst headache it has ever experienced.

To make a bad job still worse, the new plan has broadened the gulf between the radio industry and the FCC. Let's examine the three most obvious faults in the FCC proposal.

Allocations in the UHF Band:

The FCC takes the position that, unless they apply pressure, the industry will not push ahead with UHF development, and large parts of the country will have no TV service because of the shortage of VHF channels. The facts are:

1. The industry's VHF efforts have run up a tremendous financial loss, and plain business sense indicates that VHF television broadcasting and set sales must at least show a promise of reaching the break-even point before the large investment necessary can be made in UHF development.

2. It is certain that, when the industry is prepared economically to undertake commercial UHF development, considerable further improvement will have been made in video quality. What it will be, or what direction it will take, no one knows.

However, we can be sure that further development will be limited by the present 6-mc. channel width and the VHF standards of transmission. We said last April1: "The possibilities for further development of television are unlimited. Today, it is only in its initial stage as a public service. The industry is only beginning to raise its sights to look into the possibilities of UHF television. For all the limitations imposed by the 12 VHF channels, the present technical and economic situation is such that television will not start to use the higher band until there is a UHF system of such superior performance as to make VHF service obsolete by comparison."

3. That opinion is widely held in the industry today. But the planners are prepared to stifle television development

¹¹"Obsolescence of TV Receivers" by Milton B. Sleeper, FM-TV April, 1949. (Continued on page 8)

SYLVANIA TUBES ARE RIGHT AT HOME IN THE FINEST HOME RECEIVERS



Motorola nat nai Olympic PHILCO Regal Sentinel Ladis Silvertone parton STROMBERG-CARLSON Tele-tone Temple TRAV-LER Westinghouse (ENITH RADIO



Sub-miniatures, seven- and nine-pin miniatures, standard types, and the great Lock-In radio tubes are all in-

cluded in the famous Sylvania line . . . all represented in the leading makes of home receivers-from portable models to console combinations and television receivers.

It is the high quality of these Sylvania tubes that has made them preferred . . . has made them famous throughout the world.

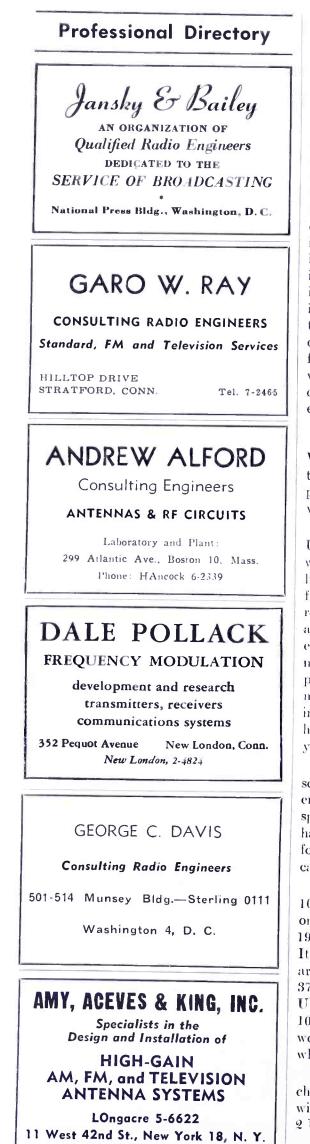
For full information about Sylvania tubes, see a Sylvania Distributor, or write Sylvania Electric Products Inc., Radio Tube Division, Emporium, Pa.



RADIO TUBES; CATHODE RAY TUBES; ELECTRONIC DEVICES; FLUORESCENT LAMPS, FIXTURES, WIRING DEVICES; PHOTOLAMPS; ELECTRIC LIGHT BULBS

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7



WHAT'S NEW THIS MONTH

(Continued from page 6) in its infancy by tieing down UHF development to the bandwidth used for VHF in the first commercial equipment ever to be put in operation.

Both radio and automotive industries have grown in public service by making a virtue of obsolescence based on technical progress. But the FCC, all the way back to the administration of Lawrence Fly, has spent its energies on effectuating ideologies, rather than facilitating the development of the industry in the service of public interest, convenience, and necessity. And now, sounding out the future of TV expansion with its ears tuned to voices on Capitol Hill, the Commission has decided that the optical quality of television must be frozen at the present standards, without waiting to see what improvements will come with UHF equipment when UHF equipment has been developed.

Allocations vs. Markets:

Why, if industry is so dissatisfied with the TV allocations plan, haven't better plans been offered? There are several very good reasons.

The industry is not ready to go into UHF. Less than 20% of the transmitters which can be accommodated on VHF have been installed. During the current freeze, the limited number of markets for receivers has engendered the most devastating price competition that has ever existed in a business where prices have never been stable. The Government planners wouldn't know about it, but the manufacturers may not be able to invest in UHF development before VHF sales have climbed a reassuring distance beyond the break-even point.

The new allocations proposal is not self-explanatory, and the FCC, consistently indifferent to industry relations despite its protestations to the contrary, has not seen fit to issue more that a formal statement to accompany the allocations table.

The analysis of allocations to cities of 100,000 population and over, published on the front cover of FM-TV for August, 1949, is not a picture of practical thinking. It shows 164 channels for 40 VHF-only areas, 88 VHF and 65 UHF channels for 25 UHF-only areas, and 59 channels for 25 UHF-only areas. Of the 102 areas with 100,000 population or more, only 46 would have 4 VHF stations or more, while 56 would have 1 to 3 stations.

On the other hand, 2 VHF and 3 UHF channels are provided for Augusta, Me., with 19,000 population, and 3 VHF and 2 UHF channels for Sheridan, Wyoming,

(Continued on page 9)

Professional Directory



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WHAT'S NEW THIS MONTH

(Continued from page 8) with 11,000 population, to pick just two examples.

Altogether 1,056 allocations are proposed for 880 areas of less than 10,000 population. It is obvious, therefore, that in 62% of the 1,420 areas where allocations are planned, TV stations will never be built!

Does this mean that 42 UHF channels are not needed to provide service where the population density is sufficient to support transmitters? Or, to put it differently, if allocations were made only to areas above 50,000 population, to take a very low figure, how many channels would be needed?

Frankly, we don't know. We haven't found anyone who does. The FCC may know, but they saw fit to leave the industry in the dark on that important point. So no one understands the significance of allocations to Hermitage, Missouri, with 75 families, or to Rankin, Texas, with 50 families.

Then there's the VH-UHF headache. Experience shows that at least two stations are required to build an audience large enough to support TV broadcasting. In 12 VH-UHF areas, ranging from 110,-000 to 712,000 population, only 1 VHF channel is proposed. People in those areas aren't going to buy VHF sets to receive one TV station when they know that added local service, if, as, and when available, will be on UHF. And who would want to build a VHF station with the knowledge that he may have to plug along alone for several years?

Color Television:

As if to prove that Government planners never miss an opportunity to upset an industry's apple cart, the FCC has seen fit to stir up a tempest in the color teapot. With the disregard for realistic thinking that characterizes those who attempt to run business which is not their own, the Commission apparently thinks that someone can pull a color rabbit out of the 6-mc. hat.

Probably all the excitement stemmed from the remarkably fine color demonstration at the recent convention of the American Medical Association. However, that was neither radio transmission nor was it typical program material. In that demonstration, the camera was no more than 2 ft. from the objects viewed. a condition that is seldom if ever encountered in broadcast studio practice. No statement has been made as to the video bandwidth. Maybe the transmission was in accordance with TV standards, but it's probable that the AMA performance could not be reproduced over the air.

In any case, since the FCC is only in-



received by current VHF receivers with "relatively minor modifications," there is no urgency about discussing it at a time when the subject only confuses the main issue of ending the television freeze.

Regulation Does Not Imply Control:

There is an increasing tendency for government officials to give effect to ideologies that are not in harmony with the closely-integrated relationships between industries and consumers. As public servants assume the role of planners, whether developing their own pet schemes or acting under the direction of the political administration, they forget that the life-blood of industry is that uncertain margin between revenue and the cost of doing business. In their economy, the currency is votes and reciprocities.

(Continued on page 28)

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For audio facilities that give you the *most* for your *money*...

Look into this Western Electric line!

25B Speech Input Console

The 25B provides highest quality studio control for AM, FM and TV audio. It more than meets FM performance requirements for audio equipment - wide freqencyrange, high signal-



to-noise ratio and exceptionally low distortion. It's flexible - handles two programs simultaneously without interference. It's easy to install-supplied complete with junction boxes and plug-in connectors.

23C Speech Input Equipment



The 23C is a complete, compact amplifier and control assembly combining the advantages of high quality and minimum cost. It will serve either one or two studio layouts in AM or FM stations-and because of its low cost, it's ideal for semi-permanent remote pick-up installations.

22E Portable Speech Input Equipment



This equipment provides complete high quality amplifying and control facilities in two compact, easily portable units-Amplifier-Control unit (upper illustration), and separate carrying case with space for rectifier. batteries and cords (lower illustration). Order now and be adequately equipped for the fall sports programs.

639 Type Microphones

These Western Electric Cardioids, well known for quality performance in AM and FM, are serving equally well as TV mikes. They provide excellent front-toback discrimination, wide frequency response, high signal-to-



noise ratio. The 639A provides a choice of three pick-up patterns, the 639B a choice of six.

THE above items are available for immediate delivery. For further information or prices get in touch with your nearest Graybar Broadcast Representative. Or write Graybar Electric Company, 420 Lexington Avenue, New York 17, N.Y.

- QUALITY COUNTS -





ADDING FM TO AN AM ARRAY

WCAO BALTIMORE REPLACED ONE OF ITS TOWERS IN EIGHT DAYS, RESTORED THE ORIGINAL AM PATTERN WITHIN AN HOUR — By MARTIN L. JONES & I. MAGER*



Fig. 1. Transmitter control room at WCAO, supervisor C. A. Seibold, Jr. at the desk

WHEN an AM station adds an FM transmitter, there is no question of affecting AM service if the FM installation is entirely separate. But if an FM antenna is to be mounted on one tower of an AM array, the sales and engineering departments are confronted not only with the necessity for operating on reduced AM power, temporarily, but the problem of restoring the original AM field pattern.

Lest others may be dismayed at the prospect of such an undertaking, this account of actual experience at WCAO Baltimore is offered as assurance that it is a relatively simple project, and can be completed within a surprisingly short period of time.

When station WCAO constructed a new transmitter building in 1941, FM was in its infancy, but space was provided for the possible future addition of an FM transmitter. At that time, the station had a construction permit to increase AM power to 5 kw. on 600 kc. Accordingly, the building was designed to house a Westinghouse type 5-HV transmitter, a 1-kw. stand-by transmitter and power division and phasing equipment for a 4-tower directional antenna array.

The antenna array consisted of four, 300-ft. towers in a straight line, fed by open-wire transmission lines. To provide a maximum of reliability and flexibility in operation, and to reduce time

*Respectively. Chief Engineer, Station WCAO, Baltimore, Md., and Sales Engineer, Electronics and X-Ray Division. Westinghouse Electric Corporation, Baltimore, Md. spent in tuning up the array, no expense was spared in installing adequate antenna tuning equipment. This foresight paid off six years later.

Fig. 1 shows the completed transmitter installation and control console. Part of the AM transmitter can be seen at the left, with the adjacent section containing the power division and phasing networks, with front-of-panel controls which provide a wide range of adjustment for each network. Common-point and transmission line inputs are indicated by the top row of RF meters.

Two separate racks carry monitoring, measurement, and certain control equipment. Below the phase monitor, on the left hand rack, are 4 meters which show antenna current at the base of each tower by remote indication. Just below are four meters and four telephone-type, double-throw key switches. Each key switch, by remote control, operates a motor-driven coil located in the matching network at the base of each antenna tower. The meter corresponding to each key switch indicates the position of the



Fig. 2. Array at WCAO, with new No. 1 tower and FM antenna in the foreground

variable tap on its coil. Thus, in the transmitter building and within reach are all the control and monitoring facilities necessary to adjust and observe the operation of the antenna array.

When WCAO applied for an FM construction permit, a site survey was made. It was determined that the AM location, Fig. 2, would be suitable because it has high elevation relative to, and a gradual slopedown to, the city of Baltimore.

It was decided to install a 3-kw. transmitter and low-gain antenna system for initial FM operation. A Westinghouse type FM-10, 10-kw. transmitter was purchased with the arrangement that the 3-kw. driver be delivered first, and the 10-kw. amplifier added at a later date. Work was started on that basis when the construction permit was received. The antenna system for interim operation consisted of 1 5/8-in. coaxial cable, an FM-AM isolation unit at the base of the No. 2 tower, and a single-bay turnstile antenna mounted on the top. This antenna system has been left intact and is still available for stand-by use.

Because delivery of a commerciallybuilt FM-AM isolation unit could not be made in time, WCAO decided to build its own. This is shown in Fig. 3. It consists of two inductively coupled, series resonant circuits mounted in a weatherproof metal box. The circuits are tuned easily by adjustable air-di-electric capacitors, using a loosely coupled Q meter.

The tower crew installed the FM antenna and ran the coaxial cable, plus ¹/₄-in. copper tubing, down the side of the tower in less than 6 hours. The ¹/₄-in tubing was connected to a fitting in the cable, adjacent to the antenna. so that the line could be readily flushed clean. However, just as soon as the antenna was secured to the tower, the AM array was affected as shown by the befor-and-after observations in Table 1.

TABLE 1

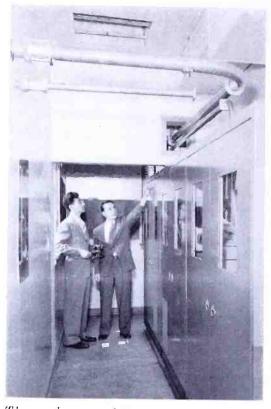
BEFORE	ERECTION OF FM	ANTENNA
TOWER	IA	PHASING
1	11 amp.	40°
2	28.6	262°

3	35.3	Reference
4	15.4	92°
Common]	Point 7.1 amp.	

AFTER	ERECTION OF	$\mathbf{F}\mathbf{M}$	ANTENNA
Tower	IA		PHASING
1	9.2 am	р.	37.2°
2	25.2 am	p.	258°
3	33		Reference
4	14.6		86°
~	and the second sec		

Common Point 7.4 amp.

