THEME AND VARIATIONS*

Andante con moto.

*OR ALL ABOUT FM ANTENNAE AND THEIR INSTALLATION

By L. F. B. CARINI

THIRTY-FIVE CENTS

ALL ABOUT FM ANTENNAE and THEIR INSTALLATION

INCLUDING FM STATION DIRECTORY

by

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"HOW" TO DO YOUR OWN ELECTRICAL SERVICING"

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— PREFACE —

A non-technical monograph prepared especially for the enlightenment of the high fidelity listener in the interest of providing a better understanding of FM reception for music appreciation. The fundamental considerations for improving and obtaining optimum results with an FM tuner are carefully reviewed for the various conditions of reception. A general knowledge of this important but neglected subject is to be regarded as conducive to the attainment of greater satisfaction in the realistic reproduction of FM broadcasts.

L. F. B. C.

Getting The Most From Your FM Tuner

It goes without saying that most hi-fi enthusiasts and serious music lovers exercise pre-eminent care and consideration in selecting their equipment and records in order to be assured of the finest in reproduction; yet practically everyone, with the exception of local and metropolitan listeners located near FM stations, fail to realize the importance of employing a proper antenna system.

Today many of us can enjoy excellent musical programs as broadcast from numerous "good music stations". More and more of the FM stations are improving their repertoire to provide a finer diversification of music appreciation. One need no longer depend upon a few local stations as has been the practice in the past when FM was limited to reception of just several stations. Indeed, why should you limit the capabilities of your tuner to local listening, when the installation of a good FM antenna would enable you to listen to many other good music stations if your tuner were given a chance to really perform as it should?

Why An FM Antenna?

Some music lovers are fortunate to be located within easy reception distance of, say, WQXR-FM or other comparable good music stations, and as a rule many listeners who are within 50 miles of an FM station usually experience little trouble with normal reception. However, there are more and more hi-fi installations being made beyond the primary listening zone, in remote areas now being referred to as the fringe perimeters. It is in such locations that it is especially important that every bit (microvolt) of signal shall be collected and delivered to the tuner in order to receive a station. The degree of listenability resulting is principally the function of three basic factors; (a) signal strength, (b) tuner sensitivity, and (c) an adequate FM antenna. Invariably, *it follows that regardless of the type of tuner used, a good high gain antenna will improve the existing reception.* Bear in mind, however, that a tuner cannot yield what it does not receive in the first place. Even a weak signal, if hardly perceptible at all, may not be capable of properly operating the limiter of the finest tuner made. The logical solution is to deliver a greater input signal strength to the tuner. This service is essentially what a good antenna system should contribute.

What Constitutes A Good FM Antenna

Ordinarily the usual FM antenna takes the form of a five feet length of ribbon wire ("T" formed) placed under the rug and connected to the tuner input terminals. Sometimes the antenna is mounted outside, such as on the roof-top, and consists of a simple aluminum configuration not unlike those used for television. These forms are usually of the elementary type, known as a folded dipole, Fig. 1, and are considered adequate only for local reception. Inasmuch as the reception of local stations therefore presents no difficult problem, let us concern ourselves with FM reception over greater distances and, in particular, fringe reception over distances in excess of 60 miles. Increasing the distance coverage will automatically provide a greater diversification of programs resulting from the additional FM stations that you will be able to pick-up. Thus, a high gain antenna offers greater collective capacity for delivering a much stronger signal than any elementary type. This special propensity is a requisite for distant reception and, indeed, it will reveal the latent merits of the tuner in realizing its full sensitivity. So astonishing can be this improvement, that the tuner will appear to be outperforming itself in the seemingly unusual ability to pick-up stations never thought to be within listening range before.

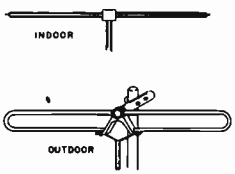


Fig. 1

Desirable Characteristics Of FM Antennae

Like any other component comprising your high fidelity equipment, an antenna may have inherent design characteristics that emphasize either desirable or unfavorable features. In evaluating the merits of an antenna, therefore, due considerations should be given to each of the following:

Frequency Coverage

Most antennae are designed to provide a nominal coverage of the FM band, i.e., 88 to 108 megacycles. Like an amplifier or speaker, the degree of coverage over the inclusive frequency range should be normalized to provide good broadband response at a *uniform signal level.* Too many of the so-called broadband antennae now offered are the result of poor engineering design and give their optimum sensitivity in only a portion of the 20 mc. band so that severe signal attenuation may result at either upper or lower section of the FM band. Their gain is concentrated at one point and give peak performance only over a relatively narrow band. This is particularly true of the ribbon dipole which is resonant to the center of the band and other antennae of poor design as shown in Fig. 2.

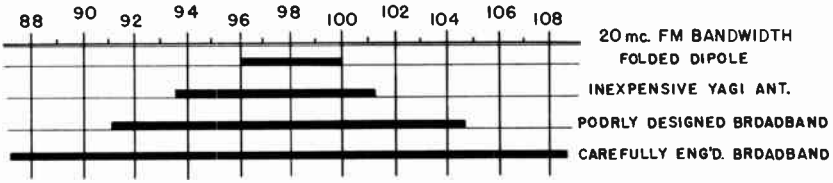


Fig. 2

Other designs usually known as single driven yagi, have a contracted frequency coverage of only four or five megacycles wide. Such an antenna is employed where reception is limited to only one or several stations, all of which have frequencies within the narrow band of a few megacycles, say 88 to 93 or 98 to 103 mc.

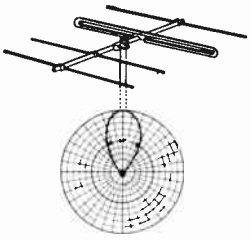


Fig. 3

Usually when only one FM station frequency is desired, a single channel yagi, Fig. 3, may be used in order to obtain optimum gain and greatest sensitivity. For example many music lovers listen only to a favorite station, such as WQXR-FM on 96.3 mc., while employing a crystal controlled or single frequency tuner. For such exacting requirements, we design a single frequency antenna to provide maximum response for the specified frequency only.

Gain and Sensitivity

The performance of an antenna is usually adjudged on the basis of these several characteristics. Among the inherent qualities, gain or sensitivity is indeed a salient merit; the more gain (in db.) it has (up to a certain point) the stronger will be its signal pick-up and yield to the tuner. Obviously, this degree of efficiency at the proper frequency is very important for long distance fringe reception.

The above statement, however, implies a certain qualifying aspect in its true interpretation. Just as automobile manufacturers feature maximum horsepower ratings in establishing the prowess of their engines, some antenna manufacturers do likewise, but the important consideration is in accepting an honest evaluation of *gain for overall performance* and not only for certain "peak" frequencies. This is what some manufacturers offer as grossly exaggerated gain figures used only to decieve the public.

Front-to-back Response

There are a variety of types of antenna designs, some of which are better than others for a specific characteristic, but the one perfect design that affords all of these attributes is yet to evolve in the future.

For greatest diversity of reception, an antenna should receive stations equally well in any direction. This objective is accomplished in one of two manners; (a) with a crossed dipole having omni-directional signal response or, (b) with a broadband uni-directional antenna controlled with a rotator. See Fig. 4.

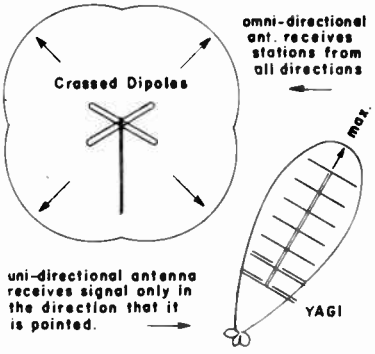


Fig. 4

The former is an elementary type antenna and because of its relatively low gain can serve only for local FM service. However, since signals are received with equal ease in any direction, it is not possible to discriminate between one of two close or adjacent frequencies without some degree of station interference due to the lack of preselection.

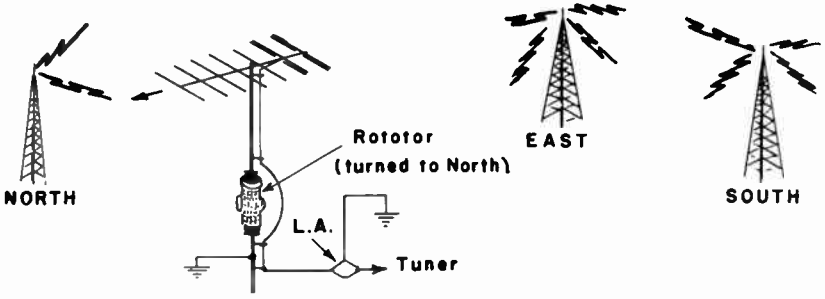


Fig. 5

With a uni-directional antenna and rotator, it is possible to revolve the antenna about a 360° azimuth and because its sense of directivity is very sharp, a station located towards the north can be favored in preference to a station whose location is to the south, notwithstanding the fact that these two stations may occupy adjacent frequencies and be equally distant from the tuner. See Fig. 5. Such an antenna, obviously, has very desirable characteristics in that it can be beamed like a search light to afford excellent exclusion of unwanted signals and a maximum rejection of pickup from the sides and the rear. Thus the ratio of forward pick-up to that at the rear is expressed as the antenna's *"front-to-back" ratio*. A high F/B ratio is highly desirable and advantageous in long distance reception and is recommended for any other location where maximum rejection of spurious or noise signals is desired for the suppression of interference. Fig. 6 illustrates this characteristic of the yagi antenna.

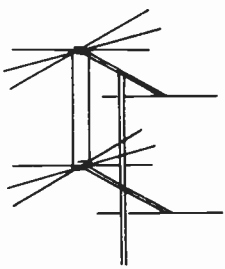
Fig. 6

Choosing The Correct Antenna For Your Installation

Tuner manufacturers usually furnish a folded dipole, Fig. 1, constructed of ribbon wire in "T" form, which serves as a simple antenna of the most elementary type. In terms of gain, F/B, etc., it leaves much to be desired although it is satisfactory for metropolitan service. Considered as a reference standard for comparison, its gain is 0 db.

Its equivalent in aluminum as constructed for outdoor installation may offer some slight degree of improvement and only if mounted at higher roof-top elevations. The pick-up response pattern is bi-directional as a figure 8 and is varied only when produced as a *crossed dipole*. Fig. 4, in which form it evolves as a broad cloverleaf configuration. Gain is still 0 db.

While singularly popular for television reception, some TV antennae of the conical design, Fig. 7, have also been adapted for FM. Fundamentally, the conical is a very broadband type of antenna and because it covers the VHF TV band 2 to 13, it will also serve for the FM frequencies which, of course, fall in between channels 6 and 7 of the TV band. The conical is better adapted for TV than FM because its gain, F/B and response pattern do not afford the desired performance demand by the more closely spaced FM stations. Its F/B is poor, propensity for noise pick-up is regarded as especially bad for FM, and there is considerable wind resistance due to the large frontal area presented in its structural configuration. Gain is 3 db.



CONICAL ARRAY

Fig. 7

The Yagi Antenna

For optimum performance where reception is difficult, either because of long distance, co-frequency or noise interference, the yagi design has no practical equivalent. A good rugged yagi of superior engineering design can provide more of the desirable attributes that are sought for in an FM antenna than all others combined.

Essentially, the basic yagi consists of a folded dipole, a director (forward) and a reflector at the rear of the dipole as shown in Fig. 8. For the FM band, the standard yagi would normally consist of five elements mounted upon a supporting boom. The folded dipole is the terminal element to which the lead-in or transmission line is attached. The reflector at the rear serves as a shield to reject unwanted signal pick-up from the back while the three director elements mounted ahead of the dipole serve as collectors to focus the signal that is directed to the dipole. Gain is 5 to 7 db. with an average frequency coverage of 4 to 6 mc. bandwidth.

As the basic yagi will cover an average 5 mc. band width, a total of four such antenna would necessarily be required to provide full frequency coverage of the complete FM band of 20 megacycles. Since each yagi would have a specific range of its own, such as 88-94, 94-99, 99-104, 104-108 mc., the

installation would necessitate a four bay array if superposed upon a common mast. Such yagi types are desirable only where a small antenna is to be used and where reception is confined to that portion of the band covered by the particular antenna.

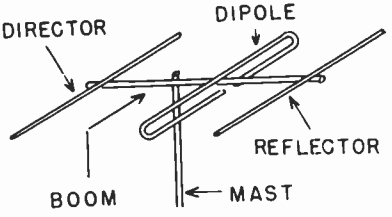


Fig. 8

The Broadband Multi-element Yagi

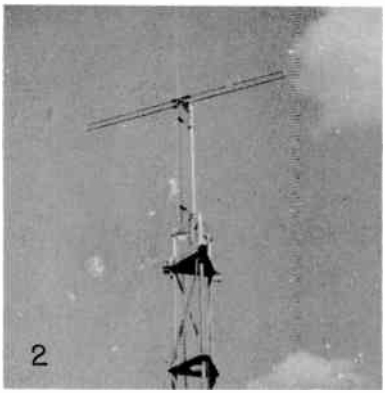
A more ideal antenna to employ is the broadband yagi which is designed for an extended frequency bandwidth. This development is a hybrid version of the basic type and has appeared in various forms, generally distinguished by the use of two dipoles and many more additional director elements. A broadband yagi can be designed to cover the complete FM band without impairing any of the special virtues of the basic type. Some accomplish this feat efficiently and others do not. Given the prime engineering parameters, the solution of the problem is fundamentally one of determining what is the best element size to employ, their optimum spacing, and exactly how many shall be integrated into the overall design. Many varied configurations will necessarily result. However, by knowingly proportioning the dipoles and elements, one outstanding prototype will evolve that is collectively representative of the optimum criteria that has been sought as the ideal objective. Among the various types of antenna now in use, the "FM/Q" design is without reservation the finest broadband yagi available today.

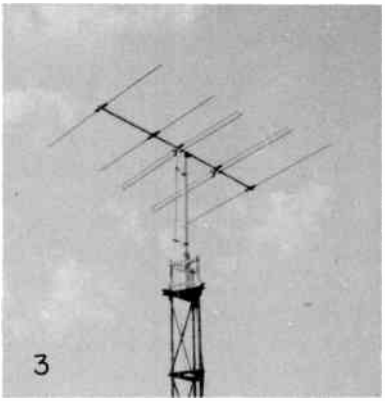
Cognizant engineers have acclaimed it as indisputably offering the very best of engineering features in both electrical and mechanical development. This antenna was perfected by FM engineers after extensive research and tests with actual conditions of reception in locations presenting the most challenging problems. It is recommended as representative of every desirable attribute that a good FM antenna should possess and is endorsed by all of the prominent tuner designers as unsurpassed for top performance.

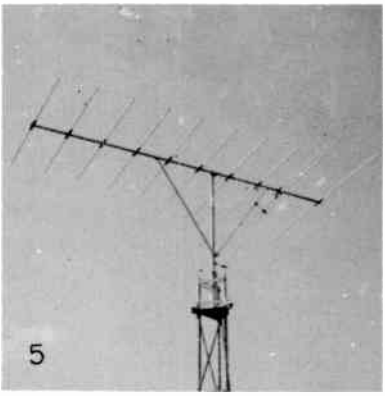
Antenna For Fringe Reception

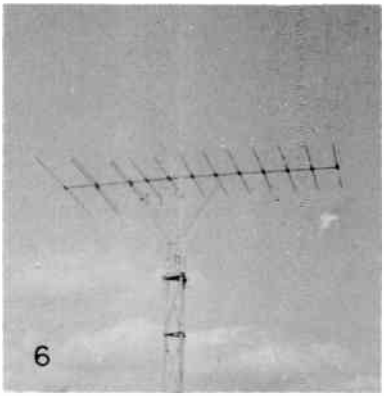
Many tuners today offer excellent sensitivity and are naturally preferred for fringe reception. For distances in excess of 100 miles from an FM station, the tuner should have a sensitivity of at least 3 microvolts for 20 db. of quieting, or better. The less the μv and the more the db. rating, the greater is the sensitivity of the tuner. It follows then, that the antenna should likewise possess equally superior features as it will be necessary to employ a high gain yagi in order to obtain the most signal strength.

