DataFM: FM Reception Basics

The advantages and disadvantages of FM are almost exactly opposite those of AM—FM signals travel over much shorter distances than AM; however, FM is far more immune to noise and interference and has a much better frequency response and higher fidelity. The overall quality of the FM signal (noise level, dynamic range and so on) you receive is dependent upon the quality of the transmitted signal, your antenna, and by the sensitivity, selectivity and quality (in terms of fidelity and musical accuracy) of your radio or receiver. We mentioned that AM signals, which are much lower in frequency than FM signals, travel much farther than very high frequency FM signals. erefore, there is more of a potential for two or more AM stations to bereceived at the same time. The signals from AM stations can travel hundreds of miles, and it's possible that distant stations on the samefrequency can be heard along with a local station's broadcast. In contrast, this is usually not an issue with local and distant FM stations broadcasting on the same frequency. That's because of the relatively short distances FM signals can be transmitted over the Earth's surface compared to AM (and other radio bands). Also, FM tuners have the ability to capture the strongest FM signal available and reject weaker signals on the same frequency.

Antennas are Important

Aside from the radio (or receiver, or tuner) the most important component for receiving AM and FM broadcasts is the antenna. For FM listening, the most appropriate type of antenna is one that is specifically tuned to receive the FM broadcast band, 88 - 108MHz. Along with choosing the correct type, optimum placement is almost equally important**. (In most installations a simple di-pole, FM or residential VHF TV antenna is adequate) It is also possible to split the signal from an existing master antenna system if there is on site emergency power or there is sufficient signal without powered amplification in the system. It is not recommended that the CATV system be used even if it carries the FM band since the CATV system generally suffers from power outages.** For best reception, an antenna should be located as high as possible. However, height is not the only factor—care must be taken to keep building materials such as brick and stucco from coming between the antenna and the broadcast station, as such materials block radio (and TV) signals.

Also, antennas should not be placed near or behind metal of any type, including gutters, aluminum siding, metal furniture, electrical wiring, the "guy" wiring that secures an outdoor antenna mast, and so on. These can reflect signals and can create unwanted multipath problems, or detune the antenna by their proximity, reducing its efficiency.

Directional or Omnidirectional?

An antenna can be either directional or omnidirectional. A directional antenna has a narrow pickup pattern, and is designed to be aimed at the broadcast station for best reception. A irectional antenna can also reduce multipath distortion, which occurs when part of a broadcast signal reflects off a surface before reaching the antenna. An omnidirectional antenna receives signals equally from all directions, and does not have to be re-oriented for different stations. Some antennas, such as TERK's AM/FM Q, can be oriented for either directional or omnidirectional response to achieve the best reception for the entire FM band.

Choosing and Installing Antenna Downlead Cabling

There are three types of cable in general use for FM antennas. One is the flat 300-ohm twin-lead cable that has been in use for decades. The second and more popular type is RG59/U 75-ohm coaxial cable. **The typical line loss of RG59/U is about 3dB per 100ft at 100MHz. More recently a 75-ohm coaxial cable bearing the designation RG6/U has been popular. It is available in a single-shielded version and in a "quad-shielded" (4 layers of shielding) version. This type of cable has a larger 18ga. center conductor and is capable of passing more signal. with less line loss than RG59/U.** The RG6/U "quad-shielded" variety offers maximum shielding from extraneous interference from devices such as computers, CD players and other electronic sources of interference. However, while the RG6/U has similar specs to RG59/U, it is not a match in terms of electrical specifications, and we do not recommend using it in an installation already containing RG59/U cable. In fact, we offer a word of caution about coaxial cables in general: do not mix different types of coaxial cable unless their technical specs match exactly. Generally speaking, the better grade of 300-ohm twin lead has only about half the losses that occur in coaxial cable. However, because it is unshielded, its superior signal-carrying efficiency can only be taken advantage of in areas where interference is very low. Shielded coaxial cable is far more resistant to picking up interference, as well as less expensive and easier to install. Practically speaking, coaxial cable is the best choice in the majority of circumstances. However, the rural listener who lives in an area of minimum interference might want to take advantage of the higher signal yield provided by a good grade of 300-ohm twin lead, especially when a long length run of lead-in cable is necessary. Typical line loss for a good grade of 300-ohm twin lead cable is only about 1.1dB per 100 ft. at 100 MHz—significantly less than coaxial cable. For best performance, make sure to keep cable installations neat, with clean, tight connections that have been protected against the elements. Here's a tip: when installing coaxial cable, a little bit of silicone grease applied to the connector threads will help guard against corrosive buildup. In an installation using 300-ohm twin lead, the cable should be kept free of anything metal. If the cable must go over metal eaves, pipes and so on, make sure it is kept a distance of at least four inches away to avoid picking up interference. The cable should also be twisted 360 degrees for each foot of cable run, to avoid becoming an antenna itself and detuning the system. Commercial applications may be required to use a Plenum cable.