Surprisingly, it was not difficult to get the array back to normal adjustment. The operation took but ten minutes. Adjusting the remote tuning control of tower No. 2 to a 1/3-turn reduction in inductance of the shunt coil restored the



The authors at the rear of the FM unit

original current values. A field intensity check of the 6 nulls of the array indicated that normal operation had not been disturbed.

The final installation was put in operation about 6 months later. This consisted of adding the Westinghouse 10-

be replaced by a stronger one to support a high-gain FM antenna. This antenna has two adjustable cans on its center conductor so that it can be tuned to present a low standing-wave ratio. The tower crew was cautioned not to paint either the cans or the center conductor, but paint them they did! This is not the first time the same thing has happened. The error was discovered when it came time to tune the antenna, and an otherwise perfectly good night was spent scraping off paint. The antenna was tuned with an RF bridge connected to the input to the coaxial cable, and fed by a small amount of energy taken from a low-power stage of the transmitter.

To avoid serious interruption to existing AM service during change-over to the new tower, special temporary authority was obtained for interim operation, using reduced power and one of the three other towers. By using two tower crews, only 8 days were required to dismantle the old tower and erect the new one.

As in the case of No. 2 tower, resonant loop coupling of the FM was used for isolation at the new No. 1 tower. As might be expected, this coupling unit, together with 25-ft. overall increase in height, caused some detuning of the array. The extent of this detuning is shown in the phase and current values preceding

T.	A	B	L	E	2

	TADLE 2		
WCAO Four-Element	Directive Array	Operating	Constants
	TTTL I DIT	633	

			With N	ew Tower	With N	ew Tower
	Orig	inal	(before re	adjustment)	(after rea	adjustment)
TOWER	PHASE	CURRENT	PHASE	CURRENT	PHASE	CURRENT
1	40°	11.0 amp.	9°	1.2 amp.	37°	10.1 amp.
2	262°	28.6	253°	21.3	261°	28.1
3	Ref.	35.3	Ref.	25.2	Ref.	35.1
4	92°	15.4	71°	19.8	93°	15.0

kw. amplifier, 3 1/8-in. line, an FM-AM isolation unit, and an 8-bay antenna on a new No. 1 tower. The tower had to

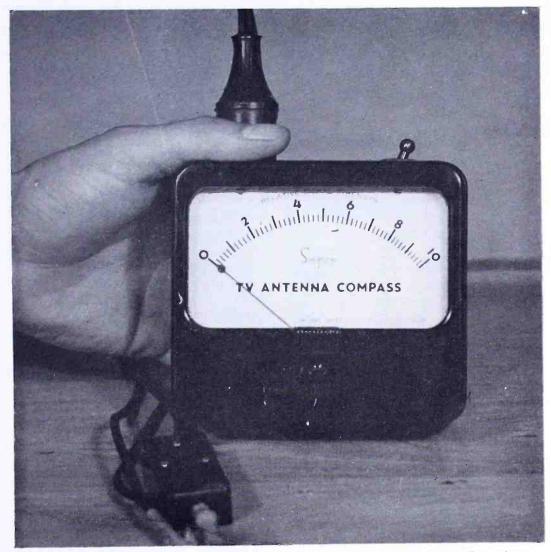


Fig. 3. Isolation unit built at WCAO

and following the change-over. Table 2. Readjustment was not too difficult. Current, phasing, and remote tower tuning controls were available in the transmitter building. The array was adjusted to the original values in all but the new tower. The current in No. 1 tower was reduced by approximately 8% over its original value to allow for the expected increase in radiation.

The validity of this adjustment was confirmed by a field check of the 6 monitoring points. The common-point resistance measurement was made, and the exact operating power established. No further tuning being required, proof of performance field intensity measurements were made at each of the monitoring points, and at locations along the same radials. Additional observations were made along two radials in the direction of the major lobe. Less than one hour was required to readjust the array; approximately three days were required for the field intensity proof of performance measurements.

FM and TELEVISION



This Antenna Compass indicates the signal strength fed to FM and TV receivers

LOCATING & ORIENTING ANTENNAS A NEW METER PERMITS EXACT ADJUSTMENT OF TV-FM & COMMUNICATIONS ANTENNAS—By ROY ALLISON*

TO anyone familiar with the erection of VHF and UHF antennas, the use of the Simpson Antenna Compass is a new and surprising experience. The reason is that this instrument, connected to the receiver by a cord of suitable length, enables the man on the roof to follow the changing signal strength exactly as he moves or turns the antenna.

This method is so much more accurate than shouting down or using a telephone to determine the optimum adjustment as to make the latter method seem antiquated. Furthermore, re-checks on antennas installed by voice instructions have disclosed considerable differences, in some cases, between received signal strength and the maximum obtainable by the use of the Compass.

Checking TV Reception:

Essentially, the Antenna Compass is a DC microammeter which measures the video input to the picture tube of a television set. One lead has a small case containing a germanium rectifier. This

* Engineering Consultant, North Egremont, Mass

lead is clipped to the video input of the picture tube at the socket. A needle point is used in the clip to pierce the insulation on the wire. The other lead is connected to the ground return circuit. It should be noted that most sets employ control grid drive, but some employ cathode drive. It is advisable, therefore, to refer to the schematic in order to determine the proper connection. The cable should be plugged into the meter as shown in the accompanying illustration.

If the antenna has been set up temporarily, and connected to the receiver, it is well to check the meter first at the set. Put the range switch in the LOW position, tune in a station, and adjust the contrast control so that the meter reading is at about one-third of the full scale deflection.

Then remove the cable plug from the meter, and connect a length of two-conductor cord between the meter and the cable plug. The meter should show approximately the original reading, and will be ready for use at the antenna.

Of course, if the antenna is mounted on a tower, the only adjustment possible is the orientation. In most cases, the Compass will show the adjustment for orientation to be much sharper than is indicated by merely watching the picture tube.

Experience shows that, if the signals are fairly strong, pickup can be reduced substantially by turning the antenna without affecting the picture noticeably. But with the antenna set for less than optimum pickup, if the signal strength is reduced by seasonal variations, it may drop below the value required for satisfactory signal-to-noise ratio.

The Compass is very helpful when two or more stations are to be received from different directions. Checking the signals on each channel, as the antenna is turned, gives exact answers to the questions of orienting separate upper- and lowerband antennas, and compromise adjustments that will provide sufficient signals from the weaker stations.

If the antenna can be moved around on a roof, the Compass shows the exact changes in signal strength. Often, a difference of a few feet makes a marked difference in the pickup.

Just as conditions vary at each installation, so the method of using the Compass will be different. But in every case, the exact information provided by this instrument removes the inaccuracies and uncertainties which result from trying to adjust the antenna by following voice instructions based on the appearance of received images.

Checking FM Reception:

For FM reception, the method of using the Compass on the roof is the same, but the connections at the set are necessarily different. The meter must be inserted in the grid return of the first limiter tube. Since this is a DC circuit, the germanium rectifier is not needed, but a .1 mfd. condenser must be connected across the points where the meter is cut into the grid return circuit. If that is not done, oscillation will be set up.

The operation of the Compass is the same as a conventional signal strength meter on an FM receiver, with connections extended to the location of the antenna.

For both FM broadcast and point-topoint communications receivers, the use of such an instrument is absolutely necessary when adjusting directional antennas, since a very wide change in the received signal cannot be detected by listening to the loudspeaker. This is due, of course, to the action of the limiter circuits. Consequently, received signal strength must be measured at a point preceding the first limiter.

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SPOT NEWS NOTES NOTES AND COMMENTS ABOUT SIGNIFI-CANT ACTIVITIES OF PEOPLE & COMPANIES

Scavengers of the Air Waves:

Our heartiest congratulations to FCC Commissioners Walker, Sterling, and Webster for their stand against giveaway programs. Whether they are lotteries or not, 30-minute programs that are personal to half a dozen listeners do not serve the public interest, convenience, and necessity. Broadcasting of such program material under FCC license implies Government approval of a national something-for-nothing philosophy which has no place in our United States. ABC has 13 giveaway shows, Mutual 10, CBS 8, and NBC 7. It's a sad commentary on the creative ability of the program directors when they have to give away merchandise in order to hold their audiences. As for the program content of these shows-radio is used only as an accessory to a game of chance played with telephone numbers. This, we hold, never was intended to become an authorized use of broadcast frequencies.

1950 Chicago Parts Show:

Will be held at Hotel Stevens during the week of May 22. New officers of the Show Corporation are: Jerome Kahn president, Walter Jablon vice president, William Schoning secretary, and Les Thayer treasurer, with Kenneth Prince as show manager.

TV Set Production:

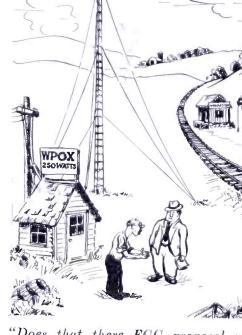
According to J. B. Huarisa, Admiral's executive vice president, production by this company has been increased from 10,000 to 13,500 TV sets per week. Admiral is not a member of RMA, and its production is not included in monthly RMA figures.

Sign of Progress:

CBS officials are listening critically to commercial announcements in an effort to increase their selling power. Dare we hope that, some day, broadcasters will begin to listen critically to their programs in an effort to make them more entertaining?

Commissioner Edward J. Hickey:

The man who staked his personal reputation on the success of FM for Connecticut's State Police system told us recently that since the installation went into operation on October 1, 1940, there has never been an interruption to state-wide police communications. Added the Commissioner: "That's a remarkable record, and the highest recommendation that anyone could give to FM." This was the first state-wide radio system ever installed, and led the way to what has



"Does that there FCC proposal mean someone's gonna build a TV station here?"

become the universal use of FM for mobile radio. The installation was described in FM MAGAZINE, December 1940 and January 1941.

Picture Size vs. TV Standards:

Disappointment is being voiced widely over picture quality of 16-in. sets. People assumed that they would "see more" in bigger pictures. Instead, they feel that they see less because the defects of small pictures are magnified. Actually, the demand is for better optical quality. This point is so important as to deserve the most careful consideration in deciding on transmission standards for UHF.

Railroad Radio:

New report by the Communications Section of the Association of American Railroads contains 354 pages. Apparently much has been done in developing "nonpressure hot and cold bath treatment of lodgepole pine poles," and the requirement specification for "purple copy and black record ribbons for use in telegraph printers" is just coming along fine, but in the 20 pages devoted to railroad radio, we didn't see much evidence of interest or progress.

4th-Round Wage Demands:

UE officials seeking higher weekly pay, with work-week reduced to increase number of employees, might do well to study financial reports now coming out for first 6 months of 1949. RCA shows gross income up \$11 million over same period of '48, but net profit was lower by \$728,-000. Sylvania increased gross income by \$1.4 million, with net profit down \$556.-000. Philco sales in second quarter of '49 were 24% below same '48 quarter, with net earnings down 56%, while Stewart-Warner's sales dropped 26%, with net profits 57% under the same period of '48. Motorola upped gross income by \$6.9 million, with only \$258,000 added to net profit. Comments AFL publication Labor's Monthly Survey: "Perhaps your employer's prospects are excellent, but if his profit margin is being squeezed by price declines, your future will be more secure if you help him improve his competitive position."

25.8% Preference for AM:

Of 1,000 listeners reached by phone calls, WHA Madison, Wis., reports that 18.4% have FM-AM sets. Of these 74.2% prefer FM reception. Most of those preferring AM explained that certain favorite network programs were not available on FM. An additional 66% of the people called plan to buy FM sets. Zenith models have been promoted actively in this area.

Full-Time FM in Australia:

Sydney now has an FM broadcasting station on the air 7 days a week from 11:00 AM to 10:30 PM.

AES Convention & Exhibit:

The Audio Engineering Society's first convention and exhibit at New York City promises to be an event of unusual interest. It will be held on the 6th floor of Hotel New Yorker, October 27 to 29, with a banquet the first night. Further information can be obtained from George Daniel, Box F, Oceanside, N. Y.

Markets for FM Sets:

FM broadcasting has now progressed to the point where it can show a profit on big-scale promotion of receiving sets. This is indicated by the following comparison of FM and AM stations in the principal markets:

	FM	AM		$\mathbf{F}\mathbf{M}$	AM
Baltimore	6	7	New Orleans	5 7	11
Boston	6	. 7	New York	12	14
Buffalo	5	6	Philadelphia	10	10
Chicago	14	16	Pittsburgh	9	7
Cincinnati	4	5	Portland	-6	10
Cleveland	6	6	Providence	5	6
Columbus, C). 5	4	Richmond	5	6
Dallas	5	5	San. Fran.	8	8
Detroit	6	5	San Antonio	6	9
Kansas City	4	4	Syracuse	4	5
Los Angeles	10	12	Toledo	3	3
Miami	7	6	Washington	9	7

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WDTV FIELD-STRENGTH REPORT

DATA PRESENTED HERE IS OF PARTICULAR INTEREST BECAUSE OF THE ROUGH TERRAIN IN THE PITTSBURGH SERVICE AREA -By THOMAS T. GOLDSMITH, JR.*

THIS report covers field measurements made during the period February 20 to March 25, 1949, to determine the performance characteristics of television station WDTV Pittsburgh.

A total of 1,148 measurements were made, all at a receiving antenna height of 28 ft. above the ground, and all lying precisely on 8 radials at approximately uniform spacing about the transmitter.

Basic Specifications:

Following are brief specifications of the television transmitter and the field equipment used in measurements reported here:

nere.	
Television Equipment	
Television transmitter	Montana &
	Grizella Sts.
	Pittsburgh, Pa.
North latitude	40° 29' 37"
West longitude	80° 01′ 05″
Transmitter power out	put
	5 kw. peak
	video
	2.5 kw. audio
Diplexer efficiency	99.5%
Transmission line eff.	88%
Antenna power gain	3.8
Effective radiated pow	ver
	Video-16.6 kw.
	Audio-8.3 kw.
Effective antenna heig	tht 815 ft.
Video modulation	Test pattern
	and program
Receiving Equipment	

Receiving Equipment

- a. One 21/2-ton G. M. C. bus
- b. Built-in PE-197, 110-volt, 60-cycle, 5-kva Generator
- c. Model M-58 Measurements Corporation field strength meter and standard dipole
- d. Hallicrafters S-36 receiver
- e. Model 18-B signal generator
- f. Du Mont Type 72 Duo-band antenna
- g. Du Mont Chatham receiver
- h. 40-ft., 72-ohm, dual coaxial transmission line
- i. 28-ft. collapsible antenna mast
- j. Exacta camera

The receiving equipment was operated by Messrs. Robert P. Wakeman, J. D. O'Neill, and Herbert Ferrell.