In hilly terrain where there is rough topography between tuner and station, a single antenna may not deliver sufficient signal despite the excellence in



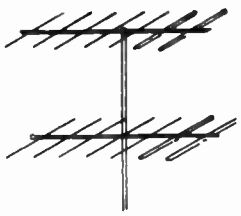






1. Alford loop, omni-directional, for primary regional reception.
2. Folded dipole, bi-directional, 0 db. gain, for local reception. (FM/Q Cub)
3. Broadband 5 element yagi, 6 db. gain, for reception to 75 miles. (FM/Q Jr.)
4. Broadband 7 element yagi, 9 db. gain, for reception to 140 miles.
5. Single frequency or narrow band yagi, 12 db. gain, for selective reception or fringe service. (FM/Q LR)
6. Very high gain 12 element broadband yagi for extreme fringe. 14 db. gain single, may be stacked to yield extra 3 db. to produce most powerful FM antenna array available. FM/Q

choice of equipment used. In such locations, the usual resort taken is to "stack" several bays of antennae together as in Fig. 10. Either two (or as many as four) antennae may be interconnected together with a parallel wiring arrangement known as a "harness" to obtain an increase of gain. Each antenna (bay) is superimposed upon a common mast and spaced ¾ or ½ wavelength apart for best performance. A common connection of the harness (or stacking bars) ensures the correct terminal impedence of 300 ohms for direct attachment to the transmission line and then to the tuner input. Where a single antenna, such as the "FM/Q" Sr. model yields an honest gain of 9 db., a two bay stacked array will deliver an additional gain of from 35 to 41% more signal. Such an installation would then provide the equivalent gain that could otherwise be obtained only by stacking four five element standard type yagi.



STACKED YAGI
Fig. 10

Double stacked "FM/Q" yagi will normally fulfill all of the challenging requirements for long distance reception of upwards of 250 miles when employed with a sensitive tuner and an approved antenna system. One should bear in mind that even the best tuner and the best antenna, such as the "FM/Q" Sr., may result in disappointment unless careful attention is also directed to the proper installation of the entire antenna system. The antenna system consists not merely of the antenna itself, but in addition, it includes the transmission line, (lead-in), insulators and method of installation to the tuner. Essential considerations that will determine the ultimate results obtained therefore call for a special regard of the following:

Impedance Matching

All FM tuners have a standard nominal input of 300 ohms corresponding to the equivalent terminal impedance of most antennae and related accessories. A few of the better tuner circuits also have an alternate input of 72 ohms for use with co-axial line. The importance of maintaining compatible impedance relations in the system should not be overlooked as any disparity between these circuits will create an electrical mismatch which results in an attenuation of signal. This condition is analagous to a pipeline made by coupling a ½ inch diameter pipe to a 1 inch size and expecting to obtain the rated water output which the larger size is capable of delivering. While a variation of from 250 to 375 ohms exists in the impedance of many antenna types, the variance is less important here than when introduced in the antenna system between the tuner and the antenna proper. Because it is so easy to loose much of an elusive signal through mismatches after it is delivered by the antenna, it behooves us to pay particular care in installing an antenna system that is to serve for fringe reception.

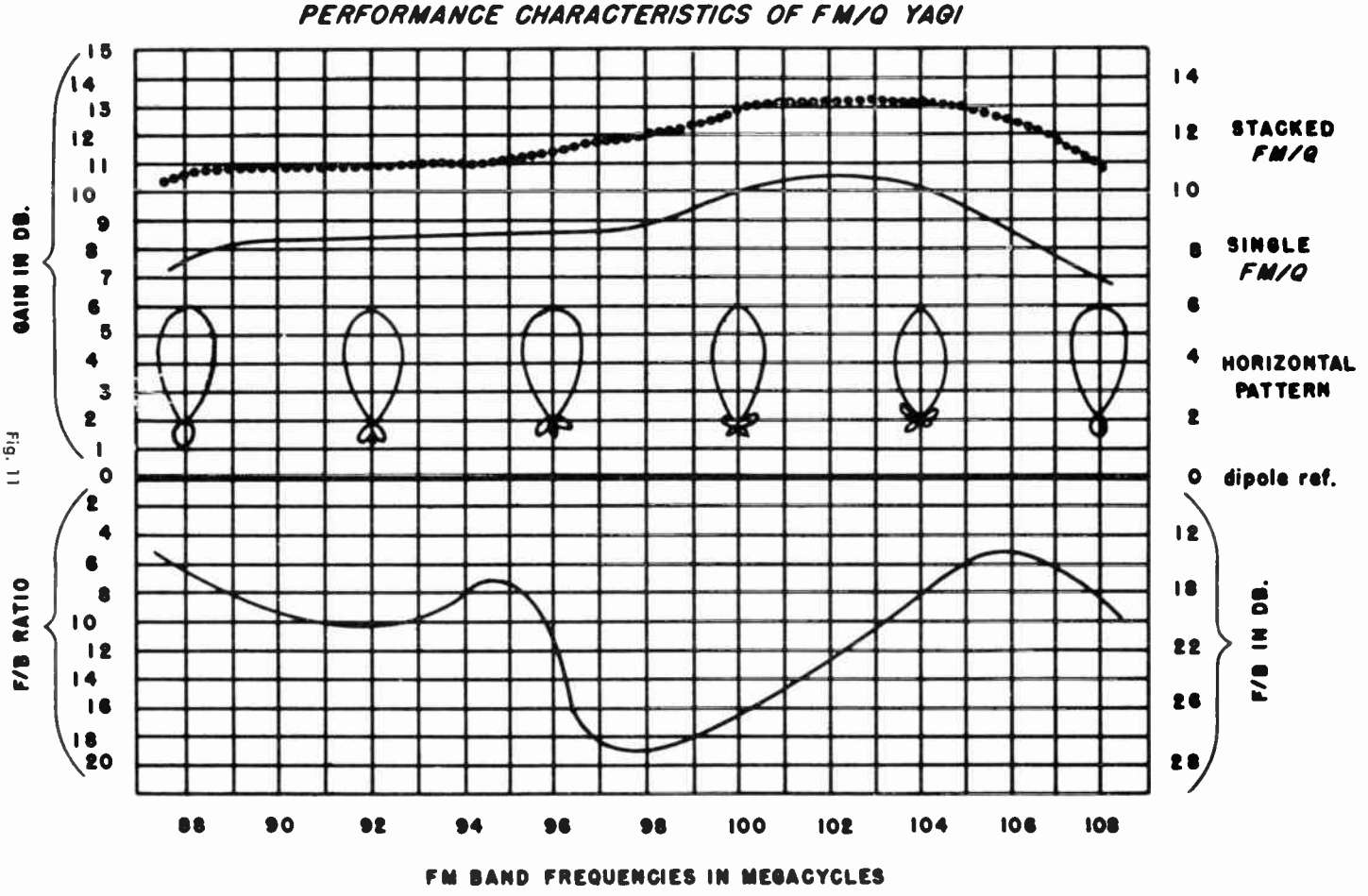


Fig. 11

The Transmission Line

Ordinarily, the common lines such as employed with TV antenna will suffice for most FM installations. Among the numerous types in use, Fig. 12, some offer less losses than others and are preferred because of their special merits, particularly for fringe service where insertion loss must be reduced to a minimum. A reference to the accompanying chart will disclose that there is a great variation according to type. Note also the detrimental losses introduced when a line becomes wet due to rain, snow or ice.

Several noteworthy rules to practice include:

1. Suspend the line over a roof so as to prevent contact with shingle in order to minimize leakage of signal.
2. Whenever possible run the line in a vertical path with minimum horizontal traverse. Noise pick-up is far less in a vertically transported line than in a horizontally strung lead-in.
3. Never coil an unused portion of the line at the tuner.

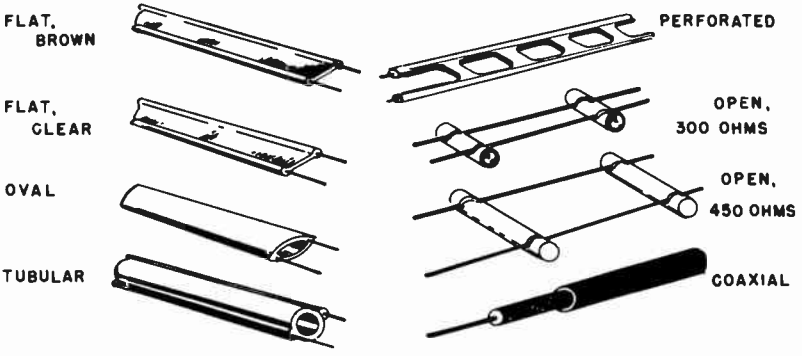


Fig. 12

Standard 300 ohm flat ribbon line (TV type) is available in either clear or dark brown color, the former to be used for indoors and the latter is made especially for outdoor service. These lines employ polyethylene insulation and despite the pigmentation added, their average service life is seldom more than 20 months due to ultra-violet solar depreciation which induces progressive losses in the insulation. Accordingly, it is recommended that poly type lines should be replaced at least every two years to ensure good signal strength at all times. Variations of the standard, such as the perforated and the silicone coated (a film easily applied over the surface) lines are better; however, the lowest losses are to be realized only when open wire line is chosen. For general usage, silicone is highly endorsed as an excellent preservative for the entire antenna system.

Insertion Loss Of Lines In DB. Per 100 Ft. at 100 MC.

Type	*Dry*	*Wet*	*Impedance*	*Remarks*
Co-axial, RG-59/U	3.7	3.7	72	Shielded cable, small
Co-axial, RG-11/U	2.2	2.2	72	Shielded cable, medium
Co-axial, JT-200S	0.92	0.92	72	Shielded cable, large
shielded twin lead	3.4		300	balanced line
flat ribbon, brown	1.6	7.3	300	polyethlyene insulation
oval, air core	1.3	4.8	300	polyethlyene insulation
tubular, air core	1.2	2.5	300	polyethlyene insulation
flat ribbon, clear	1.1		300	for indoors only
perforated flat	0.7		300	punched ribbon
open wire	0.3		300	5/16 inch spacing
open wire	0.3		450	1 inch spacing

Open Wire Line

Open wire line has the lowest loss providing the best signal path for either fringe or other installations where the antenna must be located more than 100 feet away from the tuner. As illustrated, this line consists of parallel exposed wires equidistantly separated by a polystyrene insulator. The spacing of the wires determines the line impedance. For lines from 150 to 500 feet, the 300 ohm size is recommended; however, the wider spaced 450 ohm line is preferred for distances of from 500 to 1,000 feet as it is less susceptible to retaining formations of snow and ice. Open wire line is also advised for coastal locations where saline deposition is inescapable and causes serious signal depreciation. Of course, the use of either type of open wire line implies that proper impedance matching shall be provided to tuner and antenna terminations. Fig. 13 shows how this may be accomplished within the line itself. Copperweld wire, which has the equivalent electrical conductivity as the annealed copper conductor, is preferred in any open wire line as it affords greater tensile strength and less expansion, thereby enabling the use of fewer pole supports throughout the suspended length. Open wire line naturally demands a greater care in installation because it is not as flex-

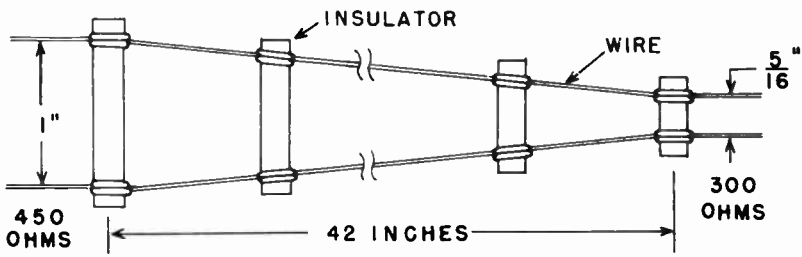


Fig. 13

ible as flat ribbon lead and can easily kink if improperly handled. It is held away from buildings by special all-plastic retainers (or standoff insulators) designed especially for low loss support. When bypassing a rotator, a 'flexoff" insulator, Fig. 14, should be employed to prevent contact and short circuiting the wires to the rotor or mast. This device is helpful with any type of transmission line as it prevents the loss of signal whenever the rotor turns and wraps the line about the mast.

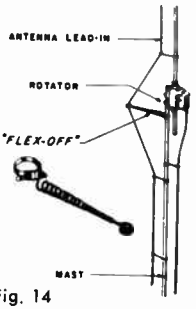


Fig. 14

The Lightning Arrestor And Ground

Inasmuch as the antenna is normally erected in an unobstructed area, usually at roof top elevation, the supporting mast must be grounded for protection against lightning. It is recommended that No. 6 or 8 aluminum wire shall be employed in effecting a good contact connection between the mast and the earth.

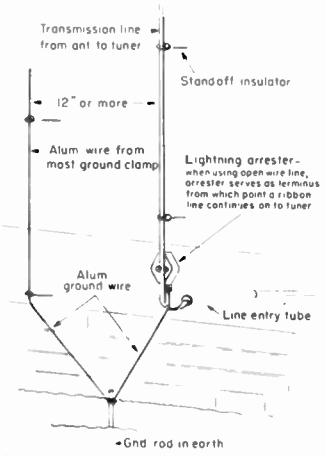


Fig. 15

This wire may be run directly to a 5 or 6 ft. rod driven into the earth near the building foundation. Thus, if lightning strikes the antenna, the discharge will be carried safely and dissipated to ground.

Additionally, an approved UL type of lightning arrestor must be attached to the transmission line for the purpose of dissipating electro-static charges that accumulate upon the antenna. Static charges are collected by the antenna with the passage of clouds, wind and snowfall. As a result static charges are concentrated within the antenna system and must be dissipated and neutralized with the ground potential. A lightning arrestor accomplishes this by by-passing the charge to the earth before it continues on to the tuner circuit where it would eventually result in component breakdown.

The Truth About Chimneys

While the chimney affords a simple and convenient support for mounting an antenna, it is nevertheless the worst possible location for the FM antenna. Such installations are a condemnable practice and should not be permitted in the interest perpetuating good reception.

An antenna should never be mounted upon an active chimney. The smoke and fumes discharged are detrimental in the manner that they attack the insulators, line and the very metal itself to induce rapid deterioration of the complete assembly. It is significant to recall that resistances are basically of carbon composition and smoke is essentially carbonaceous. To apply a resistance coating to the antenna, particularly the insulators, is comparable to effecting a high resistance short circuit and by-passing the signal to ground.

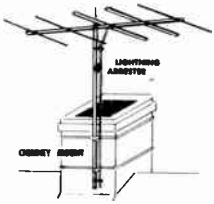


Fig. 16

Attic Antenna Installations

Some listeners prefer to install the antenna in the attic of their home. While such an installation will give satisfactory results for primary and regional service, it is not recommended for fringe reception. As compared to the usual outdoor mounting, the attic antenna may operate at a loss of from 10 to 30 percent of its rated efficiency. However, mounting the antenna in the attic simplifies installation and offers desirable protection but there are environmental influences which may seriously affect reception and these should be duly considered before deciding on such an installation.

If the antenna is to be installed in the attic, a stationary mounting is easily made by suspending the yagi in free space using a strong string (do not use wire) and positioning the antenna so that it points in the direction of the principal stations to be received. Where the antenna is to be orientated, the rotator mast may be suspended from the overhead rafter and allowing enough clearance to accommodate the turning radius of the antenna. Avoid placing the antenna near to electrical wiring and never point it towards the standpipe or any other metal object. Homes with metal roofs or where aluminum foil is used for insulation under the shingles should not contain attic installations as the shielding thus provided will seriously impair reception. There are also other influences which can affect the reception when using an attic antenna and these may be observed when the roof is wet (particularly slate roofs) or when covered with snow or with reflective aluminum paint.