Suggested Cables

	Standard	Quad Shield	Standard Plenum	Quad Shield Plenum
Coleman RG6/U	92001		921009	921019
Coleman RG59	992101	921024		
Belden RG6/U	1694A	3092F	82120	82248
Belden RG59	8212		82241	1151A
Delco RG6/U			51108P	394167P
Delco RG59			51140P	

Suggested FM Antenna

Terk FM Pro half-wave folded dipole antenna with dual-mode amplifier
Fanfare FM-2G half-wave vertical high-performance antenna

Location and Reception

Generally speaking, the closer you are to the radio station's transmitter, the better your reception will be. The FM broadcast band signal is, for the most part, available only within the line-of sight in a radius around the transmitter. With no hills, mountains or buildings to block its progress, the signal will continue traveling into the atmosphere. However, a phenomenon known as diffraction causes the FM signal to "hug" the earth to a distance (if unobstructed) of approximately 30 percent beyond the line of sight. Reception in this area just outside the primary radius area is referred to as "fringe," and beyond that, "deep fringe". While reception in these areas is unreliable, satisfactory reception can be made possible through the use of an antenna with an inherent signal gain, such as an outdoor Yagi type, or using an amplified antenna or in-line signal amplifier. However, few of these options will likely provide noise-free, reliable reception. In fringe areas, as in the case of primary reception areas, the single best thing to do to provide reliable reception is to mount the antenna as high as possible. Interference problems generally increase as the distance between the transmitting and receiving antennas increase, along with noise that can become mixed in with the broadcast signal.

Important Radio/Tuner Specs

The DataFM excels in all of the following categories of FM tuner specifications:

Sensitivity — the ability of a tuner to pick up stations. The higher the sensitivity, the better the tuner's ability to bring in weaker stations clearly. A good sensitivity figure will indicate the tuner's ability to pull in a moderately distant station mostly noise-free and in stereo. While here are three different specifications, IHF, Usable and 50dB quieting, that can be used to xpress sensitivity, the most commonly used spec is the 50dB quieting sensitivity. The lower the number, the better. The number for mono will be lower than for stereo. A tuner with excellent specs will have a 50dB quieting sensitivity of better than 30dbF (stereo) and 10dBf (mono).

Adjacent channel selectivity — the ability to receive a station without interference from the station next to it on the dial. The more commonly seen specification is alternate channel selectivity — the ability to reject a strong station two channels away from the one you want to receive. The higher the number the better; 40dB-50dB is the range for a quality tuner. Selectivity is often expressed for both narrow and wide IF bandwidth; it will be higher for narrow. In urban areas with a lot of stations, adjacent channel and alternate channel selectivity are prime considerations; in rural areas with fewer, more distant stations, sensitivity is more important.

Capture ratio — when two stations are broadcasting at the same frequency, the difference in dB between the strengths of the stations needed for the tuner to receive the stronger station and reject the weaker one. The lower the ratio, the better. 1dB is excellent; 2 dB is barely adequate.

Signal-to-noise ratio — a measurement indicating the difference in dB between the level of the background noise and the level of the signal. The higher the number, the better the signal to noise ratio and the quieter the tuner. Usually expressed in maximum S/N, dB, mono/stereo. A specification of 65dB stereo/80dB mono is good while 70dB/80dB is excellent.