Method of Measurements:

Eight approximately equi-spaced radials were laid out, emanating from the WDTV transmitter. The exact azimuths were selected from a consideration of

*Director of Research, Allen B. Du Mont Laboratories, Inc., 2 Main Avenue, Passaic, N. J.

population densities and main arteries of travel. Measurements were made at intersections of roads with these radials at spacings of .5 to 2 miles, the greater spacings being used at the extremities of the radials. At each cluster point, at least 3 measurements were made within a radius of approximately 100 ft.

The bus was equipped with two antennas, one 12 ft. high and the other 28 ft. high. Along the north radial, measurements were made on both antennas at every point. A statistical analysis of the height-gain relationship thus obtained has been made by Kenneth Norton of Central Radio Propagation Laboratory of the National Bureau of Standards and appears in Reference C of the Ad Hoc Committee report to the Federal Communications Commission. As this relationship is not employed in this report, these measurements will not be described in detail here. It was found that, statistically, a linear height-gain relationship exists. This statement must not be construed to mean that at any given location the received signal is linearly related to the height of the receiving antenna, but rather that the median value of a large number of measurements will be approximately proportional to the an-tenna height. On all other radials measurements were made only at the 28-ft. height.

All measurements included in this report were made using a Measurements model M-58 field strength meter and Du Mont type 72 Duo-band antenna. The field strength meter was calibrated by Measurements Corporation both before and after the survey. The calibration of the type 72 antenna versus the standard dipole is described later in the report.

During the entire survey, the transmission-line voltage at the transmitter was monitored with a diode rectifier and an Esterline-Angus recording meter. An analysis of the tape indicated that no significant variations occurred in this voltage at any time while measurements were actually being taken.

Presentation of Data:

It should be kept in mind that only a very simple dipole antenna was employed, and that no attempt was made to find the best possible location at each cluster. Of the total 1,148 measurements, all ghost-free pictures were classified as weak, good or excellent. Where

multi-path conditions existed, pictures were classified as slight ghost or bad ghost.

Obviously, the installation of a receiving antenna having a reasonable amount of gain and some front-to-back ratio would bring many of the weak and good pictures up into the excellent class, and would eliminate many of the slight-ghost conditions.

A second count was made to determine the number of locations within the theoretical primary and secondary service areas actually receiving primary or secondary service. Of the 507 measurements made within the theoretical 5,000-uv/m contour, 47% actually exceeded 5,000-uv/m. Of the 1,081 measurements made within the theoretical 500 uv/m contour, 68% were found to exceed 500 uv/m.

Although these percentages are rather low, it should be pointed out that a very large number of the roads on which measurements were made lie along rather deep river valleys, whereas most of the Pittsburgh suburban residential areas are located on the hill tops. Consequently, these figures probably give a somewhat pessimistic view of the useable television signal in the Pittsburgh area.

Space does not permit reproduction of the 8 radials plotted. However, the one radial shown in Fig. 1 was selected because it is a particularly interesting example of rugged terrain, with a considerable number of measurements made at low points. The abscissa of the radial indicates the distance from WDTV transmitter. The lower ordinate indicates the elevation above mean sea level; and the upper ordinate, the field strength in microvolts per meter. The lower portion of the graph is, therefore, a profile of the radial on a four-thirds earth basis. Cluster points are indicated at their actual locations (elevation and distance) along the profile. The several values of field strength measured at each cluster are shown. A vertical line joins the extreme values, and the arithmetical averages are connected by straight lines. Because of the extreme roughness of the terrain, points on the curve lying between measured cluster points cannot be expected to indicate true values of signal strength. It will be noted that we were frequently obliged to make measurements at two consecutive points in deep valleys separated by a high hill. Obviously, the straight line connecting the low signal

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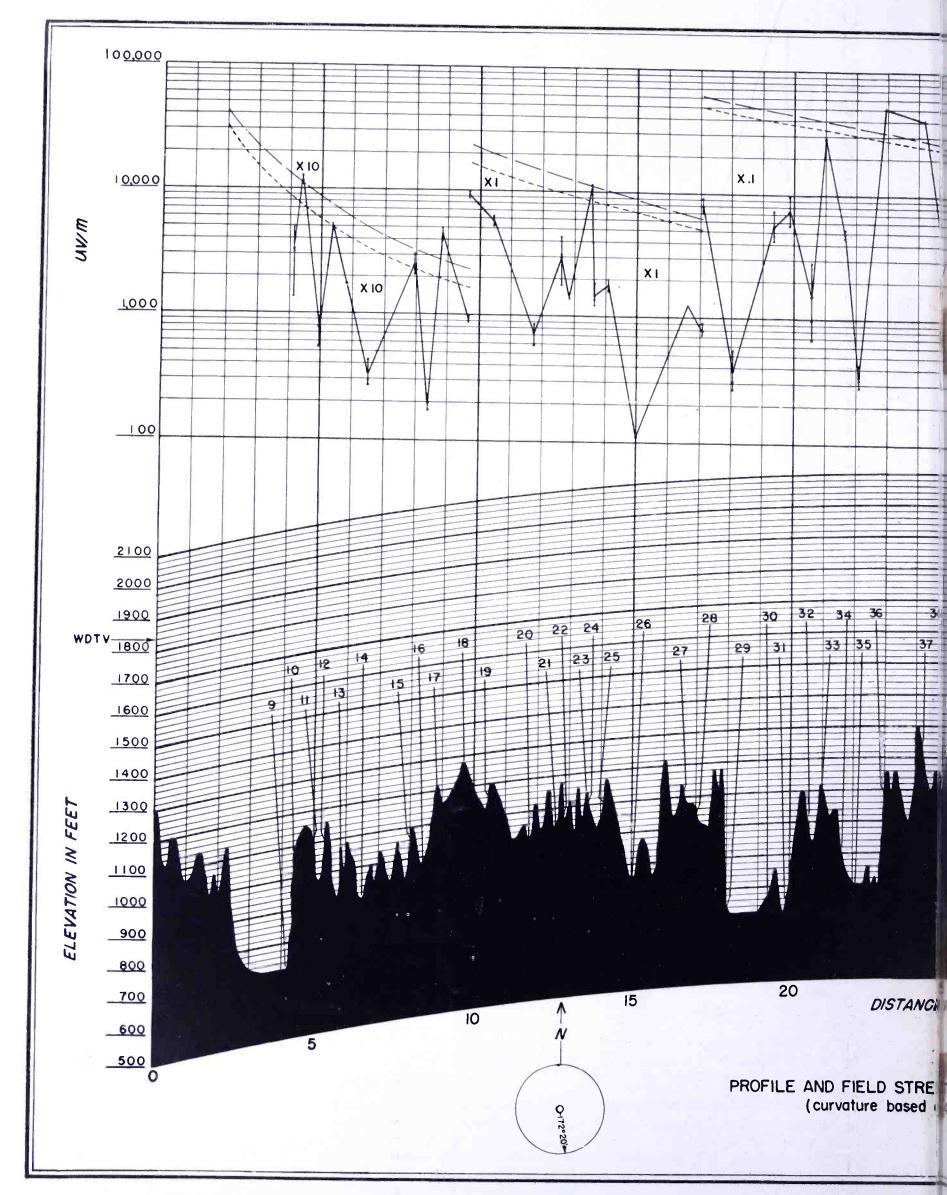
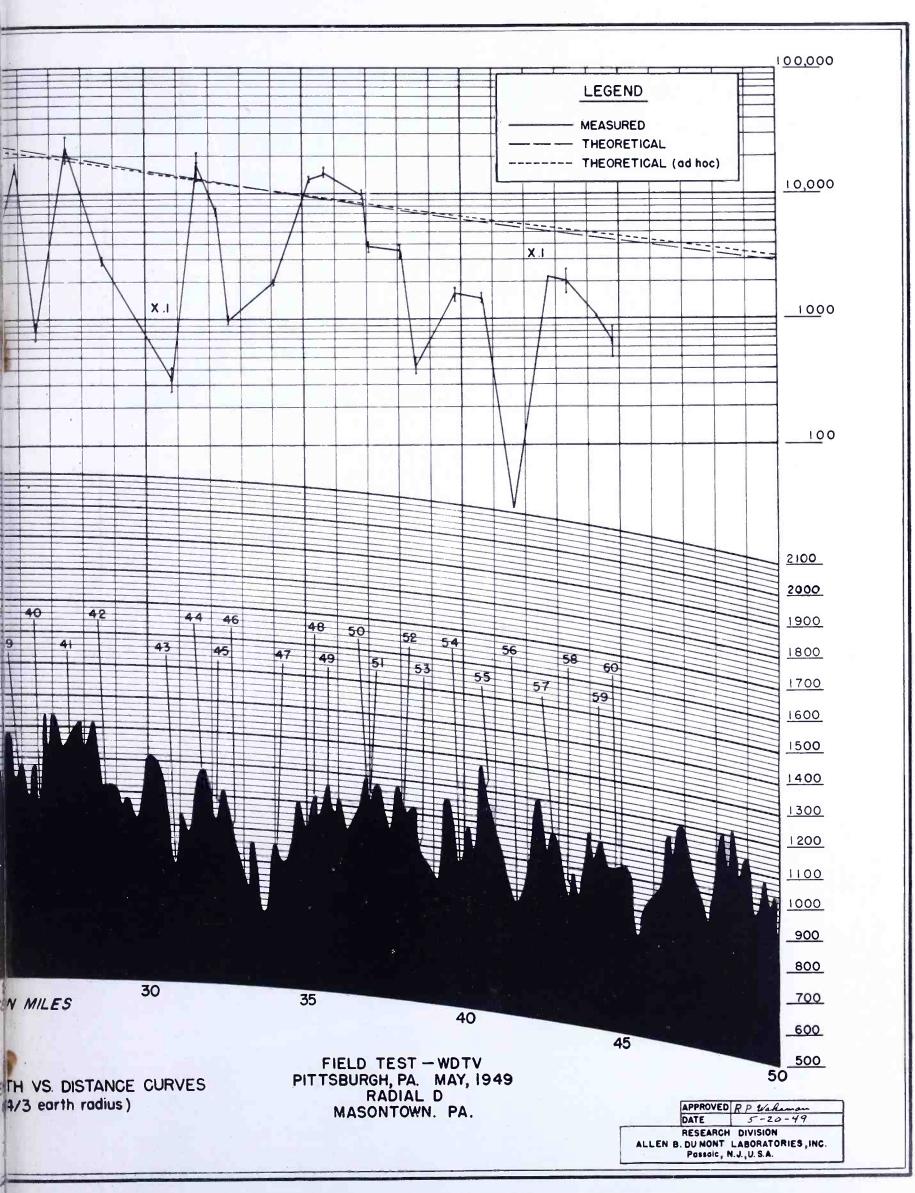


Fig. 1. Theoretical and measured values of field strength from WDTV Pittsburgh, on channel No. 3. Actual values of the

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eo and audio signals, and description of the picture quality at cluster points 9 to 60 are shown in the accompanying table

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values obtained in the valleys bears no relation to the probable high signal values which would have been obtained on the hills. The same is true, of course, in places where consecutive measurements were made on hill tops separated by a deep valley.

In addition to the measured data plotted, the smooth earth ground-wave field strength, as calculated by Norton's curves, is shown at the top of the graph. For comparison, the smooth earth ground-wave field strength as corrected by Fig. 1 of the Ad Hoc Committee Report is also shown. As can be seen, this correction in the case of channel 3 results only in a minor decrease in expected signal strengths for points lying within the primary service area and a very slight increase in expected signal strengths in the secondary and fringe areas.

It should be noted that whereas measurements made in New York and other large metropolitan areas have frequently shown considerably greater deviation from the theoretical at shorter distances

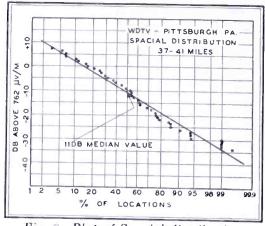


Fig. 2. Plot of Spacial distribution

from the transmitter than at greater distances, this is not particularly true in the Pittsburgh area. In the case of New York City measurements, this condition has been explained as being due to the heavily built-up areas close to the transmitter. In Pittsburgh, however, the absence of large buildings in the secondary service area is entirely counter-balanced by the very hilly terrain. Consequently, we find that the signal strength, as a function of

MEASUREMENTS MADE ON RADIAL D

MARCH 14, 1949 11:21 AM to 3:45 PM

Pr. No.	MI.		SOUND, UV/	M		- PICTURE, UV /	M	Pic. Qual.
9 10 11 12 13 14 15 16 17 18 19 20 21 22	4.2 4.4 5.0 5.2 5.8 6.4 7.9 8.3 8.8 9.7 10.4 11.8 12.5 12.8	33,000 55,000 8,700 36,000 21,800 2,180 15,200 1,640 39,000 9,000 5,700 650 3,100 980	24,000 65,000 8,200 44,000 18,600 3,300 1,850 38,000 8,500 5,300 5,300 5,300 1,200	23,000 49,000 8,700 39,000 16,400 1,960 25,000 1,520 39,000 8,200 3,700 480 1,310 1,090	50,000 124,000 8,700 53,000 17,300 4,300 22,000 1,730 39,000 9,900 6,200 870 4,300 1,500		31,000 112,000 9,500 50,000 17,300 2,850 30,000 1,980 50,000 8,700 5,800 5,800 5,800 5,800 5,800 1,740 1,360	EX GD BCT BCT BCT SG SG EX EX EX EX BG
			M	ARCH 7, 1	949 4:55 PM to 8:4	49 PM		
23 24 25 26 27 28 29 30 31 32 33 34 35 36	13.5 13.6 14.1 15.0 16.6 17.1 18.0 19.3 19.8 20.6 21.0 21.7 22.1 22.9	7,800 1,420 1,530 55 930 820 33 380 370 240 3,100 310 12 3,900	7,600 1,310 1,640 33 980 550 33 360 550 164 2,940 370 14 3,600 MARC	7,400 1,200 1,200 82 1,040 760 22 380 490 142 2,730 390 12 3,400 H 3, 1949	00	9,400 1,360 2,000 81 1,240 920 31 470 600 68 2,600 530 32 5,000 PM	10,500 1,240 1,600 161 1,240 740 27 740 990 990 990 2,500 480 28 4,800	EX EX EX EX EX EX EX EX FR EX FR EX EX EX EX EX EX EX EX EX EX EX EX EX
37	24.1	3,500	3,500	3,300	4,000	4,100	3,900	EX
38 39 40 42 43 44 45 44 45 47 48 47 51 52 53 55 55 55 55 55	25.0 25.9 26.5 27.5 28.7 30.9 31.7 32.2 32.7 34.1 35.2 35.6 35.2 35.6 38.1 38.6 38.1 38.6 39.9 40.7 41.7	164 1,040 65 2,300 230 930 650 65 174 1,090 1,860 850 153 310 31 142 98 Signal coul	230 1,090 53 2,400 300 1,750 580 79 174 980 1,640 910 196 262 38 164 142 d not be meg	55 1,040 45 2,500 250 27 1,640 560 69 153 940 1,420 820 218 262 38 153 109 sured	270 1,740 93 1,740 310 35 1,240 740 94 210 1,360 1,600 940 310 310 37 136 136	136 1,600 84 2,00 300 41 1,740 710 107 200 1,360 1,360 1,360 1,360 1,050 400 390 41 150 160	150 1,500 68 2,850 270 27 2,100 690 94 1,86 1,240 1,360 910 370 390 50 174 136	FR EXGGGGXGKK SSESGKK EXXD FWK WW
57 58 59	42.8 43.4 44.3	218 15 104	262 13 109	251	210	222 25	222 19	FR WK
60 03 00	44.3 44.8 00.0 00.0	87 00,000 00,000	82	79 65 00,000 0 3,0 00	108 87 000,000 000,000	99 50 000,000 000,000	105 62 000,000 000,000	WK WK WK
DI CELLI	E OILLIT							

PICTURE QUALITY: BCT: Bad coax transmission — BG: Bad ghost — EX: Excellent — FR: Fair — GD: Good — NSY: Noisy — SG: Slight ghost — TG: Transient ghost — WK: Weak.

distance, frequently varies to a marked degree throughout the entire area.