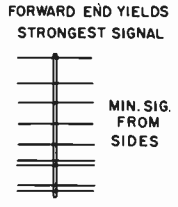


Fig. 17

Advantages of a Rotator

A uni-directional antenna operates best when it can be properly orientated and beamed directly to the source of signal broadcast. Any degree of rotation for exact antenna positioning is easily accomplished with a rotator. The device is mounted on the mast, supports the antenna, and is remotely controlled by the listener at the tuner. Inasmuch as a good FM antenna has a sharp directional pattern, the advan-

tage of being able to turn it in any direction enables the listener to not only obtain the best pick up of signal, but also to search for elusive stations. The much improved performance means that this added feature of operational control can be used to augment the tuner in providing for better selectivity. Thus, by careful positioning of the antenna, certain stations may be more easily segregated to the exclusion or satisfactory suppression of others since the antenna receives signals best in its forward plane.

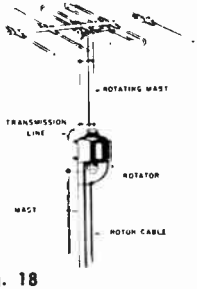


Fig. 18

The inclusion of a rotator should be considered as essential with every high gain broadband installation. This provision is indispensable for fringe reception and also for 72 ohm installations using high gain broadband yagi. With coaxial line, there is no spurious signal pick up in the lead-in and because the antenna will exhibit its true performance characteristics as interceptor, a rotator is necessary for proper orientation.

For FM, the manually controlled models of rotator are preferred to the automatic type. The latter do not index at sufficiently close intervals as required for precise positioning of the antenna and cannot be jogged as may sometimes be necessary. Where stations can be picked up at all points of the compass, the rotator is a definite aid to tuning as it can effectively improve signal strength, reduce adjacent and co-frequency interference, minimize distortion and enhance tuner selectivity.

Mounting FM and TV Antennae

For practical reasons, it is sometimes desirable to install both FM and TV antennae on the same mast. If this type of installation is contemplated, a separation of at least one quarter wavelength (24 to 30 inches) should be allowed for spacing between them in order to prevent electrical interaction. Usually the larger antenna is at the bottom; however, for fringe reception, the FM antenna should be mounted in the most favorable position at the top. Individual transmission lines for the lead-in should always be installed for the respective antennae. Arrange the lines so that they are on opposite sides of the mast, or to be as far apart as practical and thereafter separate them by increasing the distance to 12 inches or more. Under no condition should these antennae be connected together with a common coupling device to provide for a single lead-in as cross channel interference will result.

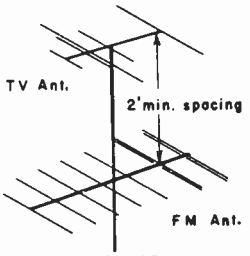


Fig. 19

TV Antenna for FM?

For the sake of convenience, some listeners would also use their TV antenna for alternate FM reception. Good reception of FM stations cannot be expected when a TV antenna is employed as a compromise for both services.

Because TV antennae are especially designed to give the best sound and picture resolution on the specific TV channels, their gain response for the FM band is purposely suppressed to minimize interference. Poor response on FM with a TV antenna is therefore an inherent characteristic, otherwise the FM stations would also be equally well received and there would be a serious source of picture interference as a result. As the FM band is between TV channels 6 and 7, the obvious necessity for a frequency hiatus at this point conforms with good design practice for TV antennae. Accordingly, while the TV antenna may suffice for local FM reception, it will never give the comparable performance delivered by an antenna that is designed especially for FM.

Two Set Couplers

Two set couplers are not recommended as an accomodation for multiple tuner operation unless FM reception from the one available antenna is limited to local stations. It should be noted that the insertion loss as imposed by the use of a coupler is approximately 3 db. This loss is equal to the gain that is obtained by stacking and it is a high sacrifice of signal that can thoughtlessly be lost to such inconsiderate improvisations. If a two set coupler must be employed, first install a high gain antenna that is capable of delivering enough signal to service more than one tuner.

Local-Distant Reception

Many urban installations have one or more local stations which provide programs in addition to other more distant sources of broadcast. The installation is best made using a high gain yagi for the distant objectives, notwithstanding the fact that a folded dipole would easily suffice for the local service.

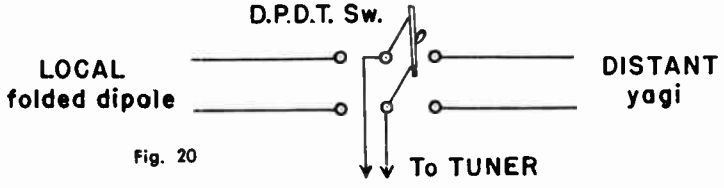


Fig. 20

A compromise calls for the use of an antenna transfer switch which is installed behind the tuner to change over from the dipole to yagi according to station demand. The switch eliminates possible overloading of the tuner on local stations were the yagi is to be used alone.

FM Reception In Cities

Perhaps the most trying situations in obtaining good reception with FM is to be experienced in cities. Aside from the restrictions on the type of antenna that may be installed, reception may suffer from structural barriers, noise, spurious images and an unfavorable signal-to-noise level. All this is true, notwithstanding that the transmitting antenna may be only several miles away. A solution to these disspiriting problems is not easily offered because the situation is indigenous to the surrounding environment. Unfortunately, FM is influenced by buildings to the extent that they cause an obstruction, reflection or absorption of the signal. This coupled with the fact that in most instances it is only possible to employ an indoor folded dipole is indeed a discouraging matter.

Many apartments are provided with a master TV antenna system and because of restrictions, this outlet is usually the only facility available for FM reception. Such installations will not give satisfactory FM performance as being designed especially for TV service, they include a filter which suppresses the FM frequencies in order to eliminate possible TV picture interference.

The obvious remedy is, of course, to install a roof top antenna. However, where restrictions do not allow its use, the next best alternative is to place the dipole at the window. Too frequently, ribbon dipoles are placed under the rug, along an inside wall or tacked behind a cabinet. These are all poor locations and contribute to a worsening of the condition under the circumstances.

Distortion and Multipath Reception,

FM distortion is a common complaint wherever the antenna, in addition to the direct signal received, also intercepts secondary signals that are being picked up as reflections. This form of distortion is similar to and may be compared with the phenomena of "ghosts" as observed on many TV sets. Because one of these signals is a reflection and therefore arrives slightly later than the direct transmission, a time lag occurs between them that is of sufficient delay to result in distorted reproduction.

The condition is most prevalent in cities where reflected signals abound but may also be encountered in mountainous regions. FM distortion due to multipath reception can be expected with the use of any of the omni-directional types of antennae such as the folded dipole, crossed dipole and conicals. Their lack of directional pick up, makes them susceptible to spurious signals and when used with conventional ribbon line, such distortion is inevitable.

The uni-directional antenna (yagi), however, offers a solution as its forward response and high order of F/B discrimination may be used advantageously

for directive signal interception while minimizing the pick up of reflections arriving at the sides and rear. Also, the use of such an antenna predicates the utilization of shielded coaxial cable as a necessary provision to prevent the infiltration of secondary signals in the line.

For city reception, a high gain yagi, equipped with an attenuation pad and the coaxial line to tuner will effectively correct the problem provided that the installation is made in an approved manner at roof top elevation or in an area free from immediate obstructions.

The 72 Ohm Co-axial Antenna System

Several FM tuners of the better type are equipped with an alternate 72 ohm antenna input. Such tuners are particularly desirable for service in locations where an abnormal noise environment exists as created by either automotive ignition or other electrical equipment. Obviously, a sensitive tuner cannot escape noise pickup and be expected to discriminate between good music and man made interference. For relief, any degree of noise suppression is desirable and assuming that the tuner is adequately well shielded, the rest of the problem is largely dependent upon; (a) type and location of antenna, (b) transmission line employed, (c) nature of noise generator. Some antenae, such as the common dipoles, have poor response patterns that are inherent in their design and afford no directive discrimination for sensitivity. A good yagi, such as the "FM/Q", which has a minimum vertical pick-up and pronounced directivity in the forward plane (like a light beam), will exclude much of the surface pick-up which is where the majority of noises originate. The most troublesome interference is that produced by autos, electrical utility lines and appliances (as in Fig. 21); all of which are usually found near the ground surface level. In other words, *by locating the proper antenna high enough so as to be above the source of noise, much of the interference can be eliminated or effectively reduced.* However, since the transmission line is also a part of the antenna system, the special shielded line known as co-axial cable (type RG-59/U) is employed. Co-axial line will not absorb noise voltages and is ideal for this purpose. Due to the capacitive effect introduced by the close proximity of the braided shield and the center wire conductor, co-axial line has more loss than the unshielded lines. This relatively greater insertion loss of the shielded line results in considerable signal attenuation which explains why (despite the apparent added sensitivity shown by tuner manufacturer's specifications) there is little difference in the relative signal strength obtained when delivered to the tuner input through either a 72 or 300 ohm system.

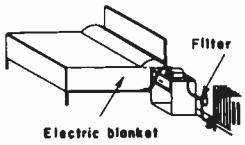


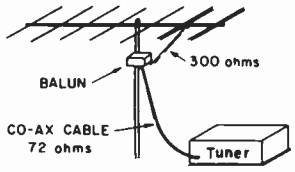
Fig. 21

The 72 Ohm Installation

The 72 ohm system is recommended as a solution to two prevalent complaints as experienced with installations in city and suburban areas;

(a) for suppression of noise and interference

(b) for alleviating signal dominance from a nearby station



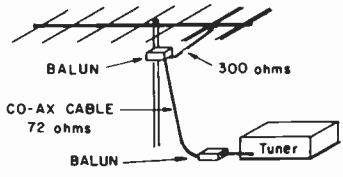
Co-ax system for 72 ohm tuner input.

Fig. 22

Its installation may be made with any standard FM antenna while using either of two popular types of co-axial cable, RG-59/U or RG-11/U. For a line length of 100 feet or less, use the former and for lines of greater length use the latter type which has less attenuation loss.

The standard 300 ohm antenna is adapted to this system by employing a balun which is an impedance matching transformer designed to effect a low-loss coupling between 300 and 72 ohms or vice versa. An outdoor type balun is mounted on the mast, below the antenna, and to which the co-axial cable is connected and run to the tuner. If the FM tuner has a 72 ohm input, a direct connection can be made using the proper fitting. Where there is no 72 ohm input, an indoor type balun must be employed to reconvert the cable impedance back to 300 ohms in order to match the standard tuner input. The successful operation of the system is dependent upon the location of the antenna, use of a low-loss balun and good weatherproof cable connections.

Because unshielded transmission line readily picks up a signal as additional to the antenna, too much signal delivery to a tuner can result in overloading. This is an existing problem near to FM stations and the 72 ohm system is therefore desirable in strong signal areas to limit signal interception to the antenna so that the usuable signal can be controlled.



Co-ax system for 300 ohm tuner input.

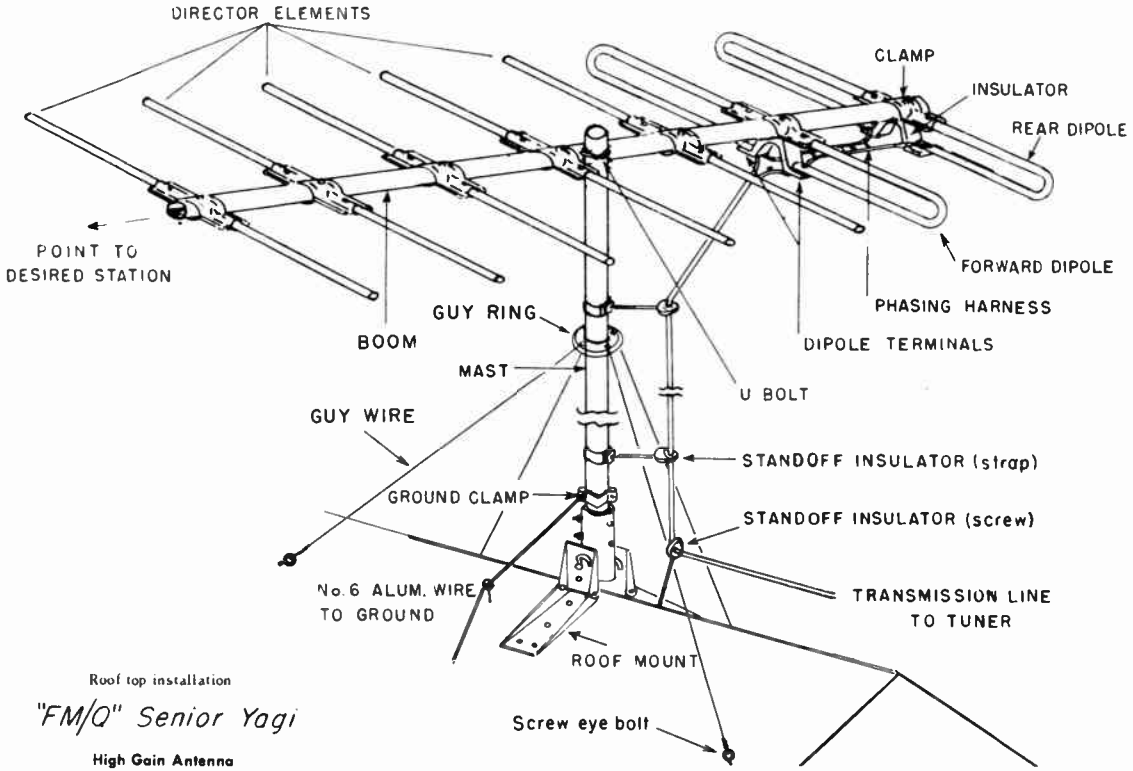
Fig. 23

Fringe Area Reception

Good music is contagious to many people and we find that there are golden ears located at remote distances striving to catch the elusive signal of a station that is beyond the normal limits of reception.

Fig. 24

To those who would overcome this obstacle of distance, my advice is necessarily tempered by the type of tuner selected or already in use. However, *it is always better to obtain maximum signal strength through the use of stacked yagi* than to resort to other ques-



Roof top installation

"FM/Q" Senior Yagi

High Gain Antenna

Fig. 25

For an installation where the antenna is to be orientated, a rotator is employed and is mounted on the mast where the guy ring is shown. The supporting guy ring wires are then attached directly to the anchoring lugs as provided on the rotor.

tionable expedients. Any gain that is achieved by the use of stacked antennae has less noise content than by voltage amplification through other alternatives. It is also prescribed that you employ half-wave spacing if at all possible for stacked arrays to realize optimum gain. Open wire line is a must and all the special precautions should be taken to keep losses at a minimum or to eliminate them entirely from the antenna system. Accordingly, avoid the use of standard TV standoff insulators and guard against running the transmission line either close to or in parallel to any other wire or metal surface, not, of course, excluding contact with foliage and roof surfaces.

Fig. 26

In some locations, such as hilly or mountainous terrain, the use of a mast or tower to gain elevation cannot be advocated as always advantageous. Often-times, the signal is found to be stronger near the ground than at 60 to 100 feet above. This surprising fact is true because the signal wave washes over the mountain Fig 24 and spills down along the sides or contours of the mountain. Probing and trial locations will frequently disclose the best spot where the antenna should be placed. Also, because a good yagi antenna posses a pronounced directivity pattern, it may even be necessary to try tilting the antenna so as to aim it over the ridge of the mountain. It is further suggested that the antenna should be carefully orientated around a full 360 degrees, all the time noting for the best position that gives the maximum signal. The best position indicated may not necessarily point toward the transmitter as it is possible to obtain a very strong signal as a reflection from another mountain as shown in Fig 26 Last, but not least, a pick-up antenna located on a mountain top can be made to direct or retransmit the intercepted signal down to the antenna proper at the tuner, each of which may be located at varying levels of altitude. At other times, prevailing weather conditions may also influence long distance reception as illustrated in Fig. 27 These are some of the uncertainties of long distance reception and indicate various approaches in the solution of the problem.