Detailed data taken on this radial is presented in the accompanying table. The three readings of microvolts per meter taken at cluster points for sound and picture signals are shown, with reference letters indicating picture quality. At each location, the antenna was oriented for maximum signals.

Sample Computations:

In order to obtain a suitable conversion factor from microvolts at the receiver terminals to the field strength in microvolts per meter, two locations were selected at which a minimum amount of reflection was experienced. At each of these locations, the field strength was obtained by measuring the voltage received on a standard dipole and dividing this value by λ/π , the effective length of a half-wave dipole. In each case, the field strength was then compared to the voltage measured using the Du Mont type 72 antenna. The average ratio thus obtained was

E = 0.87e

where

E =field strength in microvolts per meter

and

e = voltage at receiver terminals in microvolts

A laboratory setup to determine the relationship between voltages measured on the M-58 and RMS sync peak voltages was made by Mr. J. Minter of Measurements Corporation. This calibration was made for both the test pattern and typical television programs. It was found that the instrument reads essentially pedestal level regardless of modulation.

As the RMA standards specify that this voltage is to be 0.75 times sync peak voltage, a factor of 1.33 was used to convert from meter reading to sync peak. It is believed that the error resulting from a deviation from the RMA standard is a second-order effect. A second factor of 1.07 was employed to convert from the 28-ft. height at which our measurements were made to the 30-ft. height on which the theoretical curves are based.

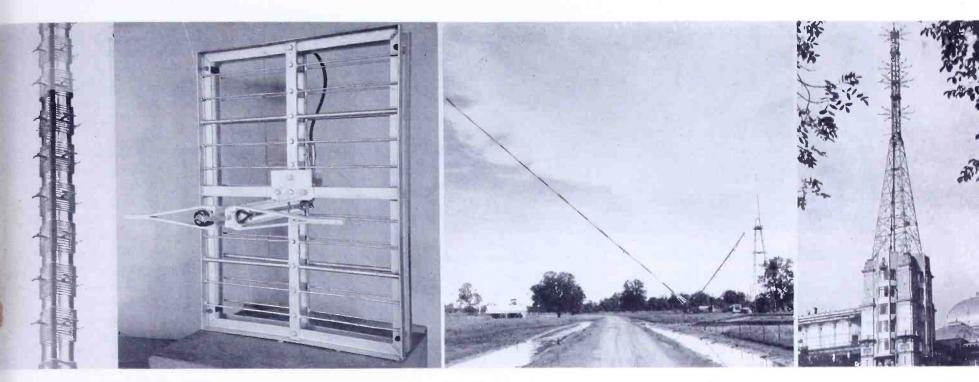
Conclusions:

This is probably the first time that a complete field survey has been made in an area having terrain of the type found around Pittsburgh.

In accordance with methods suggested in the report of the Ad Hoc Committee to the Federal Communications Commission, a sample analysis of spacial distribution of field strength has been made. The results of this study are shown on the (Concluded on page 30)

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NEWS PICTURES

A T the top, left, is something new in a super-gain television antenna built by RCA for WBNT, Columbus. The adjacent photograph shows a single section of the antenna, comprising a dipole and screen. One unit, 30 by 48 ins., weighs 100 lbs. Since gain is increased by stacking the units, a directional pattern can be achieved by increasing or reducing the number of units on any one side of the tower.

The third picture at the top shows how oil men run up towers in Texas. It hardly seems possible, but this 500-ft. mast was assembled completely, right down to the tower lights and a relay dipole, on the ground. Then, with a boom and donkey engine, it was pulled up to a vertical position. This particular antenna, at Thompson, Texas, 30 miles south of Houston, is part of a Link Radio mobile system operated by the West Production Company.

Quite different from television types in this country is the design of the BBC's installation at Alexandra Palace, North London. This is the only television station in the British Isles.

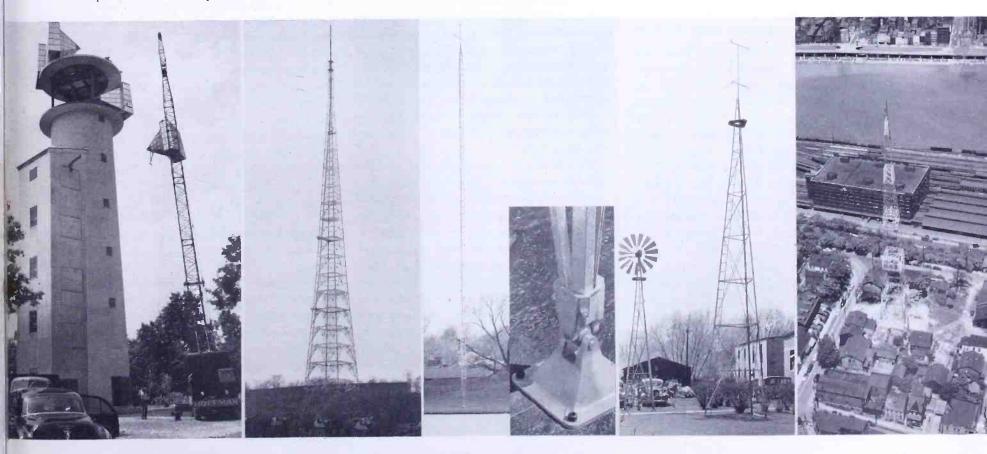
On the bottom row, the photograph at the left shows A T & T's tower design for microwave relays which will soon connect New York City and Chicago. This type, of reinforced concrete construction, carries a heavy load inposed by four lens antennas, and houses the considerable amount of equipment required.

Blaw-Knox furnished the 500-ft. tower for DuMont station WDTV, Pittsburgh. Assembled from 2,700 structural pieces, it weighs 500 tons, and measures 60 ft. square at the base tapering to $5\frac{1}{2}$ ft. at the top.

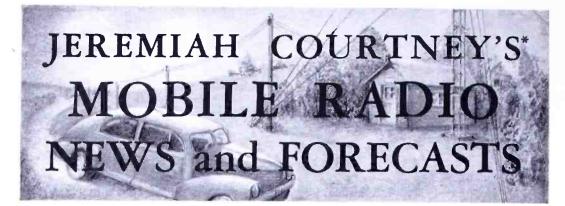
In sharp contrast is the slim guyed tower produced by Baker Manufacturing Company. Evansville, Wisc. The bottom section tapers to a universal joint, shown in detail, so that the tower can be assembled on the ground and erected in one piece.

The 3-legged, self-supporting tower is also a Baker design. Either this or the guyed tower can be used for a TV or FM receiving antenna, or the antenna of a fixed station in a mobile system.

Orange and white paint give an odd effect to the 350-ft. Blaw-Knox tower at KQV-FM, overlooking Pittsburgh. The 53 tons of structural steel, held together by 5,000 bolts, will withstand a wind of 125 miles per hour. The FM antenna adds 40 ft. to the height.



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THE flow of applications for FM mobile radio facilities has been so constant that the FCC apparently does not recognize that it is supported by the work of equipment manufacturers and their field representatives.

Need for Demonstrations:

At least, the cavalier treatment accorded the manufacturers and their field men in the matter of experimental frequencies for coverage-survey purposes, under the new land-mobile service rules effective July 1, 1949, suggests that the Commission believes that the source of the applications is a spontaneous urge, with which manufacturers' field service has no connection.

This view probably results from the fact that the FCC budget does not permit members of its engineering staff to spend a little time in the field each year. It demonstrates the gulf that separates the staff at Washington from the realities of commercial sales promotion. Applications don't just happen (ask any sales manager!) Somebody has to be sold on the contribution of radio to public safety or the efficient discharge of the applicant's business.

Method Now in Use:

How has all the selling of the past been accomplished? Certainly not by paper charts and oral representations. All manufacturers have held Class 1 experimental authorizations under the old Part 5 Rules. These rules set aside a batch of frequencies for Class 1 experimental purposes in the various mobile bands (1 in the 27-mc. band; 9 in the 30- to 40-mc. band; 1 in the 40- to 50-mc. band; 2 in the 72- to 76-mc. band; and 3 in the 152to 162-mc. band). The portable and mobile licenses issued for these frequencies authorized operations "within the continental limits of the United States." A single manufacturer would have a license, for example, for all three 152-mc. experimental frequencies. Thus, his field representative could demonstrate to any prospective user, upon his first visit, the exact coverage range of the equipment he was selling.

Since the beginning of mobile radio, these authorizations have been used by manufacturers' representatives to show the doubting Thomas, far from Washington and its radio experts, what radio can do for *his* business in *his* area.

Actually, the Part 5 Rules provide that experimental stations "shall not be used to demonstrate equipment for prospective sales purposes." This anachronistic provision has been deemed to have been complied with in such cases on the theory that the field tests conducted by the manufacturer's representative were for the purpose of planning the most efficient radio system. Although all equipment sales were officially recognized as being only incidental to research and engineering surveys, sales nevertheless happily resulted; and with remarkable frequency in some fields, such as taxi radio. All of which benefited the affected user-industry, reduced manufacturers' selling costs, and contributed to the FCC's goal of securing maximum frequency utilization in the service of public interest, convenience, and necessity.

Effect of New Rules:

Under the new land-mobile Rules, however, no frequencies were set aside for experimental purposes. All the available mobile frequencies were assigned to various user-services. Employment of any of these user-service frequencies for experimental purposes was also strictly limited to the extent indicated in the NG1 footnote to the Part 2 frequency allocation table:

"NG1. On the condition that harmful interference will not be caused to services operating in accordance with the table of frequency allocations, the following classes of stations may be authorized to use frequencies in this band: 1) Experimental stations engaged solely in scientific or technical radio experiments not related to an existing or proposed service nor intended to develop a proposed service or specific use of radio, 2) contract developmental stations, and 3) export developmental stations."

So that there would be no ambiguity about the restrictive nature of the note, the FCC issued an explanatory release on July 11 (Public Notice 38164):

"In the past, the vast majority of applications for authorizations to conduct field intensity or field coverage surveys have been considered as falling within the class 1 experimental category and have been authorized as such. However, effective July 1, 1949, provisions have been made for such operations in the various mobile Rules of the Commission. Accordingly, operations of this character will no longer be authorized in the Class 1 experimental service but will be considered as falling within the developmental category in the particular service for which the person or organization for whom the tests are being conducted are eligible. For example; if a power utility is proposing a new radio communication system or a change in its existing system which requires field intensity surveys to determine the coverage to be obtained from the proposed system, the power utility would submit application for a developmental class of station in accordance with the Commission's Rules and Regulations governing power utility radio services (Part 11 of the Commission's Rules-industrial radio services). The authorization would then be issued in the name of the power company. This procedure differs from past procedures wherein most of these authorizations were granted to manufacturers or their field representatives to conduct such tests for potential licensees."

In announcing the new procedures no mention was made of the enormous burden that would be placed on the sales staffs of the various manufacturers. The power utility would henceforth have to be sold on radio without benefit of actual observation; if successfully sold, a developmental application would then have to be filed; then the usual application processing delay at the FCC would elapse; one or more revisits to the power utility would be necessary by the sales representative; then, assuming the power utility's interest in radio had not cooled meanwhile, a regular application would have to be filed; and finally, after a second application-processing delay, a construction permit would issue. Altogether, it is a most inefficient method.

Remedy Is Needed Urgently:

The need for remedying this situation is obvious. It affects not only manufacturers but all engineering consultants as well. Either some frequencies must be set aside for field survey purposes or the present rules must be liberalized to make the prospective user's entry into radio less difficult and time-consuming. The FCC staff has the problem under consideration and some remedial action may be expected prior to November 1, 1949, when the present experimental authorizations expire.

^{*}Courtesy, Krieger, and Jorgensen, Washington 6, District of Columbia.

What the New FCC Allocations and Rules Mean to the **RADIO COMMUNICATIONS SERVICES**

A QUICK-REFERENCE GUIDE TO THE FREQUENCY ASSIGNMENTS AND TECHNICAL REQUIREMENTS FOR THE VARIOUS CLASSES OF MOBILE RADIO SERVICE-Part 3

POWER RADIO SERVICE

Individuals or companies eligible to operate power radio systems are those engaged in generating, transmitting, collecting, purifying, storing, or distributing, by means of wire or pipe line, electrical energy, artificial or natural gas, water, or steam for use by the public, or by the members of a corporation organization;

A non-profit organization formed for the purpose of furnishing a radio communication service solely to persons who are actually engaged in one or more of the activities set forth above.