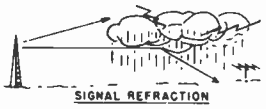


Fig. 27

Very Long Distance Reception

Aside from the important consideration noted in the preceding paragraphs, long distance FM reception implies the use of an antenna system that is designed for exceptionally high gain signal yield. A multi-element yagi, preferably installed as a stacked array and using low-loss line, will assure the most promising performance. It is not unusual, therefore, to anticipate reception over distances of from 200 to 500 miles when such a system is operated in conjunction with a tuner of relatively high sensitivity.

For consistent long distance reception, the considerate selection of a well designed FM tuner that is to be used in conjunction with a high gain stacked array is of equal importance. The tuner should offer a high order of sensitivity, good limiting and adequate IF amplification for a better than average performance. The array should be equipped to permit orientation using a rotator that is capable of supporting the load. A tilt-down type of tower is also highly recommended to facilitate installation, gain elevation and to lower the antenna in the event of impending storms which might cause extensive damage.

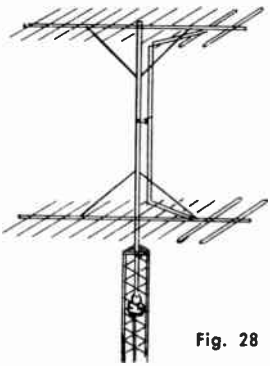


Fig. 28

Because long distance reception covers a range of considerable territorial extent, special regard should necessarily be allowed for the intervening and perimeter influences which affect propagation. A range that is interspersed with mountains and the variable weather conditions that are associated therewith, can seriously affect the signal delivery to account for fading, pulsing, etc. Experiments disclose that signal stability over extended distances is most favorably controlled when employing a multiplicity of elements with the antennae arranged in a stacked array. These ideals have been realized in special designs as recommended for such application. See page 7.

Antenna Booster or Preamplifier

Where a stacked antenna fails to bring in sufficient signal, the additional use of an approved FM preamplifier *may,* in some instances, further enhance the objective signal yield. Because FM boosters are of varied design, care should be exercised in appraising the claims made for them. Recently, there have appeared small antenna mounted units of dubious value and which leave much to be desired towards improving FM reception.

The well designed modern tuner, already possessing a high degree of sensitivity, will not benefit from the additional use of an auxiliary signal booster that is of inferior design to the tuner itself. As a result, no specific contribution is to be gained in their useage because in many instances reception may be further impaired due to their unsatisfactory operation in conjunction with an FM tuner. Among the common difficulties experienced are circuit instability resulting in oscillations, stray signal and interference pick up and the generation of spurious images of strong local stations. The latter is particularly troublesome as it causes the station to repeat at many points of the dial.

In general, signal boosters are not recommended for use with tuners of high sensitivity. Older type circuits, lacking good sensitivity, may benefit a little, but the overall signal-to-noise level will usually remain unchanged. Consequently, it is possible for the inexperienced audiophile to invest in the use of a preamplifier and still fail to gain any appreciable improvement in the resulting signal-to-noise level.

Low Signal Intensity Areas

Occasionally an antenna installation may provoke a great disappointment due to its apparent failure to produce the expected results. Since "shadow spots" are nondescript and because an antenna that is erected within these confines leaves much to be desired in terms of performance, it is usual to discredit the equipment and not the condition that is prevalent. Locations known as low signal intensity areas do exist and may likely be encountered anywhere. In particular, these areas are to be found in canyons, deep valleys and in mountainous terrain with dense foliage. Here poor signal interception can present a problem because the immediate and surrounding topography limits the usual recourse to special provisions that might otherwise be taken to improve the signal deficiency.

A relocation of the antenna from the "shadow" area to a more favorable site offering better signal intensity is about the only practical approach to the problem. A solution suggests placing the antenna on a nearby hilltop and using low-loss open wire line to carry the signal down to the tuner. This in effect is what is accomplished on a commercial scale with community TV service.

Signal Flutter Due to Aircraft

Many listeners suffer the annoyance of sporadic signal loss coincident with the flight of aircraft traveling enroute between the receiving and transmitting sites. This disturbance is also a form of multipath reception wherein the aircraft diverts the usual path of signal transmission by introducing a moving reflector to distort the normal pattern of wave propagation.

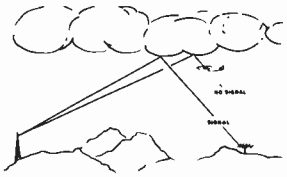


Fig. 29

The susceptance to such disturbances may be minimized by the installation of two uni-directional antennae erected at random locations and dispersed approximately ten wave-lengths apart or as to be determined by trial and experiment. Each of the separated yagi is individually terminated to an antenna discriminator using shielded coaxial cable so that the entire system is effectively protected against secondary signal pick up. The output from the discriminator feeds the tuner with a signal voltage that is not below the value as required to maintain the threshold of limiting for a stable signal.

FM Wave Traps

A frequent complaint amongst FM listeners results from a strong adjacent frequency station creating interference which defies suppression. Where this situation exists and cannot be eliminated by either the usual methods of proper antenna orientation or tuner selectivity, a wave trap must be employed.

In most instances it is folly to buy an inexpensive type of trap and hope that it will prove effective. Likewise the use of any of the selective types of signal attenuators as sold for the purpase will not correct the problem. Its proper solution implies the use of a complete 72 ohm system with baluns in conjunction with a well designed high-Q wave trap. In order that the system shall be fully effective, the tuner must also be 100% shielded.

By providing for a completely shielded recieving system, the antenna alone is exposed to intercept the signal. The interfering signal is absorbed by the resonant trap circuit and there being no additional signal reinforcement from spurious pick-up, its cancellation is subject to maximum attenuation. While such a trap may not be as effective as Armstrong's cavity resonator, it will alleviate the most stubborn cases and bring relief.

Antenna Requirements for Multiplex

The new multiplex system utilizes a composite signal (*representing the left channel*) consisting of the main FM signal (*which is the sum of both channels*) and an AM 38 kc. sub-carrier which conveys the difference (*representing the right channel*) between the two signals to provide true stereo reproduction. As *the full composite signal is transmitted as an FM signal,* segregation of the respective FM main carrier and the AM sub-carrier channels results after detection in the FM tuner or adapter. This implies that distortion may occur with some tuners (and locations) as a result of; (a) poor tuner design having inadequate IF bandwidth and discriminator linearity for low distortion reception of the sub-carrier, (b) insufficient signal voltage yield from antenna to tuner.

The type and adequacy of the receiving antenna employed now assumes a new importance for good FM multiplex reception. With added demands being placed upon the tuner conversion operation, *a much stronger signal voltage is required as the range of reception is substantially reduced from 30 to 50%* of the normal coverage. Thus while the range of usual mono signal reception may be 50 miles, a good tuner will now only have a range of 35 miles and a poorly designed tuner may be limited to reception within 25 miles of the station. Because the signal voltage level to tuner input is so essential to good stereo resolution, *a high gain broadband FM antenna is a must* if distortion is to be avoided. This means that ribbon dipoles, turnstile folded dipoles and the inadequate TV antenna (see page 15) are to be discarded for the more efficient FM yagi which is capable of delivering a maximum signal to tuner. In many instances, the indoor antenna is totally ineffective and a roof top installation will be required in order to obtain sufficient signal improvement, or gain, to escape the distortion that is to be attributed to this inadequacy.

FM Antenna Should Compliment The Tuner

So many audiophiles are prone to overlook the importance of equipping their FM tuner with an efficient antenna system. While the selection of a tuner and the attention devoted to specifications receives careful scrutiny worthy of a professional piece of equipment, most people are content to operate their system with a wholly inadequate antenna. This important oversight defeats the original intent and special advantages that might have been realized as a result of their considerate investment. Therefore, if you select a tuner, believing it to be the best for superior performance, by all means also install a suitable antenna that is complimentary to its design. Otherwise how can these objectives be fully realized? In failing to make this necessary provision, the tuner operates under a handicap because you will be limiting its potential capability by making it subservient to an inefficient antenna. Don't make the mistake of putting the plow before the horse.

If the antenna that is selected is adjudged to be both adequate and efficient, then make certain that it is also properly installed so that it may deliver the most favorable signal to ensure optimum tuner performance. A haphazard installation that is characterized by hasty and careless workmanship, while taking short cuts with unapproved practices, can only result in a progressive loss of signal. An efficient antenna, properly installed, is an asset to any hi-fi installation.

Antenna Installation Accessories

An outdoor installation is considerably simplified if suitable accessories as designed for use with the antenna system are employed. Below are listed various items of common usage and their application to the job. Their provision, as required, will ensure a low-loss, permanent and safe installation. See Fig. 25.

ANTENNA INSTALLATION KIT — Contains all of the essential accessories needed to make installation of the antenna for an average roof top mounting.

ANTENNA MAST GROUNDING CLAMP — Provides a connection for attaching ground wire to the mast as necessary for grounding the antenna against lightning.

ANTENNA SWITCH — A transfer swith designed to permit the selection of one of several available antennae.

ATTENUATION PAD — An electrical device used to reduce the signal strength from strong local stations to a value that will not overload the tuner.

COAXIAL CONNECTOR — An electrical connector used with shielded cables in a 72 ohm system for terminating the line to balun or wave trap.

GUY RING — Attached to mast to provide anchoring and support for the antenna. When a rotator is employed, guy wires are attached to rotator to dispense with guy ring.

GROUND ROD — The terminal stake that is driven into the earth and to which the ground wire from the mast (and lightning arrestor) is attached. Usually 4 to 6 ft. long.

GUY WIRE — Aluminum stranded wire attached to guy ring and anchored to roof to support the antenna permanently in place.

GUY WIRE THIMBLES — Small "U" bolt clamping devices, two of which are used for securing each of the guy wires.

LIGHTING ARRESTOR — A protective device used in the antenna system to dissipate electro-static discharge.

LINE ENTRY TUBE — An insulated lead-in sleeve used to admit the line into the building with a minimum loss of signal.

MAST — The tubular standpipe upon which the antenna is mounted in order to gain clearance and elevation in free space. Heavy duty aluminum tubing of from 1¼ to 1½ inch diameter is preferred as it is non-rusting, light weight and strong. A mast that is 4 to 12 ft. high is usually employed for roof installations.

ROOF MOUNT — The mast is held in position with a receptacle known as the roof mount. For end of the building installations, an eave or wall mast bracket is needed to support the mast. Specify aluminum for roof mounts and hot dip galvanized steel for wall type brackets.

ROTATOR THRUST BEARING — Multiple antenna installations and stacked arrays designed for rotation, should be supported with a thrust bearing to relieve the load imposed on the rotator mechanism.

STAND-OFF INSULATORS — To support the transmission line, use strap type along the mast or tower. Change to screw type to support the line along sides of a building using one at intervals of every 4 to 8 ft. or as necessary.

TRANSMISSION LINE — The lead-in carrying the signal from antenna to tuner should be of good low loss polyethylene and preferably made with 18 gauge stranded wire conductors. Perforated ribbon line is highly recommended as best for general use. Twisting the line one turn per linear ft. sometimes helps to minimize noise pick-up.

Final Recommendations

Recommendations for selecting the correct antenna for your FM tuner should be considered on the same order as when evaluating any other component of the high fidelity system. In the aforegoing review, the principal aspects of what constitutes a good FM antenna have been carefully pointed out in an endeavor to give you the significant features that contribute to an attainment of FM reception at its best. With regard to specific brand, I will singularly specify the "FM/Q" yagi for the following outstanding features;

1. Unsurpassed performance with optimum gain, exceptionally high F/B ratio, reflecting superior engineering design throughout.

2. Has permanent mortise type of element attachment to boom. Only FM antenna made assuring rigid assembly as protection against the formation of high resistance grounds which cause weak signals, loss of sensitivity, intermittent noise and disabled elements. Notice that it *does not* use "quick-rig or snap-lock" type of construction, principal cause of the above failures in 90% of antennae.
3. Has recursive dipole in a continuous length assuring the lowest possible electrical resistance and uni-potential conductivity for permanent high-gain sensitivity. Mechanical connections will not loosen up to result in progressive signal attenuation.
4. Only FM antenna using stainless steel bolts, nuts and washers. Offers finest protection against rust corrosion and mechanical breakdown.
5. Employs durable oversize heavy-duty aluminum seamless elements for maximum strength and weather protection from wind, ice and storms.
6. Insulator made of non hygroscopic dielectric material for low-loss efficiency. Minimizes attenuation of signal due to moisture-path leakage.
7. Designed by renowned FM antenna engineer for optimum tuner performance over the entire FM spectrum. The "FM/Q" is not a Chinese copy of an existing prototype nor is it made up of incidental lengths of tubing thrown together for a bargain.
8. Only FM antenna made that approaches perfection.

Bibliography

For addional collateral research, interested readers are referred to a special article on "Antenna Systems for FM", written by the author of this book and published in the July 1956 issue of "AUDIOCRAFT" magazine.

Free Engineering Counsel

Interested audiophiles who desire to improve their FM status and others who have special problems of reception, are invited to write us for advisement. We shall be pleased to give you our honest analysis of your specific problem and suggest proper remedial measures for your consideration.
To avail yourself of our engineering counsel, please enlighten our antenna authority with pertinent information regarding the following provisions;

1. Make and model of FM tuner, sensitivity, 72 or 300 ohm input?
2. What type of antenna is in use; is rotator employed?
3. FM stations you desire to receive.
4. Distance of the desired stations.
5. General topography.
6. Extent of present FM reception.

Address all correspondence to the attention of L. F. B. CARINI, in care of

APPARATUS DEVELOPMENT COMPANY, INC.,
Drawer 153, Wethersfield 9, Conn.

NOTICE

"FM/Q" is the trade mark of the Apparatus Development Company, Inc., manufacturers and purveyors of the foremost type of antennae systems designed exclusively for FM reception. The more popular types available include those illustrated opposite page 6.

Descriptive literature on "FM/Q" antennae, installation kits and the related accessories comprising a complete antenna system may be obtained by writing directly to the company.

APPENDIX

FREQUENCY IN MC VS. FM CHANNELS

88.1	201	.7	234	.5	268
.3	202	.9	235	.7	269
.5	203	95.1	236	.9	270
.7	204	.3	237	102.1	271
.9	205	.5	238	.3	272
89.1	206	.7	239	.5	273
.3	207	.9	240	.7	274
.5	208	96.1	241	.9	275
.7	209	.3	242	103.1	276
.9	210	.5	243	.3	277
90.1	211	.7	244	.5	278
.3	212	.9	245	.7	279
.5	213	97.1	246	.9	280
.7	214	.3	247	104.1	281
.9	215	.5	248	.3	282
91.1	216	.7	249	.5	283
.3	217	.9	250	.7	284
.5	218	98.1	251	.9	285
.7	219	.3	252	105.1	286
.9	220	.5	253	.3	287
92.1	221	.7	254	.5	288
.3	222	.9	255	.7	289
.5	223	99.1	256	.9	290
.7	224	.3	257	106.1	291
.9	225	.5	258	.3	292
93.1	226	.7	259	.5	293
.3	227	.9	260	.7	294
.5	228	100.1	261	.9	295
.7	229	.3	262	107.1	296
.9	230	.5	263	.3	297
94.1	231	.7	264	.5	298
.3	232	.9	265	.7	299
.5	233	101.1	266	.9	300
		.3	267		

DIRECTORY OF FM STATIONS

● Indicates FM Stereo Multiplex. Ch. 201-220 are educational stations.