Frequency Assignments:

Available frequencies are listed in the accompanying table, subject to qualifications set forth in the footnotes.

Technical Information:

Applicants and licensees must cooperate in the selection and use of assigned frequencies in order to minimize interference and obtain the most effective use of facilities authorized. Each frequency or band is available on a shared basis only, and will not be assigned for the exclusive use of any one applicant. Such use may be restricted as to geographical area.

Mobile system frequencies have been made available on the basis of singlefrequency, simplex operation. Not more than one frequency or band of frequencies will be assigned to a single applicant unless a conclusive showing is made that an additional assignment is necessary to the operation of the system.

Since most fixed, point-to-point circuits require simultaneous 2-way communication, it will be customary to assign two frequencies or bands with such frequency separation, where possible, as to allow full duplex operation.

EMISSION LIMITATIONS: Bandwidth for AM phone is 8 kc.; for FM phone, 40 kc. The specified band shall contain those frequencies on which 99% of the radiated power appears, extended to include any discrete frequency of which the power is at least .25% of the total radiated power. Radiation in excess of these limits is considered unauthorized emission. Emission appearing on any frequency removed

¹ This frequency may be subject to change when the Atlantic City table of frequency allocations below 27.5 mc. comes into force.

from the carrier frequency by at least 50% but not more than 100% of the maximum authorized bandwidth must be attenuated not less than 25 db below the unmodulated carrier. Spurious or harmonic emission appearing on any frequency removed from the carrier frequency by at least 100% of the maximun authorized bandwidth must be attenuated below the unmodulated carrier by not less than:

40 db with maximum plate power input to the final stage of 3 watts or less. 60 db with more than 3 watts and including 150 watts.

70 db with more than 150 watts and including 600 watts.

80 db with more than 600 watts.

MODULATION: Maximum audio frequency required for speech intelligibility is considered 3,000 cycles. Transmission of higher frequencies will not be author-

POWER RADIO FREQUENCIES

FREQ. CLASS	NOTES.	FREQ.	CLASS	Notes	FREQ.	CLASS	Notes
2292 kc. Base, Mob.	1, 3	48.30	Base, Mob.	5	457.45	Base, Mob.	\overline{i}
4637.5 "	1, 2, 3	48.34	>>	5	457.55	**	7
35.06 mc. "	3, 4	48.38	99	5	457.65	2 9	7
35.10 "	3, 4	48.12	,,,	5	457.75	99.	$\overline{7}$
35.14 "	3, 4	48.46	33	5	457.85	3.7	7
35.18 "	3, 4	48.50	99	5	457.95	99	7
37.46 "	5	48.54	,,,	5	952	to	
37.50 "	5	72.02	to		960	Fixed	8
37.54 "	5	75.98	Fixed	6	1850	to	
37.58 "	5	153.41	Base, Mob.	5	1990	,,	8
37.62 "	.5	153.47	99	5	2110	to	
37.66 "	5	153.53	9 9	5	2200	**	8
37.70 "	5	153.59	99.	5	2450	to	
37.74 "	5	153.65	.9.9	5	2500	Base, Mob.	7, 8, 9
37.78 "	5	153.71	,,	5		Op. Fixed	
37.82 "	5	158.13	2.7	5	2500	to	
37.86 "	5	158.19	9 9	5	2700	Fixed	8
47.70 "	5	158.25	>>	5	3500	to	
47.74 "	5	456.05	99	7	3700	Base, Mob.	7
47.78 "	5	456.15	,,,	7	6425	to	
47.82 "	5	456.25	33	7	-6575	>>	7
47.86 "	5	456.35	**	7	6575	to	
47.90 "	5	456.45	,,	7	6875	Fixed	8
47.94 "	5	456.55	59.	7	11700	to	
47.98 "	5	456.65	5.5	7	12200	Base, Mob.	7
48.02 "	5	456.75	23.	7	12200	to	
48.06 "	5	456.85	,,,	7	12700	Fixed	8
48.10 "	5	456.95	,,	7	16000	to	
48.14 "	5	457.05	99	7	18000	**	8, 9
48.18 "	5	457.15	9 9	7	26000	to	
48.22 "	5	457.25	>>	7	30000	29	8
48.26	5	4 57 .35	**	7			

² Limited to daytime use only, with a maximum vice on the condition that no harmful interference plate power input to the final RF stage not to exceed 100 watts. ³ Available for assignment to base and mobile ⁷ Available for assignment to base and mobile

 τ Available for assignment to hase and mobile stations in the power radio service on a shared

³ Available for assignment to base and mobile stations in the power radio service on a shared basis with other services.
⁴ Use of this frequency by stations in the power radio service is subject to causing no harmful interference to the marine mobile service.
⁵ Available for assignment to base and mobile stations in the power radio service only.
⁶ Assignable frequencies spaced by 40 kc. beginning with the frequencies 72.02 and 75.42 mc., and ending with the frequencies 74.58 and 75.98 mc., respectively, are available on a shared basis to operational fixed stations in the power radio service.
⁷ Available for assignment to base and mobile service.
⁶ Available for assignment to fixed stations in the power radio service on a shared basis with other services, under terms of a developmental grant only.
⁸ Available for assignment to fixed stations in the power radio service on a shared basis with other services, under terms of a developmental grant only.
⁹ Use of frequencies in the 2,450- to 2,500-mc. band and 17,850- to 18,000-mc. band is subject to no protection from interference due to the operational fixed stations in the power radio service on 2,450 and 18,000 mc.

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ized. On FM, deviation due to modulation must not exceed plus and minus 15 kc. from the unmodulated carrier.

Each transmitter authorized or installed after July 1, 1950, must be provided with a device which will automatically prevent modulation in excess of that specified above, except that this shall not apply to mobile transmitters using a maximum plate power input to the final RF stage of 3 watts or less.

MAXIMUM POWER: Maximum plate power input to the final RF state shall not exceed 2 kw. at 1.6 to 3 mc.; 500 watts at 25 to 100 mc.; and 600 watts at 100 to 220 mc. Power at frequencies above 220 mc. will be specified in the FCC authorization. Stations presently authorized to use power in excess of the limits specified above may continue their operation until the expiration of their current license term. Power and antenna height shall be no more than the minimum required for satisfactory technical operation commensurate with the area to be served and local conditions which affect transmission and reception.

TRANSMITTER MEASUREMENTS: Frequency and modulation measurements on each fixed and mobile unit must be made and entered in the log every 6 months, or whenever an adjustment is made that might affect frequency or modulation. Mobile units may be checked on the bench if they are operated under load conditions. The use of automatic frequency monitors is approved for frequency checking.

Any independent, qualified engineering measurement service may be employed, provided the log entries show the name and address of the firm, and the name of the person making the measurements.

OPERATOR'S LICENSE: While unlicensed persons may operate the transmitters. all adjustments or tests for installation, service, or maintenance "which may affect the proper operation of such a station, shall be made under the immediate supervision and responsibility of a person holding 1st or 2nd class commercial radio operator license, either radio-telephone or radiotelegraph, who shall be responsible

for the proper functioning of the station equipment."

At radiotelegraph stations, adjustments affecting frequency must be made by a person holding a 1st or 2d class commercial radiotelegraph operator license.

No person is required to be in attendance at a transmitter when operating in the course of normal service, or at transmitters used for telemetering or for selfactuated retransmission.

CHECKING LIGHTS: The licenseee shall make a daily check of the tower lights "either by visual observation of the tower lights or by observation of an automatic indicator to insure that all such lights are functioning properly." Any observed failure of a code or rotating beacon light not corrected within 30 minutes must be reported immediately by telegraph or telephone to the nearest Airways Communication Station or CAA office regardless of the cause of the failure, and notice given immediately on resumption of illumination. Lights and light controls must be inspected at least once every three months.

PETROLEUM RADIO SERVICE

Those eligible to operate stations in the petroleum radio service are persons engaged in prospecting for producing, collecting, refining, or transporting by mcans of pipelines, petroleum or petroleum products, including natural gas; or

A non-profit organization formed for the purpose of furnishing a radio communication service solely to persons who are actually engaged in one or more of the activities set forth above.

Frequency Assignments:

Available frequencies are listed in the accompanying table, subject to qualifications set forth in the footnotes.

Technical Information:

The same requirements apply to the petroleum radio service as are listed under Technical Information for power radio service.

basis with other services, under terms of a developmental grant only. ⁷ Available for assignment to fixed stations in

PETROLEUM RADIO FREQUENCIES

E	0	N.T.						
FREQ.	CLASS	Notes		CLASS	NOTES		CLASS	Notes
1602	ke Base, Me		48.86	Base, Mob.	4	457.35	Base, Mob.	6
1628	3 3	1, 2	48.90	3 3	4	457.45	**	6
1652	2 9	1, 2	48.94	> >	4	457.55	35	6
1676	33	1, 2	48.98	22	1	457.65	99 ,	-6
1700	33	1. 2	49.02	,,	4	457.75	2.9	6
2292		1, 2	49.06	33	4	457.85	23	6
4637.5	**	1, 2, 3	49.10	3 9	4	457.95	33	6
25.02	mc. "	4	49.14	3 9	4	952	to	
25.06		4	49.18	> >	4	960	Fixed	7
25.10	>>	4	72.02	to		1850	to	
25.14	33	4	75.98	Fixed	5	1990	••	7
25.18	., *	4	153.05	Base, Mob.	1	2110	to	
25.22	9 9	4	153.11	33	1	2200	8.9'	7
25.26	3.9	1	153.17	33	1	2150	to	
25.30	> >	1	153.23	33	1	25 00	Base Mob.	
30.66	2.9	1	153.29	3.9	1		Op. Fixed	6, 7, 8
30.70	3.5	1	153.35	**	1	2500	to	
30.74	7 3	1	158.31	>>	1	2700	Fixed	7
30.78	>>	1	158.37	"	1	3500	to	
30.82	3 9	1	158.43	"	1	3700	Base, Mob.	6
33.18	••	4	456.05	**	6	6425	to	
33.22	> ?	4	456.15	3.9	6	6575	>2	6
33.26		4	456.25	13	6	6575	to	
33.30	**	4	456.35	>>	6	6875	Fixed	7
33.34	3 3.	e k	456.45	**	Ĝ	11700	to	
33.38	5.9	-4.	456.55	32	6	12200	Base, Mob.	6
48.58	5.97	4	456.65	22	6	12200	to	
48.62	39	4	456.75	**	6	12700	Fixed	7
48.66	• •	4	456.85	23.	6	16000	to	
48.70	3 \$	4	456.95	>>	6	18000	39	7, 8
48.74		4	457.05	53,	6	26000	to	
48.78		4	457.15	2.5	6	30000	37	7
48.82	33	4	457.25	63	6			- s - ,
						Ë#		

the petroleum radio service on a shared basis band and the 1,750- to 18,000-mc. band is subject with other services, under terms of a develop-mental grant only. ⁸ Use of frequencies in the 2,450- to 2,500-mc. 18,000 mc.

¹ Available for assignment to base and mobile stations in the petroleum radio service on a shared

basis with other services. ² This frequency may be subject to change when the Atlantic City table of frequencies below 27.5

³ Limited to daytime use only, with a maximum plate power input to the final RF stage not to exceed 1000 watts. ⁴ Available for assignment to base and mobile

stations in the petroleum radio service only. ⁵ Assignable frequencies spaced by 40 kc., be-ginning with the frequencies 72.02 and 75.42 mc. and ending with the frequencies 74.58 and 75.98 mc., respectively, are available on a shared basis mc, respectively, are available on a shared basis to operational fixed stations in the petroleum radio service on the condition that no harmful inter-ference will be caused to the reception of tele-vision stations on Channels 4 or 5. ⁶ Available for assignment to base and mobile stations in the petroleum radio service on a shared basis, with other services under the stations for

FOREST PRODUCTS SERVICE

Those eligible to operate stations in the forest products radio service are persons engaged in tree logging, tree farming, or related woods operations; or

A non-profit organization formed for the purpose of furnishing a radio communication service solely to persons who are actually engaged in one or more of the activities set forth above.

Frequency Assignments:

Available frequencies are listed in the accompanying table, subject to qualifications set forth in the footnotes.

Technical Information:

The same requirements apply to the forest products radio service as are listed under technical information for power service.

¹ Available for assignment to base and mobile stations in the forest products radio service on a shared basis with other services.

² This frequency may be subject to change when the Atlantic City table of frequency allocations below 27.5 mc. comes into force.

³ Available for assignment to hase and mobile stations in the forest products service only.

⁴ Assignable frequencies spaced by 40 kc. begin-*Assignable frequencies spaced by 40 kc. begin-ning with the frequencies 72.02 and 75.42 mc. and ending with the frequencies 74.58 and 75.98 mc., respectively, are available on a shared basis to operational fixed stations in the forest products radio service on the condition that no harmful interference will be caused to the reception of

MOTION PICTURE RADIO SERVICE

Those eligible to operate stations in the motion picture radio service are persons engaged in the production or filming of motion pictures or

A non-profit organization formed for the purpose of furnishing a radio communication service solely to persons who are actually engaged in one or more of the activities set forth above.

Frequency Assignments:

Available frequencies are listed in the accompanying table, subject to qualifications set forth in the footnotes.

Technical Information:

The same requirements apply to motion picture radio service as are listed under Technical Information for power radio service.

The rules applying to this service specify that prior approval must be obtained from the Commission for each person who proposes to participate in the licensee's service.