City	Call	Freq.	Ch.	Kw.
ALABAMA				
Albertville	WAVU-FM	105.1	286	4.5
Alexander City	WRFS-FM	106.1	291	4.6
Andalusia	WCTA-FM	98.1	251	10.0
Anniston	WHMA-FM	100.5	263	3.6
Athens	WJOF	104.3	282	1.05
Birmingham	● WSFM	93.7	229	20.0
	● WCRT-FM	96.5	243	55.4
	WAPI-FM	99.5	258	72.0
	WJLN-FM	104.7	284	23.0
	WBRC-FM	106.9	295	15.0
Clanton	WKLF-FM	100.9	265	0.37
Cullman	WFMH-FM	101.1	266	5.3
Decatur	WHOS-FM	92.5	223	8.6
Huntsville	● WNDA	95.1	236	3.0
	● WAHR	99.1	256	72.0
Montgomery	WAJM	103.3	277	29.2
Mobile	WKRG-FM	99.9	260	3.0
Tuscaloosa	WUOA	91.7	219	15.0
	WTBC-FM	95.7	239	17.5
ALASKA				
Anchorage	● KBYR-FM	102.1	271	3.0
	KTVA	105.5	288	0.75
ARIZONA				
Globe	KWJB-FM	100.3	262	11.0
Mesa	KBUZ-FM	104.7	284	16.0
Phoenix	KFCA	88.5	203	.01
	KOY-FM	92.5	223	27.5
	KYEW	93.3	227	4.6
	KOOL-FM	94.5	233	58.0
	KELE	95.5	238	18.0
	KPHO-FM	96.9	245	68.0
	KTAR	98.7	254	57.0
	KITH	101.3	262	4.5
	KEBJ	103.5	278	25.0
Tempe	KUPD-FM	97.9	250	6.4
Tucson	KTAP	96.1	241	25.0
	KFMM	99.5	258	7.2
ARKANSAS				
Blytheville	KLCN-FM	96.1	241	21.0
Forest City	KXJK-FM	93.3	227	0.67
Jonesboro	KASU	91.9	220	0.76
	KBTM-FM	101.9	270	8.0
Little Rock	KMMK	94.1	231	31.0
	KFMA	103.7	279	22.5
Mammoth Sprs.	KAMS	103.9	280	0.34
Osceola	KOSE-FM	98.1	251	2.2
Pine Bluff	KOTN-FM	92.3	222	3.2
Siloam Sprs.	KUOA-FM	105.7	289	2.6
CALIFORNIA				
Alameda	KJAZ	92.7	224	1.0
Anaheim	KEZE	95.9	240	0.48
Arcata	KHSC-FM	90.5	213	0.01
Arlington	KNFP	89.7	209	1.7
Atherton	KPEN	101.3	267	1.5
Auburn	KAFI	101.1	266	4.6
Bakersfield	KERN-FM	94.1	231	9.1
	KLYD-FM	96.5	243	3.0
	●KQXR	101.5	268	14.5
Berkeley	KPFB	89.3	207	0.15
	KPFA	94.1	231	54.0
	KRE-FM	102.9	275	9.9
Beverley Hills	● KCBH-FM	98.7	254	75.0
Bijou	KHVR	99.9	260	1.65
Claremont	KSPC	88.9	205	1.0
Coachella	● KCHV-FM	93.7	229	25.0
El Cajon	KUFM	93.3	227	3.4
Eureka	KRED	96.3	242	5.6
Fremont	KHYD	104.9	285	0.81
Fresno	KRFM	93.7	229	68.0
	KJPO	94.5	233	7.5
	KMAK-FM	95.5	238	26.0
	KMJ-FM	97.9	250	7.3
	KARM-FM	101.9	270	7.4
	KMER	104.7	284	2.9
Garden Grove	● KGGK	94.3	232	0.1
Glendale	KFMU	97.1	246	58.0
	KUTE	101.9	270	11.0
	KHOF	99.5	238	100.0
Hayward	KBBM	101.7	269	0.9
Hollywood	KRHM	94.7	234	58.0
	KHJ-FM	101.1	266	16.8
Inglewood	KTYM-FM	103.9	280	0.39
Lancaster	KANT-FM	107.9	300	20.5
Lodi	KCVR-FM	97.7	249	0.8
Long Beach	KLON	88.1	201	1.2
	KNOB	97.9	250	11.0
	KFOX-FM	102.3	272	1.0
	KLFM	105.5	288	0.3
Los Altos	KPGM	97.7	249	1.0
Los Angeles	KCMI	88.5	203	0.01
	KXLU	89.1	206	0.6
	KPFK	90.7	214	75.0
	KUSC	91.5	218	2.9
	KFAC-FM	92.3	222	60.0
	KNX-FM	93.1	226	67.0
	● KPOL-FM	93.9	230	17.0
	● KRHM	94.7	234	58.0
	KABC-FM	95.5	238	4.3
	KRKD-FM	96.3	242	54.0
	●KFMU	97.1	246	58.0
	KHOF	99.5	258	16.5
	●KMLA	100.3	262	58.0
	KLAC-FM	102.7	274	13.6
	KGLA	103.5	278	12.5
	KBIQ	104.3	282	53.0
	KBCA	105.1	286	6.0
	● KBMS	105.9	290	18.0
	KBBI	107.5	298	19.5
Marysville	KMYC-FM	99.9	260	4.9
Modesto	KBEE-FM	103.3	277	11.5
	KTRB-FM	104.1	281	4.7
Mt. View	KFJC	88.5	203	0.01
Nat'l City	KEAX	99.3	257	0.84
Newport Beach	KAJS	103.1	276	0.86
Oceanside	●KIJDE-FM	102.1	271	20.0
Ontario	KASK-FM	93.5	228	1.0
Oxnard	KAAR	104.7	287	10.5
Palm Sprs.	KPSR-FM	100.7	264	4.0
Pasadena	KPCS	89.3	207	0.37
Redlands	KCAL-FM	96.7	244	1.0

City	Call	Freq.	Ch.	Kw.
Redondo Bch.	KAPP	93.5	228	1.0
Redwood City	KCUF	107.7	299	20.0
Riverside	KACE-FM	92.7	224	0.7
	● KDUO	97.5	248	72.0
	KPLI	99.1	256	1.5
Sacramento	KFBK-FM	92.5	223	1.9
	KCRA-FM	96.1	241	45.0
	● KSFM	96.9	245	6.4
	KXRQ	98.5	253	3.5
	KEBR	100.5	263	15.0
	KROY-FM	102.5	273	18.0
	KHIQ	105.1	286	
	KJML	106.5	293	2.7
	KXOA-FM	107.9	300	12.5
Salinas	KSBW-FM	102.5	273	18.5
San Bernardino	KVCR	91.9	220	0.7
	KFMW	99.9	260	31.0
San Diego	KSDS	88.3	202	0.37
	KEBS	89.5	253	78.0
	KFSD-FM	94.1	231	33.0
	● KLRO	94.9	235	7.5
	KFMX	96.5	243	30.0
	KSEA	97.3	247	29.5
	KJLM	98.1	251	4.5
	KFMB-FM	100.7	264	18.5
	● KGB-FM	101.5	268	36.0
	KBBW	102.5	273	38.0
	KSON-FM	103.7	279	11.5
	KITT	105.3	287	13.0
	● KPRI	106.5	293	3.5
San Fernando	KJPL	94.3	232	0.86
	KSFV	106.3	292	1.0
San Francisco	KSFX	90.1	211	1.4
	KALW	91.7	219	3.3
	KYA-FM	93.3	227	4.9
	● KSFR	94.9	235	41.0
	KOBY-FM	95.7	239	10.5
	KRON-FM	96.5	243	13.0
	KEAR	97.3	247	125.0
	● KAFE	98.1	251	1.7
	KCBS-FM	98.9	255	35.0
	KNBC-FM	99.7	259	45.0
	KDFC	102.1	271	33.0
	KGO-FM	103.7	279	3.8
	● KBAY-FM	104.5	283	29.0
	● KCBO	105.3	287	17.5
	KFRC	106.1	291	71.0
	KHIP	106.9	295	39.0
San Jose	● KSJO-FM	92.3	222	1.0
	KPRM	98.5	253	3.3
	KEEN-FM	100.3	262	16.2
San Luis Obispo	KATY-FM	96.1	241	3.8
	KSCM	90.9	215	0.27
	● KVEC	93.3	227	30.2
Santa Ana	KWIZ-FM	96.7	244	1.0
	KFIL	106.3	292	1.0
Santa Barbara	KDB	93.7	229	5.0
	KRCW	97.5	248	17.5
	● KMUZ	103.3	277	50.0
	KGUD-FM	107.9	300	29.5
Santa Maria	● KEYM-FM	99.1	256	3.2
	KSMA-FM	102.5	273	11.0
Santa Monica	KCRW	89.9	210	0.4
	KSRF	103.1	276	1.0
Sierra Madre	KMAX	107.1	296	1.0
Stockton	KCVN	91.3	217	3.4
	KWG-FM	105.7	289	3.5
	KHIP	106.9	295	39.0
	KSRF	107.3	297	8.3
Ventura	KVEN-FM	100.7	264	12.0
Ventura-Oxnard	● KUDU-FM	95.1	236	24.0
Visalia	● KONG-FM	92.9	225	2.9
Walnut Creek	● KWME-FM	92.1	221	0.25
W. Covina	KDWC	98.3	252	1.0
Woodland	● KATT	102.5	273	33.0

COLORADO

Boulder	KRNW	97.3	247	2.0
Colo. Sprgs.	KSHS	90.5	219	0.6
	KRCC	91.3	217	0.16
	KVOR-FM	92.9	225	1.35
	KFMH	96.5	243	5.0
Cortez	KZFM	94.1	231	3.6
Denver	KDEN	99.5	238	9.1
	KALH	101.3	267	18.0
	KLIR-FM	100.3	262	2.4
	KRKY	102.1	271	8.5
	KOA-FM	103.5	278	50.0
	KTGM	105.1	286	10.0
Golden	● KFML-FM	98.5	253	2.3
Grand Junction	KREX-FM	92.3	222	2.8
Manitou Sprgs.	● KCMS-FM	102.7	274	10.0

CONNECTICUT

Bridgeport	WJZZ	99.9	260	9.0
Brookfield	● WGHF	95.1	236	20.0
Danbury	WLAD-FM	98.3	252	0.34
Darien	WDRN	95.9	240	0.75
Hamden	WDEE-FM	101.3	267	20.0
Hartford	WRTC-FM	89.3	207	0.145
	WFNQ	93.7	229	7.0
	● WTIC-FM	96.5	243	8.0
	WDRC-FM	102.9	275	7.0
	WHCN	105.9	290	7.0
	WCCC-FM	106.9	295	6.6
Manchester	WINF-FM	107.9	300	5.4
Meriden	● WBMI	95.7	239	7.0
Middletown	WESU	88.1	201	0.01
New Haven	WYBC	94.3	232	0.30
	WNHC-FM	99.1	256	10.0
Stamford	WSTC-FM	96.7	244	0.65
Storrs	WHUS	90.5	213	0.01
Waterbury	WATR-FM	92.5	223	7.0
	WWCO	104.1	281	20.0

DELAWARE

Dover	WDOV-FM	94.7	234	8.3
Wilmington	WDEL-FM	93.7	229	20.0
	● WJBR	99.5	258	20.0

DISTRICT OF COLUMBIA

Washington	WAMU-FM	88.5	203	12.0
	WGTB-FM	90.1	211	0.84
	WRC-FM	93.9	230	20.0
	WPGC-FM	95.5	238	15.5
	WTOP-FM	96.3	242	20.0
	● WASH	97.1	246	15.0
	WOL-FM	98.7	254	20.0
	WFAN	100.3	262	20.0
	WWDC-FM	101.1	266	20.0
	WGMS-FM	103.5	278	20.0
	WMAL-FM	107.3	297	20.0

City	Call	Freq.	Ch.	Kw.
FLORIDA				
Coral Gables	●WVCG-FM	105.1	286	18.5
Daytona Beach	WNDB-FM	94.5	233	8.5
Ft. Lauderdale	WMFP	100.7	264	56.0
	WWIL-FM	103.5	278	31.0
	● WFLM	105.9	290	2.9
Ft. Pierce	WIRA-FM	95.5	238	2.48
	WARN-FM	98.7	254	1.3
Gainesville	● WRUF-FM	104.1	281	12.0
Jacksonville	WJAX-FM	95.1	236	7.7
	WMBR-FM	96.1	241	50.0
	WZFM	96.9	245	9.7
Miami	WKAT-FM	93.1	226	17.5
	WMET-FM	93.9	230	13.0
	●WAEZ-FM	94.9	235	56.0
	WGBS-FM	96.3	242	1.5
	WCKR-FM	97.3	247	50.0
	WINZ-FM	99.9	260	105.0
	WWPB-FM	101.5	268	8.5
Miami Beach	WAFM	93.1	226	17.5
Ocala	WMOP-FM	93.7	229	4.3
Naples	WMFM	94.5	233	
Orlando	WDBO-FM	92.3	222	25.0
	●WHOO-FM	96.5	243	59.0
	WKIS	100.3	262	5.5
Palm Beach	WQXT-FM	97.9	250	3.6
Pensacola	● WPEX-FM	94.1	231	2.45
St. Petersburg	● WTCX	99.5	258	31.0
	WVST	105.9	290	105.0
Sarasota	●WYAK	102.5	273	2.7
Tallahassee	WFSU-FM	91.5	218	0.01
Tampa	WTUN	88.9	205	0.77
	WFLA-FM	93.3	227	46.0
	WDAE-FM	100.7	264	65.0
	WPKM	104.7	284	10.5
Winter Park	WPRK	91.5	218	0.33
GEORGIA				
Athens	● WGAU-FM	102.5	273	4.4
Atlanta	WABE	90.1	211	4.8
	WGKA-FM	92.9	225	9.4
	WDJK	94.1	231	30.0
	WAVQ	94.9	235	7.1
	● WSB-FM	98.5	253	49.0
	WPLO-FM	103.3	277	36.0
Augusta	WBBQ-FM	103.7	279	19.5
	WAUG-FM	105.7	289	5.5
Columbus	●WBRL-FM	102.9	275	25.0
Gainesville	WDUN-FM	103.9	280	0.34
La Grange	WLAG-FM	104.1	281	2.3
Macon	WMAZ-FM	99.1	256	3.0
	WNEX-FM	96.9	245	4.1
Marietta	WKLS	96.1	241	6.4
	WBIE	101.5	268	1.35
Newman	WCOH-FM	96.7	244	0.33
Savanah	WTOC-FM	97.3	247	7.9
Toccoa	WLET-FM	106.1	291	0.73
HAWAII				
Honolulu	KVOK	88.1	201	0.01
	● KAIM-FM	95.5	238	5.6
	KEFW	96.3	242	7.7
	KPOI	97.5	248	27.5

City	Call	Freq.	Ch.	Kw.
IDAHO				
Boise	● KBOI-FM	97.9	250	17.5
	KBFI	99.9	260	19.0
Coldwell	KBGN-FM	94.1	231	7.6
Lewiston	KOZE-FM	96.7	244	0.9
ILLINOIS				
Anna	WRAJ-FM	92.7	224	1.0
Arlington Hts.	WNWC	92.7	224	1.0
Aurora	WMRO-FM	95.1	236	3.6
	WKKD-FM	95.9	240	1.0
Bloomington	WJBC-FM	101.5	268	5.1
Carbondale	WSIU	91.9	220	22.0
Carmi	WROY-FM	97.3	247	11.0
Champaign	WDWS-FM	97.5	248	27.0
Chicago	WUCB-FM	89.1	206	0.01
	WMBI-FM	90.1	211	47.0
	WBEZ	91.5	218	16.0
	● WSBC-FM	93.1	226	27.5
	WEBH	93.9	230	35.0
	WENR-FM	94.7	234	4.3
	WDHF	95.5	238	52.0
	WBBM-FM	96.3	242	10.5
	WNIB	97.1	246	11.0
	WEHS	97.9	250	21.0
	● WEMT	98.7	254	29.5
	●WEFM	99.5	258	44.0
	WFMF	100.3	262	33.0
	● WMAQ-FM	101.1	266	24.0
	WCLM	101.9	270	17.0
	●WKFM	103.5	278	50.0
	WJJD-FM	104.3	282	40.0
	● WFMQ	107.5	298	11.0
Decatur	WSOY-FM	102.9	275	31.0
DeKalb	WNIC	91.1	216	0.01
E. St. Louis	WAMV-FM	101.1	261	
Effingham	WSEI	95.7	239	20.0
Elgin	WEPS	90.9	215	0.38
	WRMN-FM	94.3	232	1.0
	WELG	103.9	280	1.0
Elmwood Park	WXFM	105.9	290	32.0
Evanston	WNUR	89.3	207	0.01
	WEAW-FM	105.1	286	36.0
Glen Ellyn	WELF	107.1	296	3.6
Harrisburg	WEBQ-FM	99.9	260	4.2
Jacksonville	WLDS-FM	100.5	263	9.0
Joliet	WAJP	93.5	228	1.0
Joliet	WJOL-FM	96.7	244	1.0
Kewanee	WKSD	91.9	220	0.01
Litchfield	WSMI	106.1	291	
Macomb	WWKS	91.3	217	17.0
Mattoon	WLBH-FM	96.9	245	23.0
Mt. Carmel	WSAB	94.9	235	37.4
	WVMC-FM	101.1	266	4.0
Mt. Vernon	WMIX-FM	94.1	231	15.2
Oak Park	WOPA-FM	102.7	274	1.0
Olney	WVLN-FM	92.9	225	18.5
Paris	WPRS-FM	98.3	252	1.0
Park Forest	WRHS	88.1	201	0.01
Park Ridge	WMTH	88.5	203	0.01
Peoria	WMBD-FM	92.5	223	2.5
Quincy	WTAD-FM	99.5	258	27.0
	● WGEM-FM	105.1	286	8.3
Rockford	WROK-FM	97.5	248	16.0
Rock Island	●WHBF-FM	98.9	255	39.0

City	Call	Freq.	Ch.	Kw.
Springfield	WTAX-FM	103.7	279	6.7
Taylorsville	WGGM	95.1	236	3.4
Urbana	WILL-FM	90.9	215	30.0
Waukegan	WFME	102.3	272	1.0
Winnetka	WNTH	88.1	201	0.01

INDIANA

Anderson		WCBC-FM	97.9	250	63.0
Bloomington		WTTV-FM	92.3	222	31.0
		WFIU	103.7	279	33.0
Columbus	•	WCSI-FM	98.3	252	0.76
Connersville		WCNB-FM	100.3	262	9.8
Crawfordsville		WBBS	106.3	292	1.0
Elkhart		WTCR-FM	100.7	264	9.7
		WCMR-FM	104.7	284	8.2
Evansville		WPSR	90.7	214	4.5
		WEVC	91.5	218	1.9
	•	WIKY-FM	104.1	281	19.0
Ft. Wayne		WPTH	95.1	236	44.0
Franklin		WFCI	89.3	207	0.01
Gary		WGVE	88.1	201	0.01
Goshen		WGCS	91.1	216	0.39
Greencastle		WGRE	91.7	219	0.01
Hammond		WYCA	92.3	222	30.0
Hartford City		WHCI	91.9	220	0.01
Huntington		WVSH	91.9	220	0.01
Indianapolis		WIAN	90.1	211	0.12
		WIBC-FM	93.1	226	2.8
		WFBM-FM	94.7	234	52.0
		WFMS	95.5	238	4.5
		WAJC	104.5	283	8.8
		WNAP	105.7	289	4.6
	•	WISH	107.9	300	41.0
Jasper		WITZ-FM	104.7	284	1.65
Madison		WORX-FM	96.7	244	0.35
Marion		WBST	90.7	214	0.01
		WMRI-FM	106.9	295	31.0
Muncie		WWHI	91.5	218	0.01
		WMUN	104.1	281	7.4
New Albany		WNAS	88.1	201	0.8
New Castle		WCTW	102.5	273	4.0
Princeton		WRAY-FM	98.1	251	7.0
Richmond		WGLM	96.1	241	32.0
		WKBV-FM	106.5	293	23.0
Salem		WSLM	98.9	255	2.7
Seymour		WJCD-FM	93.7	229	5.6
South Bend		WETL	91.9	220	0.29
Terre Haute		WTHI-FM	99.9	260	7.4
		WVTS	100.7	264	3.9
Wabash		WSKS	91.3	217	0.01
Warsaw		WRSW-FM	107.3	297	34.0
Washington		WFML	106.5	293	14.0
W. Lafayette		WBAA-FM	99.1	256	36.0

IOWA

Ames		WOI-FM	90.1	211	16.0
Boone		KFGQ-FM	99.3	257	0.31
Cedar Falls		KTCF	88.1	201	0.01
Clinton		KROS-FM	96.1	241	13.0
Davenport		WOC-FM	103.7	279	33.0
Des Moines		KDPS	88.1	201	1.5
	•	KDMI	97.3	247	115.0
		KSO-FM	98.5	253	9.0
		WHO-FM	100.3	262	24.0
Dubuque		WDBQ-FM	103.3	277	15.0
Iowa City		KSUI	91.7	219	17.5
Mason City		KGLO-FM	101.1	266	16.0
Muscatine		KWPC-FM	99.7	259	0.78
Pella		KCUI	89.1	206	0.01
Sioux City		KDVR	97.9	250	3.0
Storm Lake		KAYL-FM	101-5	268	8.9
Waverly		KWAR	89.1	206	0.01

KANSAS

Emporia		KSTE	88.7	204	0.03
Lawrence	•	KANU	91.5	218	35.0
Manhattan		KSDB-FM	88.1	201	0.01
Merriam		KCJC	98.1	251	
Newton		KJRG-FM	92.1	221	0.25
Ottawa		KTJO-FM	88.1	201	0.01
Parsons		KPPS-FM	91.1	216	0.01
Salina		KAFM	99.9	260	3.6
Topeka		KTOP-FM	100.1	261	0.76
Wichita		KMUW	89.1	206	0.01
		KBBL	96.9	245	1.95
		KFH-FM	100.3	262	11.0
	•	KCMB-FM	107.3	297	30.0

KENTUCKY

Ashland		WCMI-FM	93.7	229	2.75
Central City		WNES-FM	101.9	270	21.5
Fulton		WFUL-FM	104.9	285	0.5
Glasgow		WGGC	95.1	236	1.96
Hazard		WKIC	94.1	231	8.3
Henderson		WSON-FM	99.5	258	20.0
Hopkinsville		WRLX	98.7	254	16.5
		WKOF	100.3	262	3.7
Lexington		WBKY	91.3	217	2.3
		WLAP-FM	94.5	233	3.5
Louisville		WFPL	89.3	207	0.15
		WFPK	91.9	220	19.5
	•	WLVL	97.5	248	17.5
Madisonville		WFMW-FM	93.9	230	30.0
Mayfield		WNGO-FM	94.7	243	2.3
Owensboro		WOMI-FM	92.5	223	19.5
		WVJS-FM	96.1	241	45.0
Paducah		WKYB-FM	93.3	227	31.5
		WPAD-FM	96.9	245	36.0
Somerset		WSFC-FM	92.3	227	3.0

LOUISIANA

Alexandria		KALB-FM	96.9	245	11.5
Baton Rouge		WJBO-FM	98.1	251	2.45
Monroe	•	KLMB-FM	104.1	281	17.0
New Orleans	•	WWMT	95.7	239	44.0
		WRCM	97.1	246	5.9
		WDSU-FM	105.3	287	3.4
Shreveport		KWKH-FM	94.5	233	13.5
		KBCL-FM	96.5	243	11.5
		KRMD-FM	101.1	261	11.5

MAINE

Augusta		WFAU-FM	101.3	267	4.84
Bangor		WABI-FM	97.1	246	5.0
Brunswick		WBOR	91.1	216	0.01
		WCME-FM	98.9	255	80.0
Caribou	•	WFST-FM	97.7	249	0.19
Lewiston		WRJR	91.5	218	0.01
		WCOU-FM	93.9	230	13.0
Portland		WLOB-FM	97.9	250	10.0

MARYLAND

City	Call	Freq.	Ch.	Kw.
Annapolis	WNAV-FM	99.1	256	16.6
	WXTC	107.9	300	20.0
Baltimore	WBJC	88.1	201	0.12
	WYOU	92.3	222	11.0
	WFMM-FM	93.1	226	18.0
	WRBS	95.1	236	15.5
	WBAL-FM	97.9	250	8.7
	● WAQE-FM	101.9	270	
	WCAO-FM	102.7	274	20.0
	WITH-FM	104.3	282	20.0
	WCBM-FM	106.5	293	17.0
Bethesda	● WJMD	94.7	234	20.0
	●WHFS	102.3	272	1.0
Cumberland	WCUM-FM	102.9	275	1.3
	WTBO-FM	106.1	291	7.7
Frederick	WFMD-FM	99.9	260	9.0
Hagerstown	WJEJ-FM	104.7	284	9.4
	WARK-FM	106.9	295	2.2
Havre de Grace	WASA-FM	103.7	279	3.8
Oakland	WPGC-FM	95.5	238	16.5
Silver Sprs.	WGAY	99.5	258	20.0
Takoma Park	WGTS-FM	91.9	220	0.01
Towson	WAQE-FM	101.9	265	20.0
Westminster	WTTR-FM	100.7	264	4.6

MASSACHUSETTS

Amherst	WFCR	88.5	203	34.4
	WAMF	89.5	203	0.01
	WMUA	91.1	216	0.01
Boston	WERS	88.9	205	18.0
	WGBH-FM	89.7	209	15.5
	WBUR	90.9	215	20.0
	WHDH-FM	94.5	233	3.3
	WRKO-FM	98.5	253	20.0
	WCOP-FM	100.7	264	20.0
	WEEI-FM	103.3	277	20.0
	● WBCN	104.1	281	20.0
	WBZ-FM	106.7	294	2.8
Brockton	WBET-FM	97.7	249	0.8
Brookline	WBOS-FM	92.9	225	15.0
Cambridge	WTBS	88.1	201	0.01
Cambridge	WHRB-FM	95.3	237	0.8
	WXHR	96.9	245	20.0
Fitchburg	WFGM-FM	104.7	284	20.0
Framingham	WKOX	105.7	289	15.5
Greenfield	WHAI-FM	98.3	252	1.0
Haverhill	WHAV-EM	92.5	223	20.0
Lawrence	WGHJ-FM	93.7	229	1.35
Lowell	WLLH-FM	99.5	258	12.2
Lynn	●WUPY	105.3	287	1.05
Medford	WISK	107.9	300	20.0
Mt. Greylock	WAMC	90.3	212	10.0
New Bedford	WBSM-FM	97.3	247	2.5
	WNBH-FM	98.1	251	20.0
Plymouth	WPLM-FM	99.1	256	20.0
So. Hadley	WMHC	90.7	214	0.01
Springfield	WSCB	89.9	210	0.01
	WEDK	91.7	219	15.0
	WHYN-FM	93.1	226	3.2
	WMAS-FM	94.7	234	1.35
Waltham	●WCRB-FM	102.5	273	9.2
W. Yarmouth	WOCB-FM	94.3	232	1.0
Williamstown	WCFM	91.3	217	0.01
Winchester	WHSR-FM	91.9	220	0.01
Worcester	● WTAG-FM	96.1	241	10.0
	WAAB-FM	107.3	297	1.4

MICHIGAN

Ann Arbor	WUOM	91.7	219	115.0
Bay City	WBCN-FM	96.1	241	41.0
	● WNEM-FM	102.5	273	42.0
Benton Harbor	WHFB-FM	99.9	260	9.2
Cadillac	WWTV-FM	92.9	225	100.0
Coldwater	WTVB-FM	98.5	253	6.3
Dearborn	WKMH-FM	100.3	262	7.1
Detroit	WDTR	90.9	215	2.0
	WIPE	92.3	222	10.0
	WJBK-FM	93.1	226	30.0
	WHFI	94.7	234	20.0
	● WLDM	95.5	238	20.0
	WJR-FM	96.3	242	24.0
	WWJ-FM	97.1	246	50.0
	WMZK	97.9	250	20.0
	WFME	98.7	254	8.7
	● WABX	99.5	258	36.0
	WXYZ-FM	101.1	266	27.0
	WDET-FM	101.9	270	79.0
	WMUZ	103.5	278	20.0
	● WOMC	104.3	282	61.0
	WQRS	105.1	286	28.5
	WCHD	105.9	290	34.0
	●WDTM	106.7	294	61.0
	WQTI	107.5	298	32.0
E. Lansing	WKAR-FM	90.5	213	74.0
	●WSWM	99.1	256	30.0
Flint	WFBE	95.1	236	1.3
Grand Rapids	●WJEF-FM	93.7	229	11.5
	WLAV-FM	96.9	245	1.75
	WMAX	101.3	262	7.2
	WFUR	102.9	275	40.7
Highland Park	WHPR	88.1	201	0.01
Holland	WJBL-FM	94.5	233	37.0
Interlochen	WGYA	103.1	276	1.0
Jackson	WBBC	94.1	231	5.4
Kalamazoo	WMCR	102.1	271	36.0
Lansing	WJIM-FM	97.5	248	46.0
	WMRT-FM	100.7	264	92.0
Mt. Clemens	WBRB-FM	102.7	274	80.0
Royal Oak	WOAK	89.3	207	0.01
Saginaw	WSAM-FM	98.1	251	1.7
Sturgis	WSTR-FM	103.1	276	0.28

MINNESOTA

Brainerd	KLIZ-FM	95.7	239	
Duluth	KUMD-FM	89.1	206	0.01
Mankato	● WAYL	96.1	241	10.1
	*KYSM-FM	103.5	278	47.0
Minneapolis	●KWFM	97.1	246	9.7
	KTIS-FM	98.5	253	5.3
	WLOL-FM	99.5	258	9.7
	KFMV	100.3	262	8.9
	WPBC-FM	101.3	267	5.2
St. Cloud	KFAM-FM	104.7	284	15.0
St. Paul	KNOF	95.3	237	25.0
Worthington	KWOA-FM	94.9	235	26.5

MISSISSIPPI

Jackson	WJDX-FM	102.9	275	50.0
Laurel	WNSL-FM	100.3	277	
Meridian	WMMI	91.5	223	0.65