² Available for assignment to base and mobile stations in the motion picture radio service on a shared basis with other services. ³ Available for assignment to base and mobile

stations in the motion picture radio service on a

FOREST PRODUCTS RADIO FREQUENCIES

Freq.	CLASS	Notes	Freq.	$\mathbf{C}_{\mathbf{LASS}}$	Notes	Freq.	Class	Notes
1676 kc.	Base, Mob.	1, 2	158.31	Base, Mob.	1	952	to	
1700	**	1, 2	158.37	2.2	1	960	Fixed	6
29.73 1	nc. "	3	158.43	,,	1	1850	to	
29.77	,,,	3	456.05	>>	5	1990	>>	6
49.22	> >	3	456.15	"	5	2110	to	
49.26	,,,	3	456.25	33	5	2200	**	6
49.30	,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	3	456.35	>>	5	2450	to	
49.34	3 7	3	456.45	>>	5	2500	Base, Mob.	
49.38	> >	3	456.55	**	5		Op. Fixed	5, 6, 7
49.42	> >	3	456.65	"	5	2500	to	
49.46	>>	3	456.75	,,,	5	2700	Fixed	6
49.50	"	3	456.85	,,	5	3500	to	
49.51	"	1	456.95	> 3	5	3700	Base, Mob.	$\tilde{2}$
49.58	,,	1	457.05	3 3	5	6425	to	
49.62	>>	1	457.15	3 3	5	6575		5
49.66	,,	1	457.25	* *	5	6575	to	
72.02	to		457.35		5	6875	Fixed	6
75.98	Fixed	4	457.45	••	5	11700	to	
153.05	Base, Mob.	1	457.55	*	5	12200	Base, Mob.	5
153.11	>>	1	457.65	**	5	12200	to	
153.17	>>	1	457.75	,,,	5	12700	Fixed	6
153.23	>>	1	457.85	••	5	16000	to	
153.29	,,	1	457.95	9 9	5	18000	"	6, 7
153.35	>>	1				26000	to	
						30000	**	6

television stations on Channels 4 or 5. television stations on Channels 4 or 5. ⁵ Available for assignment to base and mobile stations in the forest products radio service on a of a developmental grant only. ⁶ Available for assignment to fixed stations in the forest products radio service on a shared on 2,450 and 18,000 mc. ⁶ Available for assignment to fixed stations in ⁶ Available for a

basis with other services, under the terms of a

MOTION PICTURE FREQUENCIES

Freq.	Class	Notes	Freq.	CLASS	Notes	FREQ.	CLASS	Notes
1628 kc.	Base Mob.	1, 2	456.45	Base, Mob.	3	2110	to	
1652	>>	1, 2	456.55	,,	3	2200	>>	6
2292	**	1, 2	456.65	3.5	3	2450	to	
4637.5	3 9	1, 2, 4	456.75	>>	3	2500	Base, Mob.	
49.70 1	m c . "	2	456.85	>>	3		Op. Fixed	3, 6, 7
49.74	> >	2	456.95	>>	3	2500	to	
49.78	>>	2	457.05	>>	3	2700	Fixed	6
49.82	"	\mathfrak{Q}	457.15	>>	3	3500	to	
72.02	to		457.25	,,,	3	3700	Base, Mob.	0
75.98	Fixed	5	457.35	,,	3	6425	to	
152.87	Base, Mob.	2	457.45	>>	3	6575	> >	3
152.93	**	2	457.55	"	3	6575	to	
152.99	"	2	457.65	>>	3	6875	Fixed	6
173.225	,,	2	457.75	"	3	11700	to	
173.275	**	2	457.85	3.9	3	12200	Base, Mob.	3
173.325	,,	2	457.95	>>	3	12200	to	
173.375	>>	2	952	to		12700	Fixed	6
456.05	>>	3	930	Fixed	6	16000	to	
456.15	,,	3	1850	to		18000	>>	6, 7
456.25	,,,	3	1990	>>	6	26000	to	
456.35	>>	3				30000	,,	6

shared basis with other services under terms of a interference will be caused to the reception of developmental grant only. television stations on Channels 4 or 5.

⁴ Limited to daytime use only, with a maximum plate power input to the final RF stage not to exceed 100 watts. ⁵ Assignable frequencies spaced by 40 kc. be-ginning with the frequencies 72.02 and 75.42 mc. and ending with frequencies 74.58 and 75.98 mc., respectively, are available on a shared basis to operational fixed stations in the motion picture tion of industrial, scientific, and medical devices radio service on the condition that no harmful on 2,450 and 18,000 mc.

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¹ May be subject to change when the Atlantic City table of frequency allocations below 27.5 mc. comes into force.

RELAY PRESS RADIO SERVICE

Those eligible to operate stations in the relay press radio service are persons engaged in the publication of a newspaper or in the operation of an established press association; or

A non-profit organization formed for the purpose of furnishing a radio communication service solely to persons who are actually engaged in one or more of the activities set forth above.

Frequency Assignments:

Available frequencies are listed in the accompanying table, subject to qualifications set forth in the footnotes.

Technical Information:

The same requirements apply to relay press radio service as are listed under Technical Information for power radio service.

¹Assignable frequencies spaced by 40 kc. begin-ning with the frequencies 72.02 and 75.42 mc. and ending with the frequencies 74.58 and 75.98 nc., respectively, are available on a shared basis to operational fixed stations in the relay press radio service on the condition that no harmful

SPECIAL INDUSTRIAL SERVICE

Those eligible to operate stations in the special industrial radio service are persons engaged in an industrial activity the primary function of which is devoted to production, construction, fabrication, manufacturing, or similar processes as distinguished from activities of a service or distribution nature, and, in addition, meets one or more of the following requirements:

1) The industrial operation for which radio is desired is being conducted in a remote or sparsely settled region;

2) The industrial operation is a construction project of a public character;

3) The use of a radio is required within the yard area of a single plant for mobile service communications and the use of a low-power industrial service does not meet the operational requirements of the industry otherwise found eligible under this subparagraph.

Frequency Assignments:

Available frequencies are listed in the accompanying table, subject to qualifications set forth in the footnotes.

Technical Information:

The same requirements apply to special industrial radio service as are listed under Technical Information for power radio service.

¹ This frequency may be subject to change when the Atlantic City table of frequency allocations below 27.5 mc. comes into force. ² Limited to daytime use only, with a maximum plate power input to the final RF state not to exceed 100 watts.

LOW-POWER INDUSTRIAL RADIO

Authorization for stations to be oper-

RELAY PRESS RADIO SERVICE

FREQ.	CLASS	Notes	FREQ.	CLASS	Notes	FREQ.	CLASS	Notes
72.02	to		457.15	Base, Mob.	3	2500		
75.98	Fixed	1	457.25	>>	3	2700	Fixed	4
173.225	Base. Mob.	2	457.35	3.9	3	3500	to	
173.275	* *	2	457.45	33	3	3700	Base, Mob	. 3
173.325	3.9	2	457.55	93	3	6425		
173.375	2.9	2	457.65	> >	3	6575	,,	3
456.05	7.5	3	457.75	33	- 3	6575	to	
456.15	5.9	3	457.85	99	3	6875	Fixed	4
456.25	3.5	3	457.95	99	3	11700	to	
456.35	3.5	3	952	to		12200	Base, Mob	. 3
456.45	3.9	3	960	Fixed	4	12200		
456.55	3 5	3	1850	to -		12700	Fixed	4
456.65	3.3	3	1990	,,,	4	16000		
456.75	3.3	3	2110	to		18000	> 3	4, 5
456.85	3.5	3	2200	**	4	26000	to	-, -
456.95	33	3	2450	to		30000		4
457.05	29	3	2500	Base, Mob.				
				Op. Fixed				

interference will be caused to the reception of television stations on Channels 4 or 5. ² Available for assignment to base and mobile stations in the relay press radio service on a shared basis with other services. ³ Available for assignment to base and mobile stations in the relay press radio service on a shared basis with other services, under the terms of a develop-to advelopmental grant only. ⁴ Available for assignment to fixed stations in the relay press radio service on a shared basis with other services, under the terms of a develop-to advelopmental grant only. ⁵ Use of frequencies in the 2,450- to 2,500-mc. ⁶ and and 17,850- to 18,000-mc. band is subject to no protection from interference due to operation of industrial, scientific, and medical devices on 2,450 and 18,000 mc stations in the relay press radio service on a shared basis with other services, under the terms of a developmental grant only.

2,450 and 18,000 mc.

SPECIAL INDUSTRIAL RADIO SERVICE

FREQ.	CLASS	Numma	Pana	0	NT	D	G		
-			FREQ.	CLASS	Notes		CLASS	Note	ES
	Base, Mob.		72.02		0	952			
4637.5	33	1, 2	75.98		8	960	Fixed		6
27.31 mc	°. 99	3		Base, Mob.	4	1850			
27.35	,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	3	152.93	3 3	-1	1990	>>		6
27.39	35	3	152.99	99 93	-1	2100			
27.43	39	3	154.49		3	2200	5,5		6
27.47		3	154.57	> >	4	2450			
30.58	**	3	456.05	3.9	5	2500	Base, Mob	. =	
30.62	>>	3	456.15	,,,	5		Op. Fixed	5, 6,	7
43.02	-9.9	3	456.25		5	2500	to		
43.0 6		3	456.35	>>	ð	2700	Fixed		6
43.10	>>	3	456.45	>>	5	3500	to		
43.14	>>	3	456.55	5.5	5	3700	Base, Mob		5
43.18	>>	3	456.65	>>	5	6425	to		
49.54	,,	-1	456.75	39	5	6575	39		5
49.58	37	4	456.85	9 9	5	6575	to		
49.62	2.2	4	456.95	9	5	6875	Fixed		6
49.66	>>	-1	457.05	**	5	11700	to		
49.70	> >	4	457.15	> 7	5	12200	Base, Mob		5
49.74	35	4	457.25	9'9	5	12200			
49.78	53	4	457.35	**	5	12700	Fixed		6
49.82	3 3	4	457.45	>>	5	16000			
49.86	39	3	457.55	33	5	18000	25	6,	7
49.90	3.9	3	457.65	>>	5	26000	to	,	
49.94	3.9	3	457.75	>>	5	30000	*		6
49.98	'3 9	3	457.85	53	5	00000			
+0.00		U	457.95	3.9	5				
			101.00		ų				

Available for assignment to base and mobile stations in the special industrial radio service only. Available for assignment to base and mobile stations in the special industrial radio service on a shared basis with other services. Available for assignment to base and mobile

stations in the special industrial radio service on a shared basis with other services, under the

^a Available for assignment to fixed stations in the special industrial radio service on a shared basis with other services, developmental grant only. under the terms of a

ated in the low-power industrial radio service may be granted to any person engaged in commercial activity or an in⁷ Use of frequencies in the 2,450- to 2,500-mc. band and 17,850- to 18,000-mc. band is subject to no protection from interference due to operation of industrial, scientific, and medical devices on 2,450 and 18,000 mc. ⁸ Assignable frequencies spaced by 40 kc. begin-ning with the frequencies 72.02 and 75.42 mc. and ⁹ and 75.09 mc.

ning with the frequencies 72.02 and 75.42 mc and ending with the frequencies 74.58 and 75.98 mc., respectively, are available on a shared basis to operational fixed stations in the special industrial radio service on the condition that no harmful interference will be caused to the reception of television stations on Channels 4 or 5.

dustrial enterprise. All stations that are authorized in this service will be classi-(Concluded on page 30)

Get This Low-Rate Insurance for Your **MOBILE RADIO SYSTEM** A Browning Frequency Meter Gives 2-Way Protection

FIRST: Insure your mobile radio system against failures by each transmitter checking against a BROWNING Frequency Meter once a month. Remember that receivers are made to tune much more sharply now, in order to reduce adjacentchannel interference. That's fine as long as each transmitter is exactly on frequency, but if a transmitter drifts a few kilocycles, down goes the signal at the receiver!

Here's a report that is typical of many we have received from communications supervisors:

"Six months after our system went into operation, our solidcoverage range was down 5 to 6 miles. We supposed it was due to weather conditions, and we were considering the purchase of new mobile units of higher power for some of our cars. We didn't suspect the real trouble until we got a report that our cars were causing adjacentchannel interference. So we ordered a Browning Frequency Meter. We found that some of



Model S-4 and S-7 Frequency Meters

our units had drifted considerably. Our loss of coverage was due entirely to off-frequency operation."

If you haven't a BROWNING Frequency Meter, don't delay! Order one for your system now, and set up a regular schedule for checking your transmitters.

SECOND: Your choice of a BROWNING Meter will give you further protection. Some drift is inevitable in all meters, regardless of their initial accuracy. Therefore, they should be compared periodically with the WWV standard - frequency transmissions. If you have a BROWNING Meter, you can do this yourself in five minutes, because the 100 kc. crystal is a sub-multiple of WWV. Other meters, with crystals which are sub-multiples of the calibration frequencies, require factory service, entailing shipping expense, loss of time, and possible damage.

BROWNING Meters, for all their advantages. are very reasonable in price. Model S-4 can be calibrated at 1 to 5 points in the band from 1.0 to 70mc., accurate to .0025%; or model S-7 at 1 or 2 points between 72 to 76 and/or 152 to 162 mc., accurate to .0025%. The model S-5, with temperature-controlled crystal, can be calibrated at 1, 2, or 3 points from 30 to 500 mc., accurate to .0025%.

USE the coupon below to get detailed information. Or tell us your frequencies and we will recommend the meter best suited for your use.



IN CANADA, ADDRESS: Measurement Engineering, Ltd., Arnprior, Ont. EXPORT SALES 9 ROCKEFELLER PLAZA, Room 1422 NEW YORK 20, U. S. A.

BROWNING LABORATORIES 750 Main St., Winchester, M Please send me technical de Browning precision product	Aass. tails and prices on the following
 S-4 Frequency Meter S-5 Frequency Meter 	 S-7 Frequency Meter WWV Frequency Calibrator
Name	
Address	
Company Connection	

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THE products listed here are described in new catalogs and bulletins now available. Unless otherwise noted, they will be sent on request, without charge.

BROADCAST EQUIPMENT

Diameter Equalizer:

Attachment for 33 1/3-RPM recorders automatically applies the equalization necessary to compensate for the loss in high-frequency reproduction occurring at the inner diameters of recording discs. Can be used for either out-in or in-out cutting. Model 628. Fairchild Recording Equipment Co., Whitestone, N. Y.

Portable Tape Recorder:

Comprising tape-drive mechanism and auxiliary spooling unit, combined with a portable 3-channel mixer. Uses $10\frac{1}{2}$ -in spools to give 64 minutes operation at $7\frac{1}{2}$ ins. per second, or 32 minutes at 15 ins. per second. Designed to meet NAB specs, with a frequency response flat to 2 db from 50 to 15,000 cycles, and less than 2% distortion at full modulation. Magnecord, Inc., 360 N. Michigan Ave., Chicago.

Plug-in Amplifiers:

Carried on rack panel and terminal tray. Type BA-1-C unit is a pre-amplifier for use as microphone or transcription pre-amplifier, booster or medium-level line amplifier, or isolation amplifier. Type BA-12-A is designed as a program or line amplifier, monitoring amplifier, or isolation amplifier. General Electric Co., Electronics Park, Syracuse, N. Y.

Remote TV Control Unit:

Control panels 11 by 25% ins. are designed for sloping-front control console. Panels provide remote control of monoscope camera, power supplies, relay receiver, sync generator, and stabilizing amplifier. Adaptors are available to permit the mounting of these panels on 19-in. racks. RCA, Camden, N. J.

GENERAL COMPONENTS

Retainers for Plug-in Parts:

Stainless steel retainers for tubes and plugin units are made in 5 types for components of various dimensions and top shapes. Positive spring grip permits quick application and release. Samples are available on request. Times Facsimile Corp., 229 W. 43rd St., New York 18.

Super-Midget Relays:

Relay mechanisms $\frac{5}{8}$ in. in diameter and $1\frac{5}{4}$ ins. long and weighing $\frac{1}{2}$ oz. are dustsealed in polystyrene or glass enclosures. The latter can be evacuated and gas-filled. Windings up to 3,400 ohms permit operation at 75 volts DC with a minimum sensitivity of 5 millamperes at 80 milliwatts. Type SM. Potter & Brumfield, 549 W. Washington Blvd., Chicago 6.

Glass Waveguide Windows:

Various sizes and shapes are sealed in mount-

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ings which can be silver-soldered without damage. For frequencies or 3,500 to 40,000 me., with narrow-band or wide-band transmission. Sylvania Electric Products, Ins., 500 Fifth Ave., New York 18.

Rhombic Antenna Resistors:

Terminating resistor contains two non-inductive resistors of 362.5 ohms sealed in a glazed ceramic shell, carrying terminal eyes and center connection. Shallcross Mfg. Co., Collingdale, Pa.

Miniature Coil Form:

Silicone-impregnated ceramic-form is 19/32 in. high by 3/16 in. diameter, with mounting bushing threaded 8-32. Can be furnished with adjustable powdered-iron slug. Samples available on request. Cambridge Thermionic Corp., 445 Concord Ave., Cambridge 38. Mass.

Sealed Relays:

New circular describes a complete line of hermetically-sealed relays of all types for standard and special applications. Automatic Electric Co., 1033 Van Buren St., Chicago 7.

TV Replacements Parts:

Catalog sheets show replacement coils, transformers, and chokes packaged for shelf display. Items include peaking coils, horizontal line and width controls, horizontal and vertical blocking transformers. filament chokes, and IF transformers. Super Electric Products Corp., 1057 Summit Ave., Jersey City 7, N J

Audio Transformers:

Open-frame transformers are designed to make high-quality performance available at low cost. Line includes impedance-matching, input, output, and power transformers for all audio circuit applications. Audio Development Co., 2833 13 Ave. South, Minneapolis, Minn.

Smaller Electrolytics:

Midget-can electrolytic containers, in a wide range of single and dual ratings, measure 13/16 in. in diameter by 1½ ins. long. Aerovox Corp., New Bedford, Mass.

MATERIALS

Cellulose Tape:

Bulletin lists types of tape for various specific electrical and industrial applications. *Topflight Tape Co., York, Pa.*

Ferro-Magnetic Material:

Non-metallic substance called Ferramics is described as being so light in weight as to out-perform iron volume for volume. Material is said to be of uniform structure, free of organic compounds. Thus it does not decompose at elevated temperatures. General Ceramics & Steatite Corp., Keasbey, N. J.

Asbestos Coil Forms:

For coils subjected to high temperatures or sudden temperature changes, forms are made with spiral-wound asbestos tape, and then die-formed to square, oval, or round shape. with wall thickness from .01 in. up. Samples made to specifications are available on request. Precision Paper Tube Co., 2045 W. Charleston St., Chicago 47.

BOOKS

Information on FM:

FREQUENCY MODULATION, by Nathan Marchand, 409 pages, 6 by 9 inches, cloth binding. Five sections are devoted to fundamentals, transmitters, receivers, mobile equipment, and servicing. A practical treatment, in which mathematics are used only in explaining the theory of modulation. Price \$5. Murray Hill Books, Inc., 232 Madison Ave., New York 16.

Electromagnetic Theory:

FUNDAMENTALS OF ELECTRIC WAVES, 2nd edition, by Dr. Hugh Hildreth Skilling, executive head of the Department of Electrical Engineering, Stanford University, 245 pages, 6 by 9¹/₄ inches cloth bound. An explanation of electromagnetic theory for engineering students in their senior college year. Maxwell's equations are used to develop the presentation of waves, reflection, radiation, antennas, and wave-guides. Price \$4. John Wiley & Sons, 440 4th Ave., N. Y. 16.

Amateur Communications:

RADIO AMATEUR'S HANDBOOK, 26th edition, compiled by the ARRL Headquarters Staff, 736 pages, 6½ by 9½ inches, paper cover. This book, which has become the bible of the amateur fraternity, covers the theory, construction, installation, and operation of telegraph and telephone equipment for the amateur frequency bands. Price \$2. American Radio Relay League, W. Hartford; Conn.

Vacuum Tubes:

ELECTRON TUBES, Vol. 1, 1935-'41, edited by Alfred N. Goldsmith, Arthur F. Van Dyck, Robert S. Burnap, Edward T. Dickey, and George M. K. Baker, 475 pages, profusely illustrated, 6 by 9 inches, cloth bound. Four sections, covering general transmitting, receiving, and special tubes, present 15 papers and summaries of 32 papers by RCA engineers, as well as a list of 400 other papers which have been published by the technical press. Price \$2.50. RCA Laboratories Division, Princeton, N. J.

Record Changers:

AUTOMATIC RECORD CHANGER SERVICE MANUAL, Vol. 2, 1948. 432 pages, 8¹/₂ by 11 inches. Detailed illustrations, service instructions, and replacement parts lists on 45 models, including LP and dual-speed types and wire and tape recorders. Price \$6.75. Howard W. Sams and Co., Inc., 955 N. Rural St., Indianapolis 1, Ind.

Sound Recording:

ELEMENTS OF SOUND RECORDING, by John G. Frayne and Halley Wolfe. 686 pages, 480 illustrations, $6\frac{1}{4}$ by $9\frac{1}{4}$ inches. cloth bound. 32 chapters cover the equipment, measurements, and practice of recording by all methods now in use. This exceptionally fine presentation for engineers, professional users of equipment, and students is based on courses given by the authors at the University of California. Frice \$8.50. John Wiley & Sons, Inc., 440 4th Ave., N. Y. 16.

TV Trouble-Shooting:

PICT-O-GUIDE, by John R. Meagher. Pocketsize, loose-leaf book of 100 pages, showing off-the-tube photographs of defective TV reception, with explanatory notes identifying each source of trouble. By matching received images with a picture in the book illustrating similar effects, the faulty component or circuit can be identified quickly. *RCA Tube Dept., Harrison, N. J.*

Save Chassis Space

and Improve **Performance!**

> Reduce Assembly **Operations!**

SPRAGUE High-K Ceramic Capacitors HERLEC-

• Sprague-Herlec high-K ceramic capacitors for bypass and coupling applications offer the designer of television and F-M receivers savings in both chassis space and in component and wiring costs.

DISC ACTUAL SIZE

• Disc Types 29C and 36C capacitors are extremely small round wafer-shaped units. Mounted across miniature tube sockets with extremely short leads, they result in improved v-h-f bypassing. Both single and dual capacitors are available on one disc.

• Bulplate Type 34C multiple capacitors are rectangular wafers with as many as five capacitor sections. One rugged, ceramic Bulplate may combine into a single, compact integral assembly all the capacitors and related wiring in one or more stages of electronic circuits. In combination with miniature resistors, Bulplates make more stable and reliable network assemblies than do completely printed R-C circuits. Closer electrical tolerances are more economically obtained and circuits may operate at a higher power level.

• All Sprague-Herlec ceramic capacitors are protected by a tough, moisture-resistant insulating coating.

• A constant and reliable supply of capacitors is assured by operation of two manufacturing plants in two widely separated locations.

• Write for Engineering Bulletin 601A today!

ELECTRIC CO.

PIONEERS IN

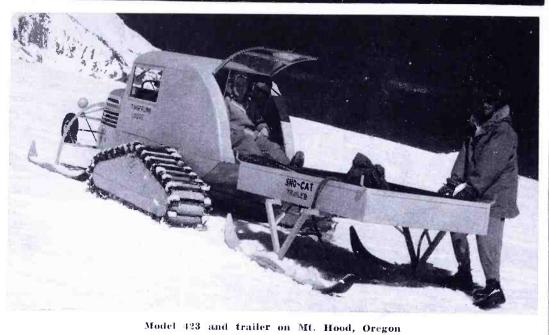
> ELECTRONIC DEVELOPMENT AND ELECTRIC

HERLEC CORPORATION . MILWAUKEE 3, WISCONSIN THE (Wholly owned Sprague Subsidiary)

SPRAGUE ELECTRIC CO. NORTH ADAMS MASSACHUSETTS

September 1949-formerly FM, and FM RADIO-ELECTRONICS

No Snow Too Deep - No Road Too Steep



Tucker SNO-CATS

Carry Men and Equipment to Isolated Places — Over Any Snow Condition!



Model 443 Utility Double Drive 8-passenger 3-door sedan, 95 H.P. Climbs grades to 65%



Sno-Cat's exclusive sliding pontoon. Sinks in less than a man on snowshoes.



Model 524 commercial 7-passenger 4-door sedan, 115 H. P. Climbs grades to 35%



DEALERS

Sno-Cat Corp. of N. Plymouth, N. H. H. W. Moore Equip. Denver, Colorado

- **OVER DEEP COVERED ROADS**
- **ON STEEP SIDE SLOPES**
- **THROUGH WOODED AREAS**
- THROUGH DEEP FRESH SNOW
- AND UP STEEP GRADES

You can keep your transmitter operating through the worst snow storms with the amazing Tucker Sno-Cat. For the Sno-Cat will carry your crews through any kind of snow with the comfort and convenience of an automobile. No other motor driven vehicle will climb so successfully over high drifts, steep grades and side slopes, on powder snow, heavy snow, drifted snow, crusted snow and ice.

HERE'S WHAT USERS SAY:

"... we are convinced by actual experience that the Tucker Sno-Cat will carry men and materials to isolated places over snow covered terrain with steeper slopes than is practical or possible with any other type of mechanical equipment with which we are familiar."

From Salt Lake Pipe Line Co. Letter of March 8, 1949 (Subsidiary of Standard Oil Company of California)

"... of course there may be a few places that the Sno-Cat can't go, but we have yet to find them. It will travel over fresh new snow 30" deep and over hard crusted snow so hard that you cannot see the marks left by the tracks! The "Cat" acted very well, sinking in the snow less than a man on snow-shoes would."

By E. R. Barber Southern California Edison Co. Big Creek, California

Sno-0	Pleaso Cats.	e sei	nd i	ne	you	r	des	er	ipt	ive	fo	lde	r e	on	ful	l li	ne	of	Tue	?ke
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WHAT'S NEW THIS MONTH

(Continued from page 9) Expense and payrolls, to them, are items in a budget met by taxes.

Because radio's pace is fast, and busy men's memories are short, let's turn back just three years and pick up the record of experience when another group of planners was cracking the whip over the radio industry. Let's run through the pages of a book issued by the Radio Manufacturers Association at that time, under the title "A Report to the Office of Price Administration."

It has some very interesting pictures. One shows the headlines on The Chicago Sun of August 14, 1945: "It's Over! It's Peace! It's Victory!"

And there's a quotation from the President under whom the planners are still at work. He said: "Production will do away with the necessity for government controls." To which the RMA replied on the opposite page: "But the radio industry today is far from that goal. It is, frankly, just plain stuck! The time for recrimination, for argument as to how it got that way in the six months since V-J Day, is past. More important is how to get it rolling."

RMA's complaint, just three years ago, was against the stifling effects of Government control exercised by OPA. At that time, the trouble was frozen prices. Today, it's frozen allocations. The book from which we quote contains many statements from member companies, such as: "We are not producing the maximum output of either our tube or receiving set facilities." "We are running at about 25% of our facilities." "Our present volume is under 30% of our maximum output." "We are at this time operating at less than half the rate necessary for efficient production."

Sounds like reports of the current status of TV production, doesn't it? But read this quotation: "We have not and are not accepting any orders subsequent to December 3, 1945, for delivery until some adjustment is made by OPA.'

It took just two years to shift from an OPA freeze to an FCC freeze. The administration is the same. The planning is the same. The result is the same. The only difference is the name of the agency that has tied up the industry.

On August 20, 1945, Melvin Karns, chief of WPB's radio and radar division said: "It is estimated that the industry is in a position to produce between 3.5 and 4 million radio sets by the end of the year." Actually, the industry was able to ship and bill less than 300,000 in that period.

The FCC was in there pitching then, too. On August 17, 1945, Paul Porter, (Continued on page 30)



Here are some of the many reasons why there are more Simpson 260 high sensitivity volt-ohm-milliammeters in use today than all others combined. The Simpson 260 has earned world-wide acceptance because it was the first tester of its kind with all these "Firsts":

Simpson 260 SET TESTER WORLD FAMOUS FOR ALL THESE "FIRSTS"

- First high sensitivity instrument to use a metal armature frame.
- First to use fully enclosed dust proof rotary switch with all contacts molded in place accurately and firmly.
- First to do away with harness wiring.
- First to provide separate molded recesses for resistors, batteries, etc.
- First to cover all resistors to prevent shorts and accidental damage and to protect against dust and dirt.
- First with a sturdy movement adapted to the rugged requirements of a wide range of service work or laboratory testing.
- First to provide easy means of replacing batteries.
- First to use all bakelite case and panels in volt-ohm-milliammeters.
- First volt-ohm-milliammeter at 20,000 ohms per volt with large 41/2" meter supplied in compact case (size 51/4" x 7" x 31/8").
- First and only one available with Simpson patented Roll Top Case.
- First to provide convenient compartment for test leads (Roll Top case).
- First to offer choice of colors.

The Model 260 also is available in the famous patented Roll Top safety case with built-in lead compartment. This sturdy, molded, bakelite case with Roll Top provides maximum protection for your 260 when used for servicing in the field or shop.

25,000 volt DC Probe for television servicing, complete, for use with 260, \$12.85

SIMPSON ELECTRIC COMPANY · 5200-18 W. Kinzie St., Chicago 44, Ill. · In Canada: Bach-Simpson, Ltd., London, Ont.