City	Call	Freq.	Ch.	Kw.
MISSOURI				
Clayton	KFUO-FM	99.1	265	6.7
Crestwood	KSHE	94.9	235	5.1
Joplin	● KSYN	92.5	223	3.6
Kansas City	KCUR-FM	89.3	207	0.36
	KTSR	90.1	211	0.01
	KCMK	93.3	227	35.0
	●KCMO-FM	94.9	235	65.0
	KXTR-FM	96.5	243	
	KISA	99.7	259	1.95
	WDAF-FM	102.1	271	56.0
	KBEY	104.3	282	16.5
Kennett	KBOA-FM	98.9	255	6.9
Poplar Bluff	KWOC-FM	94.5	233	14.0
St. Charles	KADI	96.5	243	25.0
St. Louis	KSLH	91.5	218	12.5
	WIL-FM	92.3	222	2.0
	●KCFM	93.7	229	60.0
	KPLR-FM	97.3	247	25.5
	KSTL-FM	98.1	251	76.0
	● KWIX	102.5	273	25.0
	KMOX-FM	103.3	277	28.0
	KEMO	104.1	281	76.0
	KANG	106.9	295	82.0
Springfield	KTTS-FM	94.7	234	9.1
West Plains	KWPM-FM	93.9	230	3.4
NEBRASKA				
Kearney	KHOL-FM	98.9	255	57.0
Lincoln	KFMQ	95.3	237	0.32
Omaha	WOW-FM	92.3	222	4.0
	●KQAL-FM	94.3	232	1.0
	KOIL	96.1	241	3.4
	KSWI	98.7	254	3.1
	KFAB-FM	99.9	260	58.0
Scotts Bluff	KNEB-FM	94.1	231	5.6
NEVADA				
Las Vegas	KRAM-FM	100.5	263	2.9
Reno	KNEV	95.5	238	35.0
NEW HAMPSHIRE				
Berlin	WMOU-FM	103.7	279	10.0
Claremont	WTSV-FM	106.1	291	3.4
Manchester	WKBR-FM	95.7	239	3.6
Mt. Wash.	WMTW-FM	94.9	235	48.0
Nashua	WOTW-FM	106.3	292	1.0
NEW JERSEY				
Asbury Park	WJLK-FM	94.3	232	1.0
Atlantic City	WRNJ	95.1	236	3.5
	WOSJ-FM	103.7	279	33.1
Bridgeton	WSNJ-FM	107.7	299	15.2
Camden	WKDN-FM	106.9	295	7.3
Dover	●WDHA-FM	105.5	288	1.0
E. Orange	WFMU	91.1	220	0.01
Eatontown	WHTG-FM	105.	288	1.0
Hackettst'n	WNTI	91.9	220	4.8
Long Branch	●WRLB	107.1	296	0.76
Newark	WBGO	88.3	202	20.0
	WNTA-FM	94.7	234	13.5
	WVNJ-FM	100.3	262	20.0
New Brunswick	WCTC-FM	98.3	252	1.0
Newton	WNNJ-FM	103.7	279	1.65
Patterson	● WPAT-FM	93.1	226	20.0
Princeton	WPRB	103.5	278	17.0
Red Bank	WFHA-FM	106.3	292	1.0
S. Orange	WSOU	89.5	208	2.0
Trenton	WTOA	97.5	248	14.5
Wildwood	WCMC-FM	100.7	264	3.5
Zarepath	WAWZ-FM	99.1	256	4.8
NEW MEXICO				
Albuquerque	KANW	89.1	206	0.35
	KDEF	94.1	231	1.3
	● KHFM	96.3	242	1.45
	KARA	99.5	258	3.4
Aztec	KNDE-FM	94.9	235	3.4
Los Alamos	KRSN-FM	98.5	253	4.6
Roswell	KBIM-FM	97.1	246	2.9
NEW YORK				
Albany	WROW-FM	95.5	238	20.0
Allegheny	WHDL-FM	95.7	239	43.0
Amherst	WYSL-FM	103.3	227	4.9
Auburn	WMBO-FM	96.1	241	18.0
Babylon	WBAB-FM	102.3	272	0.7
	●WTFM	103.5	278	15.0
Binghampton	WNBF-FM	98.1	251	4.6
	WKOP-FM	99.1	256	39.0
Buffalo	WBFO	88.7	204	0.19
	WBUF	92.9	225	94.0
	WEBR-FM	94.5	233	105.0
	WGR-FM	96.9	245	16.0
	WBEN-FM	102.5	273	110.0
	WWOL-FM	104.1	281	0.75
Central Square	WCSQ	89.3	207	1.0
Cherry Valley	WRRC	101.9	270	5.4
Corning	WCLI-FM	106.1	291	4.2
Cortland	WKRT-FM	99.9	260	14.0
De Ruyter	WRRD	105.1	286	5.3
Elmira	WECW	88.1	201	0.01
Foral Park	WSHS	90.3	212	0.35
Fulton	WOSC-FM	104.7	284	3.1
Garden City	● WLIR	92.7	224	75.0
Hempstead	WVHC	88.7	204	0.01
	WHLI-FM	98.3	252	1.0
Hornell	WWHG-FM	105.3	287	8.3
Ithaca	WICB	91.7	219	0.01
	WVBR-FM	93.5	228	0.7
	WHCU-FM	97.3	247	40.0
	WRRA	103.7	279	5.6
Jamestown	WJTN-FM	93.3	227	9.5
Massena	WMSA-FM	105.3	287	13.0
Mt. Kisco	WRNW	107.1	295	0.3
New Rochelle	WVOX-FM	93.5	228	1.0
New York	WKCR-FM	89.9	210	4.2
	WFUV	90.7	214	3.5
	WNYE	91.5	218	20.0
	WHOM-FM	92.3	222	11.0
	● WNYC-FM	93.9	230	18.0
	WABC-FM	95.5	238	1.5
	●WQXR-FM	96.3	242	11.0
	WNBC-FM	97.1	246	1.1
	WEVD-FM	97.9	250	20.0
	WOR-FM	98.7	254	1.7
	WBAI	99.5	258	18.0
	WCBS-FM	101.1	266	1.5
	WBFM	101.9	270	10.3

City	Call	Freq.	Ch.	Kw.
	WNEW-FM	102.7	274	2.8
	WNCN	104.3	282	15.0
	WRFM	105.1	286	20.0
	WRVR	106.7	294	20.0
	WRLB	107.1	296	
Niagara Falls	WHLD-FM	98.5	253	46.0
Olean	WHDL	95.7	239	43.0
Patchogue	WALK-FM	97.5	248	15.0
	● WPAC-FM	106.1	291	8.3
Peekskill	WLNA-FM	100.7	264	20.0
Plattsburgh	WEAV-FM	99.9	260	3.7
Poughkeepsie	WKIP-FM	104.7	284	2.3
Rochester	WIRQ	90.9	215	0.01
	● WCMF	96.5	243	1.35
	WROC-FM	97.9	250	18.0
	WHFM	98.9	255	8.7
	WRVM-FM	100.5	263	5.0
	WBBF-FM	101.3	267	27.5
Schnectady	●WGFM	99.5	258	6.0
S. Bristol	WRRE	95.1	236	5.3
Springville	WSPE	88.1	201	0.01
Syracuse	WAER	88.1	201	0.73
	WDDS-FM	93.1	226	97.0
	●WSYR-FM	94.5	233	10.0
	WONO	100.9	265	0.26
	WHEN-FM	102.9	275	9.0
Troy	WRPI	91.5	218	0.7
	WFLY	92.3	222	5.4
Utica	WRUN	104.3	282	4.3
Wethersfield	WRRL	107.7	299	5.4
White Plains	WFAS-FM	103.9	280	0.12

NORTH CAROLINA

Albermarle	WABZ-FM	100.9	265	0.75
Asheboro	WGWR-FM	92.3	222	10.0
Asheville	WLOS-FM	99.9	260	2.1
Burlington	WBAG-FM	93.9	230	2.8
	● WBBB-FM	101.1	266	3.8
Chapel Hill	WUNC	91.5	218	15.5
Charlotte	WSOC-FM	103.5	278	35.0
	WYFM	104 7	284	1.0
Clingmans Pk.	WMIT	106.9	295	36.0
Concord	WEGO-FM	97.9	250	3.35
Durham	WDNC-FM	105.1	286	36.0
Elkin	WIFM-FM	100.9	265	0.35
Fayetteville	WFNC-FM	98.1	251	14.0
Forest City	WBBO-FM	93.3	227	1.5
	WAGY-FM	105.3	287	3.3
Gastonia	WGNC-FM	101.9	270	11.1
Goldsboro	WEQR	96.9	245	25.5
Greensboro	WGPS	89.9	210	0.01
	● WMDE	98.7	254	5.8
Greenville	WWWS	91.3	217	4.0
Henderson	WHNC-FM	92.5	223	9.0
Hendersonville	WHKP-FM	102.5	273	4.0
Hickory	WHKY-FM	102.9	275	14.8
High Point	WHPS	89.3	207	0.01
	WHPE-FM	95.5	238	13.0
	WMFR-FM	99.5	258	8.0
	WNOS-FM	100.3	262	2.7
Laurinburg	WEWO-FM	96.5	243	9.2
Leaksville	WLOE-FM	94.5	233	13.5
Lexington	WBUY-FM	94.3	232	0.3
Lumberton	WTSB-FM	95.7	239	6.5
N. Wilkesboro	WKBC-FM	97.3	247	4.5
Raleigh	WPTF-FM	94.7	234	50.0
	WKIX-FM	96.1	241	29.5
	WRAL-FM	101.5	268	54.0
Reidsville	WREV-FM	102.1	271	1.6
Rocky Mount	WEED-FM	92.1	221	0.27
	WFMA	100.7	264	33.0
Roxboro	WROX-FM	96.7	244	0.6
Salisbury	WSTP-FM	106.5	293	15.0
Sanford	WWGP-FM	105.5	288	0.49
Shelby	WHOS-FM	96.1	241	2.6
Statesville	WDBM-FM	96.9	245	3.6
	WFMX	105.7	289	2.4
Tarboro	WCPS-FM	104.3	282	7.0
Thomasville	WTNC-FM	98.3	252	0.45
Wilmington	WPRV	93.9	230	6.8
Wilson	WVOT-FM	106.1	291	25.0
Winston-Salem	WFBS-FM	88.1	201	0.01
	WAIR-FM	93.1	226	34.0
	WSJS	104.1	281	12.5
	WYFS	107.5	298	1.55

OHIO

Akron	WAPS	89.1	206	1.3
	WCUE-FM	96.5	243	14.5
	WAKR-FM	97.5	248	4.4
Alliance	WFAH-FM	101.7	269	1.0
Ashland	WNCO-FM	101.3	267	10.2
Ashtabula	WREO-FM	97.1	246	200.0
Athens	WOUB-FM	91.5	218	0.01
Barberton	●WDBN	94.9	235	118.0
	● WCNO	106.9	295	28.0
Bellaire	WOMP-FM	100.5	263	9.0
Berea	WBWC	88.3	202	0.01
Bowling Green	WBGU	88.1	201	0.01
Canton	WHBC-FM	94.1	231	15.0
Celina	WMER	94.3	232	0.74
Cincinnati	WGUC	90.9	215	4.7
	WZIP-FM	92.5	223	82.6
	WOIO	98.5	253	14.0
	WFFM	101.1	266	91.0
	WKRC-FM	101.9	270	14.5
	WSAI-FM	102.7	274	14.7
	● WAEF-FM	104.3	282	4.8
	WCPO-FM	105.1	286	16.5
Cleveland	WBOE	90.3	212	9.0
	●WDGO	95.5	238	40.0
	WERE-FM	98.5	253	40.0
	WGAR-FM	99.5	258	31.0
	WHK-FM	100.7	264	11.5
	● WDOK-FM	102.1	271	31.0
	WCRF-FM	103.3	277	21.3
	WJW-FM	104.1	281	2.8
	KYW-FM	105.7	289	27.0
	WABQ-FM	106.5	293	16.5
	●WNOB	107.9	300	135.0
Cleveland Hts.	● WCUY	92.3	222	26.0
Columbus	WOSU-FM	89.7	209	14.0
	WCBE	90.5	213	11.0
	WCOL-FM	92.3	222	7.2
	WVKO-FM	94.7	234	52.0
	WTVN-FM	96.3	242	26.0
	●WBNS-FM	97.1	246	54.0
	WRDF	97.9	250	185.0
Dayton	WHIO-FM	99.1	256	19.0
	WIFE	104.7	284	24.0
	WAVI	107.7	299	31.0

City	Call	Freq.	Ch.	Kw.
Delaware	WSLN	91.1	216	0.01
Eaton	WCTM	92.9	225	7.6
E. Liverpool	WOHI-FM	104.3	282	27.0
Elyria	WEOL-FM	107.3	297	15.0
Findlay	● WFIN-FM	100.5	263	8.2
Fostoria	WFOB-FM	96.7	244	1.0
Fremont	WFRO-FM	99.3	257	1.0
Granville	WDUB	91.3	217	0.01
	WFOL	94.9	235	3.4
Hamilton	WQMS	96.7	244	0.29
	WHOH	103.5	278	8.7
Hillsboro	WSRW-FM	98.1	251	36.3
Kent	WKSU-FM	88.1	201	0.1
Lancaster	WHOK-FM	95.5	238	16.0
Lima	WIMA-FM	102.1	271	15.0
Marion	WMRN-FM	106.9	295	25.0
Marietta	WCMO	89.3	207	0.01
Miamisburg	WFCJ	93.9	230	59.0
Middletown	● WPFB-FM	105.9	290	30.0
Mt. Vernon	WMVO-FM	93.7	229	2.9
Newark	WCLT-FM	100.3	262	8.5
Oxford	WMUB	88.5	203	0.81
	WOXR	97.7	249	0.6
Piqua	WPTW-FM	95.7	239	36.0
Portsmouth	● WPAY-FM	104.1	281	7.0
Salem	WSOM	105.1	286	100.0
Sandusky	WLEC-FM	102.7	274	5.9
Springfield	● WBLY-FM	103.9	280	1.0
Steubenville	WSTV-FM	103.5	278	3.1
Toledo	WTOS	91.3	217	0.73
	WMHE	92.5	223	10.0
	WTRT	99.9	260	8.8
	WSPD-FM	101.5	268	23.0
	● WTOL-FM	104.7	284	1.3
Westerville	WOBN	91.5	218	0.01
Wooster	WWST-FM	104.5	283	13.0
Yellow Sprgs.	WYSO	91.5	218	0.01
Youngstown	WBBW-FM	93.3	227	19.5
	WKBN-FM	98.9	255	50.0
	WRED	101.1	266	24.5

OKLAHOMA

Durant	KSEO-FM	107.3	297	2.75
Norman	WNAD-FM	90.9	215	7.0
Okla. City	KOKH	88.9	205	11.0
	KEFM	94.7	234	3.0
	KYFM	98.9	255	1.5
	KIOO	100.5	263	40.4
	KJEM-FM	102.7	274	29.2
Stillwater	● KOSU-FM	91.7	219	0.38
	KSPI-FM	93.9	230	3.9
Tulsa	KWGS	89.5	203	3.2
	KOGM-FM	92.9	225	4.1
	KIHI	95.5	238	2.95
	● KOCW	97.5	248	1.5
	KAKC	99.5	258	15.5

OREGON

Eugene	KWAX	91.1	216	0.01
	KRVM	91.9	220	0.4
	KEED-FM	93.1	226	1.35
	● KFMY	97.9	250	3.6
	KUGN-FM	99.1	256	0.39
Grants Pass	KGPO	96.9	245	1.3
Medford	KBOY-FM	95.3	237	0.8
Oretech	KTEC	88.1	201	0.01
Portland	KRRC	89.3	207	0.01
	KEX-FM	92.3	222	56.0
	● KGMG	95.5	238	68.0
	● KPFM	97.1	246	33.0
	KPOJ-FM	98.7	254	4.4
	KFMC	99.5	258	7.8
	KQFM	100.3	262	17.0
	KOIN-FM	101.1	266	48.0
	KMCP	102.7	274	16.9