September 1949-formerly FM, and FM RADIO-ELECTRONICS

RANGES

+104....

ZERO OHMS

D.C.

R×10,000

Simpson

MODEL 280

500 M

20,000 Ohms per Volt DC, 1,000 Ohms per Volt AC VOLTS: AC & DC-2.5, 10, 50, 250,

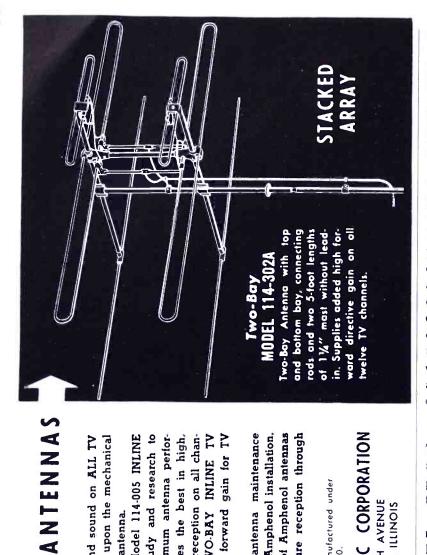
1,000, 5,000 OUTPUT: 2.5, 10, 50, 250, 1000 MILLIAMPERES, DC: 10, 100, 500 MICROAMPERES, DC: 100

AMPERES, DC: 10

DECIBELS: (5 ranges)-12 to + 55 DB OHMS: 0-2,000 (12 ohms center), 0-200,000 (1200 ohms center), 0-20 megohms (120,000 ohms center).

Prices: \$38.95 dealers net; Roll Top \$45.95 dealers net.





maintenance

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for INLINE

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on all chan

on ALL TV mechanical

-INLINE

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research

has designed the Model 114-005 INLINE performance of Amphenol antennas excellent picture reception through CORPORATION provides the best in high, Amphenol installation. for optimum antenna perfor-Antennas are manufactured under ent No. 2,474,480. dependent upon the and ILLINOIS punos reception high forward The Model 114-302A TWO-BAY antenna electrical construction of the antenna. study ERICAN PHENOLIC and 1830 SO. 54TH CHICAGO 50, 1 g to brilliant ð picture with que **ANTENNA** provides added years mance . . . this antenna meet the strict demands gain with clear, problems are eliminated ö Costly service calls Inline An Patent directly TV ANTENNA after reception sets in fringe areas. he faithful, steady is the solution for 5 Amphenol Amphenol many years. CHANNELS best uniform Ъ nels. pue

> Sia 2

WHAT'S NEW THIS MONTH

(Continued from page 28) then Chairman, announced: "The Commission is informed by transmitter manufacturers that 10-kw. transmitters will be immediately available for the new [FM] band." Actually, the delivery of 10-kw. FM transmitters did not start until 1947.

Then the planners moved again, even while FCC Chairman Coy, on May 18, 1948, was reassuring the NAB members that "The future of American radio must be planned and fashioned within the present formula of operation by private enterprise." This was followed by the announcement of a hearing on TV frequencies to start September 20. Finally, on September 29, television was gently eased into the deep-freeze locker with the assurance that its incarceration would last no more than six months. Now, as the six months stretch into twelve, the end is still at least six months away.

There's a Better Answer:

There's a better answer to the TV situation than the FCC's proposal. We don't presume to know what it is. But some things are clear:

1. VHF television is not perfect. It may not be permanent. But the public likes it, and it's the best system we have. Let's open it up to the public and the industry by establishing realistic allocations, based on the Ad Hoc Committee's propagation data, for areas that can support transmitters.

2. If that will not meet the demand for TV service, the broadcasters and set manufacturers will find it out. As businessmen, they will anticipate the need of using UHF, and will provide the equipment necessary. And in developing that equipment, they will come up with more sound and practical answers to the questions of UHF standards and color than anyone can give today.

3. The FCC must not make decisions in advance of technical progress. Rather, it must drop its closed-door policy of ruling by regulation, and adopt an openminded attitude of allowing the industry the time and opportunity to give the public a television service so superior to what we have now as to eventually make the present system obsolete.

WDTV REPORT

(Continued from page 18) graph in Fig. 2. All measurements within an annulus 4 miles wide, having a mean radius of 39 miles and centered about the transmitter, were compared to the smooth earth groundwave theoretical value at 39 miles, corrected in accordance with the Ad Hoc recommendations. There were 87 measurements lying within this area. The ratios were then converted to decibels and plotted on normal distribution paper. Although the values thus obtained represent spot measurements rather than sector median values, the distribution compares quite well with Fig. 2 of the Ad Hoc report which shows the slope of R (L) to be 22 db between the 10% and 90% values. As shown in Fig. 2 of this paper, we obtained a slope of 26 db. The slightly greater slope is readily understandable in view of the extreme roughness of the terrain. The median value shown here in Fig. 2 is, however, approximately 11 db below theoretical. As previously pointed out, this may be due, in part, to the fact that many of the roads on which measurements had to be made follow the river valleys. We do feel, however, that the smooth-earth groundwave curves, as corrected by the Ad Hoc report, are still somewhat optimistic for terrain as irregular as that encountered in the Pittsburgh area.

MOBILE SERVICES

(Continued from page 24) fied and licensed as mobile stations. Such stations, however, need not necessarily be moved nor used while in motion, and

may be at fixed locations.

Frequency Assignments:

The following frequencies are available for assignment to mobile stations in the low-power industrial radio service only:

27.51 mc. 35.02 mc. 33.14 42.98

On addition, the frequency 154.57 mc. is available for assignment to mobile stations in the low-power industrial radio service on a shared basis with services in other classifications.

Technical Information:

Low-power mobile stations operating on the frequencies listed above are subject to applicable regulations appearing in Technical Information for power radio service, in addition to the following:

Emission shall be confined to voice radio telephony.

Plate power input to the final RF stage of the transmitter shall not exceed 3 watts.

Maximum distance between the transmitter and the radiating portion of the antenna shall not exceed 3 ft.

Use of an antenna having a power gain greater than unity is prohibited.

The transmitter shall not be operated by remote control.

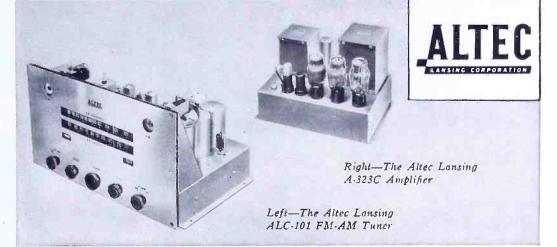
Use of repeater, control, or relay stations will not be permitted.

Stations licensed for operation on these frequencies shall not be used to communicate with stations operating on other frequencies.

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IN THE PROFESSION, AN HONORED NAME



ENGINEERED FOR THE HIGHEST POSSIBLE PERFORMANCE REGARDLESS OF COST

This superb two-unit Altec Lansing combination was designed in accordance with a single directive: "They are to be the finest. No component, no circuit, is to be chosen with price in mind. They must be able to realize the full resources of the finest AM and FM programs; they must be capable of receiving and delivering these resources undisturbed to the finest loudspeaker in the world, the Altec Lansing 604B Duplex." The AM section is an improved tuned radio frequency circuit recognized as the best for high quality reception. The distortion-free circuits of the FM section re-create all of the life-like reproduction possible with FM. The A-323C Amplifier transmits to the loudspeaker the signal delivered by the tuner, changed only in power level. This two-unit com-

bination is available with special accessories to permit rack mounting for professional monitoring. Phonograph and television inputs and required switching are provided.

Technical folder describing ALC-101 Tuner and A-323C Amplifier sent on request. Write Altec Lansing Corporation, 1161 North Vine Street, Hollywood 38, Calif., 161 Sixth Avenue, New York 13, N.Y.

WHAT'S NEW IN AUDIO?

The papers and exhibits to be presented at the nation's first Audio Fair will cover the entire field of today's developments in this important phase of FM and TV broadcasting and reception. This event, sponsored by the Audio Engineering Society, will be held at the

HOTEL NEW YORKER

34th Street & 8th Avenue, New York

October 27, 28, 29, 1949

Further information can be obtained from the Secretary, Audio Engineering Society, P. O. Box F, Oceanside, N. Y.

September 1949—formerly FM, and FM RADIO—ELECTRONICS

31

No Tube Trouble.

CON HAN B ngineers anufacturing

NO TUBE TROUBLE IN THIS 3 KW FM TRANSMITTER

If you and one of the many owners of FM transmitters where tube replacement cost has been heavily draining the reserv bank account, you will be particularly interested in the Gates BF-3D FM transmitter for 3000 watts power. The highly vulnerable power amplifier tubes which can be nighly vulnerable power amplifier tubes which can be improper air circulation around the tubes and in some instances even low line voltage, have been engineered not only to good performance but to low maintenance cost.

not only to good performance but to low maintenance cost. On the attached brochure note the unique tank circuit design where the new 4-1000 power amplifier tubes are covered with a pyrex jacket which confines all of the air around the tube and finally concentrates it on the air around the base and finally concentrates it on the 5000 hours of tube life and many purchasers of the BF-3D to 5000 hours of tube life and many purchasers of the BF-3D after many months of use. To aid long tube life is a after many months of use. To aid long tube life is a scientific air pressure control that immediately discon-nects the plate voltage where the air for any cause reduces in pressure. Also a direct reading power and standing wave in indicator which tells the operator instantly if the antenna characteristics have changed because of icing or amplifier tubes.

The BF-3D, like all Gates products, is engineered not only for fine performance, meeting rigid FM requirements, but having the practical touch added by such things as longer tube life that means dollars to the broadcaster.

Further information about this fine transmitter that cannot be found in the attached brochure will gladly be given upon

Yours very truly, request.

CATES RADIO COMPANY

Sales Department

*This letter was distributed with a brochure on the popular Gates BF-3D, 3KW FM transmitter.



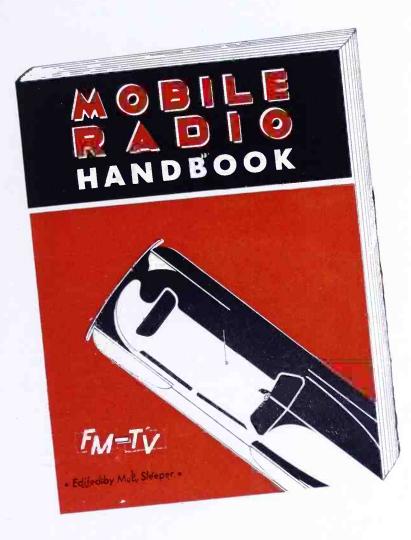
Commercially proven ... the Eimac 4-1000A is an outstanding high-power tetrode. Its rugged construction and stability of performance enable the country's leading transmitter manufacturers to enthusiastically expound the tubes' advantages in their key socket positions.

Consider the Eimac 4-1000A tetrode for your high-power equipment . . . frequency limits are well into the vhf. Complete data is available, please write direct.

EITEL - M c C U L L O U G H INC. San Bruno, Californic

Export Agents: Frazar & Hansen, 301 Clay St., San Francisco, California

EIMAC 4-1000A TETRODE



AT LAST! A COMPLETE AUTHORITATIVE UP-TO-DATE HANDBOOK ON MOBILE RADIO & POINT-TO-POINT COMMUNICATIONS

COVERS ALL THE NEW SERVICES

EVERYONE concerned with mobile radio communications and associated point-to-point systems will find the MOBILE RADIO HANDBOOK an invaluable reference guide—the sort of a book that is kept at hand to give accurate and specific answers to the increasing complications of this field.

The HANDBOOK has been in course of preparation for more than a year, but it could not be completed until after the FCC released the new frequency allocations and rules last May.

Now, thanks to the efforts of 17 engineering specialists who have cooperated in preparing the text, the MOBILE RADIO HANDBOOK presents complete and completely up-to-date information.

Written as a working text, this book contains practical, straightforward answers to problems encountered in all phases of mobile radio planning and operation. It is intended for use by company executives and public officials concerned with the use of mobile radio, as well as for engineers, systems supervisors, operators, and maintenance men.

It is a big book, 8³/₄ by 11¹/₂ ins., with easy-to-read type, profusely illustrated with photographs and drawings, and handsomely printed on fine paper.

CONTENTS

1. THEORY: A non-mathematical explanation of FM transmission and reception and the advantages of FM over AM.

2. MOBILE INSTALLATIONS: Details of the newest transmitters; standard and adjacent-channel receivers; portables; railroad equipment; methods of installation; power supplies; charging generators.

3. FIXED INSTALLATIONS: Transmitters; receivers; remote controls; typical systems plans; operation.

4. ANTENNAS AND TOWERS: Transmitting and receiving antennas; directional and special antennas; erection of a typical tower.

5. POINT-TO-POINT SYSTEMS: Types of systems and applications; transmitters, receivers, antennas; multiplex operation.

6. OPERATION: Operator requirements; maintenance and testing.

7. FCC REGULATIONS: Quick-reference information on common carrier, safety, industrial, and transportation services, showing qualifications, frequencies, and technical requirements.

FM-TV

Box 600B, Great Barrington, Mass.

Please enter my order for a copy of the MOBILE RADIO HANDBOOK, for which my remittance is enclosed:

\$2.00 Paper Bound Volume \$4.00 Cloth Bound Volume

Name	
Street	
City	State



tained antenna and LINK RADIO COAXIAL ANTENNA TYPE LCA and 25 feet of RG-58U cable\$49.50

The ANSWER To YOUR MONITORING PROBLEMS!

The LINK VHF MONITORING RECEIVER TYPE 2605 is designed to receive frequency modulated signals in the radio communications band of from 152 to 162 megacycles.

Designed along commercial radio receiver lines with continuous tuning, this new LINK unit has been manufactured primarily for use as a table model in the home or office of those persons actively engaged in the taxi, utility, emergency and similar services. Calls of stations operating in the 152 to 162 megacycle band can be monitored through the use of this high performance receiver.

As shipped, the receiver is ready for operation, it only being necessary to plug in the power cord and attach the antenna. This new unit can be used with either the inside antenna shipped with the set, or an outside antenna, provided at a slight additional cost. The LINK RADIO COAXIAL ANTENNA TYPE LCA, as shown above, is used where an outside antenna is required.

For further information, write to the Sales Department of Link Radio Corporation.