PENNSYLVANIA

Allentown	WFMZ	100.7	264	4.8
	WAEB	104.1	281	9.0
Altoona	WFBG-FM	98.1	251	33.0
	WVAM-FM	100.1	261	0.36
Beaver Falls	WBVP-FM	106.7	294	16.5
Bethlehem	WGPA-FM	95.1	236	10.0
Bloomsburg	WHLM-FM	106.5	293	8.8
Boyertown	WBYO-FM	107.5	298	20.0
Braddock	● WLOA-FM	96.9	245	68.0
Butler	WBUT-FM	97.7	249	0.72
Carlisle	WHYL-FM	102.3	272	0.76
Chambersburg	● WCHA-FM	95.1	236	2.8
Dubois	WCED-FM	102.1	271	3.2
Easton	WEEX-FM	99.9	260	3.3
	WEST-FM	105.7	289	11.0
Erie	WERC-FM	99.9	260	9.7
Glenside	● WIFI	92.5	223	20.0
Hanover	WHVR-FM	98.5	253	7.2
Harrisburg	WHP-FM	97.3	247	1.55
Havertown	WHHS	89.3	207	0.01
Hazelton	WAZL-FM	97.9	250	2.6
Jenkintown	WIBF	103.9	280	0.75
Johnstown	WARD-FM	92.1	221	0.28
	● WJAC-FM	95.5	238	8.3
Lancaster	WDAC	94.5	233	20.0
	WLAN-FM	96.9	245	6.7
	WGAL-FM	101.3	267	3.6
Lebanon	WLBR	100.1	261	0.72
Levittown	WBCB-FM	100.1	261	1.0
Meadville	WMGW-FM	100.3	262	10.0
Media	WXUR-FM	100.3	262	2.7
Montrose	WPEL-FM	96.5	243	57.0
Oil City	WDJR	98.5	253	3.4
Palmyra	WJWR	92.1	221	0.76
Philadelphia	WXPN	88.9	205	0.01
	WRTI-FM	90.1	211	0.79
	WHYY	90.9	215	20.0
	WPWT	91.7	219	0.18
	WIP-FM	93.3	227	20.0
	WIBG-FM	94.1	231	20.0
	● WFLN	95.7	239	20.0
	● WHAT-FM	96.5	243	20.0
	WCAU-FM	98.1	251	10.0
	WPBS	98.9	255	4.6
	WFIL-FM	102.1	271	6.3
	WPEN-FM	102.9	275	20.0
	WPCA-FM	104.5	283	20.0
	WDAS-FM	105.3	287	20.0
	● WQAL	106.1	291	7.8
Pittsburgh	WDUQ	91.5	218	2.75
	KDKA-FM	92.9	225	47.0
	● WKJF	93.7	229	40.0
	● WWSW-FM	94.5	233	20.0
	WCAE-FM	96.1	241	31.0
	WJAS-FM	99.7	259	24.0

City	Call	Freq.	Ch.	Kw.
	WFMP	99.7	259	24.0
	WPGH	104.7	284	2.82
	WAZZ	105.9	290	4.5
	WINE	107.9	300	36.0
Pottsville	WPPA-FM	101.9	270	2.8
Red Lion	WGCB-FM	96.1	241	20.0
Scranton	WUSV	89.9	210	1.35
	WGBI-FM	101.3	267	1.8
Sharon	WPIC-FM	102.9	275	26.0
State College	WDFM	91.1	216	0.25
Sunbury	WKOK-FM	94.1	231	4.4
Towanda	WTTC-FM	92.7	224	7.2
Warren	● WRRN	92.3	222	3.0
Waynesboro	WAYZ-FM	95.1	236	3.0
Wilkes-Barre	WBRE-FM	98.5	253	2.25
	●WYZZ	103.3	277	3.1
Williamsport	WRAK-FM	102.7	274	54.0
	WLYC-FM	105.1	286	0.84
York	WNOW-FM	105.7	289	1.2

RHODE ISLAND

Cranston	WLOV	99.9	260	3.4
Providence	WPRO-FM	92.3	222	15.0
	● WPFM	95.5	238	3.2
	WHIM-FM	98.9	255	3.36
	● WXCN	101.5	268	20.0
	WPJB-FM	105.1	286	20.0
Warwick	WDJD	107.7	299	3.3
Westerly	WERI-FM	103.7	279	17.5
Woonsocket	WWON-FM	106.3	292	0.39

SOUTH CAROLINA

Anderson	WCAC	101.1	266	6.4
Charleston	WTMA-FM	95.1	236	10.0
	WCSC-FM	96.9	245	68.0
Clemson	WSBF-FM	88.1	201	0.01
Columbia	WUSC-FM	89.9	210	0.01
	WCOS-FM	97.9	250	5.3
	WNOK-FM	104.7	284	3.4
Dillon	WDSC-FM	92.9	225	8.8
Greenville	WESC-FM	92.5	223	12.0
	WFBC-FM	93.7	229	9.9
	WMMU-FM	94.5	233	0.84
Laurens	WLBG-FM	100.5	263	3.5
Seneca	● WSNW-FM	98.1	251	9.4
Spartanburg	●WSPA-FM	98.9	255	4.9

TENNESSEE

Bristol	WOPI-FM	96.9	245	9.7
Chattanooga	WDOD-FM	96.5	243	13.0
	WLOM	106.5	293	33.0
Collegedale	WSMC-FM	88.1	201	1.0
Gallatin	WFMG	104.5	283	8.2
Greeneville	WGRV-FM	94.9	235	4.6
Jackson	WTJS-FM	104.1	281	50.0
Johnson City	WJCW-FM	100.7	264	8.1
Kingsport	WKPT-FM	98.5	253	10.0
Knoxville	WKCS	91.1	216	0.31
	WUOT	91.9	220	70.5
	WBIR-FM	93.3	227	3.3
Memphis	WQMM	95.5	238	1.3
	WMPS-FM	97.1	246	6.6
	WMC-FM	99.7	259	30.0
	WDIA	102.7	274	5.2
Nashville	WSIX-FM	97.9	250	30.0
	WFMB	105.9	290	3.4
Sevierville	WSEV-FM	102.1	271	22.0

TEXAS

Amarillo	KGNC-FM	93.1	226	14.5
Austin	KUT-FM	90.7	214	4.1
	● KTBC-FM	93.7	229	94.0
	KAZZ	95.5	238	1.35
	KHFI	98.3	252	0.78
Beaumont	KRIC-FM	97.5	248	9.1
Brownwood	KHPC	88.1	201	0.01
Cedar Hill	KDFW	99.5	258	25.0
Cleburne	KCLE-FM	94.9	235	6.35
Corpus Christi	KMFM	95.5	238	10.0
Dallas	KNER	88.1	201	0.01
	KVTT	91.7	219	0.78
	● KRLD-FM	92.5	223	40.0
	KCPA-FM	94.1	231	4.8
	WFAA-FM	97.9	250	38.0
	KOST	98.7	254	16.5
	WRR-FM	101.1	266	68.0
	KQRO	102.9	275	7.6
	●KIXL-FM	104.5	283	20.0
	• KPSD	105.3	287	8.75
Denton	KDNT-FM	106.3	292	0.76
Diboll	KSPL-FM	95.5	238	6.5
Dumas	KDDD	95.3	237	
El Paso	KVOF-FM	88.5	203	0.01
	KHMS	94.7	234	2.55
Ft. Worth	● WBAP-FM	96.3	242	25.0
	KFJZ-FM	97.1	246	22.0
	KFMF	102.1	271	1.68
Gainesville	KGAF-FM	94.5	233	2.5
Harlingen	KELT	94.5	233	3.1
Hillsboro	KHBR-FM	102.5	273	3.3
Houston	KUHF	91.3	217	9.8
	KJSB	93.7	229	18.5
	KARO	94.5	233	7.6
	KHUL	95.7	239	15.5
	●KXYZ	96.5	243	14.6
	●KFMK	97.9	250	10.5
	• KHGM	99.1	256	49.0
	KROW	100.3	262	16.5
	KTRH-FM	101.1	266	29.5
	● KQUE	102.9	275	64.2
	●KRBE	104.1	281	40.0
Lubbock	KTXT-FM	91.9	220	0.01
	KRKH-FM	93.7	229	9.6
	KBFM	96.3	242	3.6
Marshall	KMHT-FM	97.3	247	5.9
Midland	● KNFM	92.3	222	4.8
Odessa	KQIP	96.9	245	1.7
	KWMO	99.1	256	3.4
Pampa	KBMF-FM	100.3	262	3.0
Plainview	KHBL	88.1	201	0.01
	KVOP-FM	97.3	247	3.0
Porth Arthur	● KFMP	93.3	227	3.2
San Antonio	KITY	92.9	225	3.8
	KEEZ	97.3	247	17.0
	KAKI	98.1	251	25.0
	KISS	99.5	258	12.9
Texarkana	KCMC-FM	98.1	251	1.4
Waco	KEFC	95.5	238	3.2
	WACO-FM	99.9	260	3.9
Waxahachie	KBEC-FM	93.5	228	0.35

City	Call	Freq.	Ch.	Kw.
UTAH				
Logan	KVSC	88.1	201	0.01
Provo	KBYU-FM	88.9	205	0.01
Salt Lake City	KUER	90.1	211	0.35
	KLUB-FM	97.1	246	4.8
	KCPX-FM	98.7	254	1.2
	KSL-FM	100.3	262	5.9
VIRGINIA				
Arlington	WAVA-FM	105.1	286	2.05
Charlottesville	WTJU	91.3	217	0.01
	WINA-FM	95.3	237	0.62
	WCCV	97.5	248	3.4
Crewe	WSVS-FM	104.7	284	14.0
Fredericksburg	WFVA-FM	101.5	268	4.6
Gretna	WMNA-FM	103.3	277	3.0
Hampton	WVEC-FM	101.3	267	28.0
Harrisonburg	WEMC	91.7	219	0.01
	WSVA-FM	100.7	264	7.2
Lynchburg	WWOD-FM	100.1	261	0.94
Marion	WMEV-FM	93.9	230	3.7
Martinville	● WMVA-FM	96.3	242	2.9
Newport News	WGH-FM	97.3	247	36.0
Norfolk	WFOS	90.5	213	0.01
	WMTI	91.5	218	1.45
	● WYFI	99.7	259	11.5
	WRVC	102.5	273	8.7
Portsmouth	WAVY-FM	98.9	255	25.8
Richmond	WRFK	91.1	216	3.6
	WRVA-FM	94.5	233	25.0
	● WCOD	98.1	251	34.0
	WRNL-FM	102.1	271	50.0
Roanoke	WLRJ	92.3	222	2.8
	WDBJ-FM	94.9	235	14.5
	● WSLS-FM	99.1	256	21.0
So. Boston	WHLF-FM	97.5	248	2.4
Staunton	WSGM-FM	93.5	228	0.5
Williamsburg	WCWM	89.1	206	0.01
	WBCI-FM	96.5	243	3.6
Winchester	WRFL	92.5	223	22.0
Woodbridge	WWCN	105.9	290	9.5
WASHINGTON				
Bellingham	KGMI	92.9	225	20.0
Edmonds	KGFM	105.3	287	120.0
Lynden	KLYN-FM	106.5	293	1.45
Opportunity	KZUN-FM	96.1	241	3.3
Seattle	KOTO	93.3	227	6.64
	KUOW	94.9	235	45.0
	●KGMJ	95.7	239	
	●KLSN	96.5	243	14.5
	KING-FM	98.1	251	15.0
	KMCS	98.9	255	10.5
	● KISW	99.9	260	10.5
	KIRO-FM	100.7	264	16.5
	● KETO-FM	101.5	268	17.7
	KPRN	102.5	273	19.0
Spokane	● KZAM	92.5	223	175.0
	KREM-FM	92.9	225	4.8
	KXLY-FM	99.9	260	2.0
	KHQ-FM	98.1	251	47.0
Tacoma	KCPS	90.9	215	0.8
	KTOY	91.7	219	3.5
	KTNT-FM	97.3	247	10.2
	KTWR	103.9	280	0.83
	KLAY-FM	106.3	292	0.83
WEST VIRGINIA				
Beckley	WBKW	99.5	258	34.0
Charleston	WKAZ-FM	97.5	248	9.0
	● WKNA	98.5	253	2.65
Huntington	WKEE	100.5	263	53.0
Martinsburg	WEPM-FM	94.3	232	0.81
Morgantown	WAJR-FM	99.3	257	1.0
Oak Hill	WOAY-FM	94.1	231	14.5
Parkersburg	WAAM-FM	106.5	293	8.9
Wheeling	WKWK-FM	97.3	247	10.0
	WWVA-FM	98.7	254	7.4
WISCONSIN				
Appleton	WLFM	91.1	216	10.5
Baraboo	WWCF	94.9	235	37.0
Brule	WHSA	89.9	210	38.0
Chilton	WHKW	89.3	207	51.0
Colfax	WHWC	88.3	202	50.0
Delafield	WHAD	90.7	214	52.0
Eau Claire	● WIAL	94.1	231	60.0
Ft. Atkinson	WFAW	107.3	297	3.0
Green Bay	WDUZ-FM	98.5	253	2.85
	● WBAY-FM	101.1	266	13.5
Highland	WHHI	91.3	217	43.0
Janesville	WCLO-FM	99.9	260	15.5
Madison	WHA-FM	88.7	204	22.0
	● WISC-FM	98.1	251	1.0
	WIBA-FM	101.5	268	45.0
	WRVB-FM	102.5	273	3.9
	● WMFM	104.1	281	7.5
Milwaukee	WQFM	93.3	227	30.0
	●WTMJ-FM	94.5	233	4.6
	WMIL-FM	95.7	239	29.0
	●WFMR	96.5	243	15.0
	WISN-FM	97.3	247	25.5
	WMLW	98.1	251	141.0
	WEMP-FM	99.1	256	25.0
	●WMKE	102.1	271	115.0
	WRIT-FM	102.9	275	22.0
	WBON	107.7	299	38.0
Monroe	WEKZ-FM	93.7	229	15.0
Racine	WRJN-FM	100.7	264	15.0
Rice Lake	WJMC-FM	96.3	242	50.0
Ripon	WRPN-FM	90.1	211	0.01
S. Beloit	WBEL	103.1	276	
Stevens Pt.	WSPT-FM	97.9	250	15.5
Tomah	WTMB-FM	98.9	255	175.0
Watertown	WTTN-FM	104.7	284	9.6
Sparta	WCOW-FM	97.1	246	
Waukesha	WAUX-FM	106.1	291	3.3
Wausau	WHRM	91.9	220	75.0
	WLIN	95.5	238	20.5
Wauwatosa	WTOS	103.7	279	
West Bend	●WBKV-FM	92.5	223	18.0
W. Salem	WHLA	90.3	212	39.0
Wisc. Rapids	WFHR-FM	103.3	277	2.1
WYOMING				
Cheyenne	KVWO-FM	106.3	292	

FM STATIONS OF CANADA

City	Call	Freq.	Ch.	Kw.
ALBERTA				
Edmunton	CKUA-FM	98.1	251	0.352
	CJCA-FM	99.5	258	0.414
	CFRN-FM	100.3	262	0.279
Lethbridge	CHEC-FM	100.9	265	
BRITISH COLUMBIA				
Vancouver	CHQM-FM	103.5	278	18.9
Victoria	CBU-FM	105.7	289	1.4
	CKDA-FM	98.5	253	0.37
MANITOBA				
Winnipeg	CJOB-FM	103.1	276	0.25
NOVA SCOTIA				
Halifax	CHNS-FM	96.1	241	0.25
Sydney	CJCB-FM	94.9	235	0.63
ONTARIO				
Brampton	CHIC-FM	102.1	271	0.85
Brantford	CKPC-FM	92.1	221	0.25
Cornwall	CJSS-FM	104.3	282	0.5
Ft. William	CKPR-FM	94.3	232	0.25
Huntsville	CKAR-FM	98.5	253	2.8
Kingston	CFRC-FM	91.9	220	1.27
	CKWS-FM	96.3	242	0.35
	CKLC-FM	99.5	258	0.31
Kitchener	CKCR-FM	96.7	244	0.35
London	CKSL-FM	94.3	232	0.9
	CFPL-FM	95.9	240	4.44
Oshawa	*CKLB-FM	93.5	228	14.40
Ottawa	● CFRA-FM	93.9	230	0.383
	CBO-FM	103.3	277	0.38
St. Catherines	CKTB-FM	97.7	249	0.25
Timmins	CKGB-FM	94.5	233	0.425
Sherbrooke	CHLT-FM	102.7	274	57.0
Toronto	CJRT-FM	91.1	216	9.90
	●CHFI-FM	98.1	251	9.45
	●CFRB-FM	99.9	260	0.60
	CBC-FM	99.1	256	11.9
Windsor	CKLW-FM	93.9	230	0.25
QUEBEC				
Montreal	CBF-FM	95.1	236	3.86
	CBM-FM	100.7	264	3.86
	● CFCF-FM	106.5	293	7.70
Quebec	● CHRC-FM	98.1	251	0.595
Rimouski	CJBR-FM	101.5	283	0.57
Verdun	CKVL-FM	96.9	245	10.20

FM STATION LOG

CALL	FREQ.	CH.	LOCATION	ANT. POS.	REMARKS