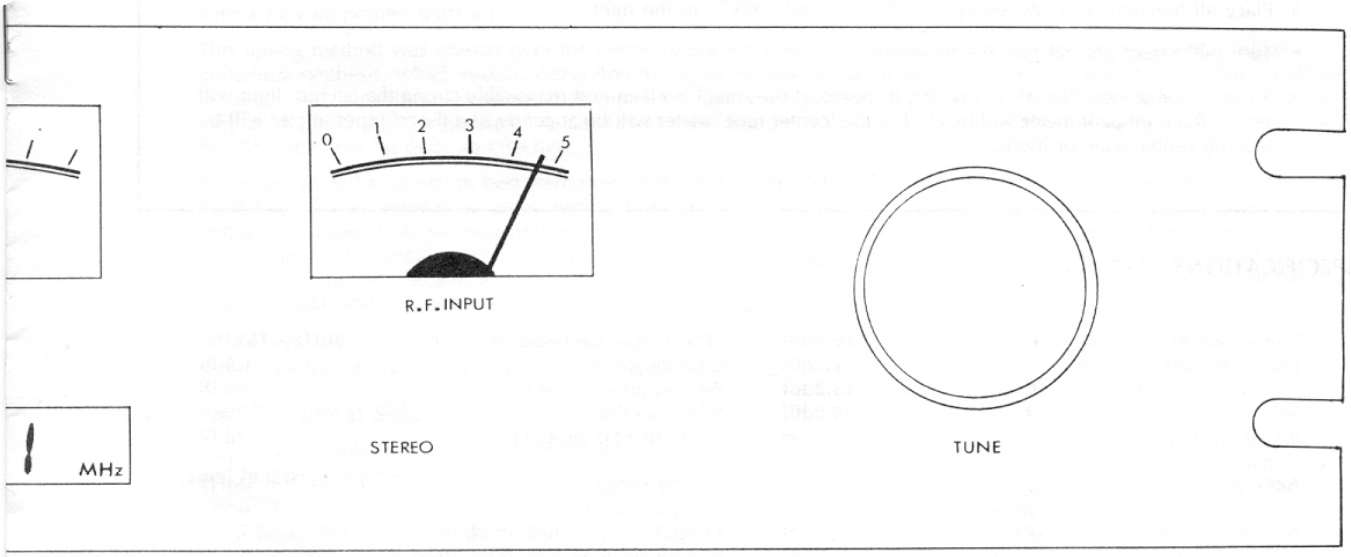
MAGNUM dynalab | **FT-101**



digital/analog reference FM tuner

Owner's Manual

OPERATION & SETUP - The short strokes for those in a hurry.

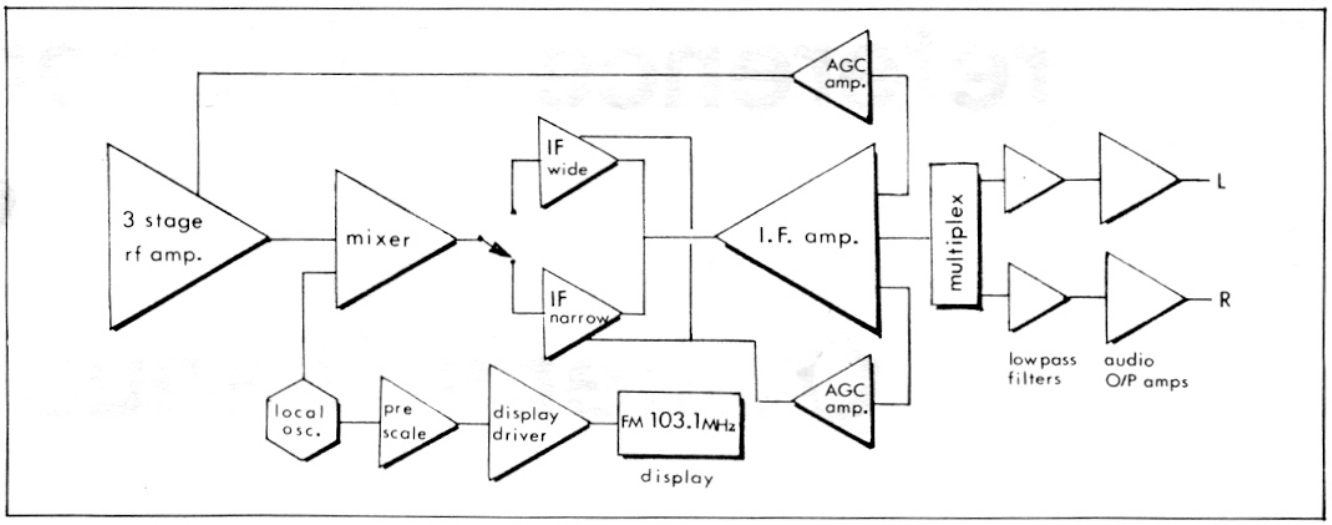
1. Place the tuner within reach of the preamp using the enclosed audio cable's length as a guide.
2. Connect output cables to "Hi-output" of FM tuner and to "Tuner" (High impedance(Z), if more than one) on the preamp.
3. Connect your FM antenna cable to the "Antenna In" terminal on the tuner. If your antenna cable is 300 ohm twin lead, use the 300 to 75 ohm matching transformer included with the tuner.
4. Plug the tuner's power cable into a 120vac receptacle, preferably one on the back of your preamp or amp that is marked "switched".
5. Place all function switches, except "IF BAND" and "AFC", to the right.
6. Turn the system on and turn the tuner on.
7. Tune a local station that is transmitting in stereo. If the signal is clean and reasonably strong the 'stereo' light will be on; the multipath meter will be at "0"; the 'center tune' meter will be at center and the 'rf input' meter will be reading center scale or more.

SPECIFICATIONS — FT-101 Digital/analog FM tuner

Usable sensitivity (mono)	**10.2dBf**	-3dB frequency response	**20Hz - 16KHz.**
Usable sensitivity (stereo)	**11.2dBf**	Capture Ratio	**1.5dB**
Sensitivity - 50dB quieting (mono)	**13.2dBf**	AM suppression ratio	**60dB**
Sensitivity - 50dB quieting (stereo)	**34.0dBf**	SCA rejection	**-75dB**
Image rejection ratio	**75dB (or better)**	19 & 38 KHz products	**-70dB**
Signal-to-noise ratio - mono	**80dB**		
Alternate Channel atten. - wide	**50dB**	**Tuning range**	87.5 - 108.5MHz
- narrow	**83dB**	**Antenna input**	75 ohms
Adjacent Channel atten. - wide	**8dB**	**Output level @ 30% mod. (hi)**	250mv
- narrow	**20dB**	**Output level @ 30% mod. (lo)**	95mv
THD (mono)	**0.10%**	**Output Impedance**	600 ohms
THD (stereo)	**0.18%**	**Power requirement**	120vac @ 75 watts
Stereo separation	**60db**	**Weight**	12 lbs. (5.5 kg)

Dimensions — FT-101 & FT-101R; Cabinet — (in.) 3.65(h) x 17.0(w) x 13.0(d) (mm) 93x432x330
Front panel — (in.) 3.65(h) x 19.0(w) (mm) 93x483

BLOCK DIAGRAM



1.0 INTRODUCTION

The **MAGNUM DYNALAB FT-101** is a fully state-of-the-art FM tuner offering the kind of sensitivity and selectivity that excelled in the much-revered, North American, FM tuner designs of years ago.

With the highest level of performance always in mind, **MAGNUM DYNALAB** has maintained a reputation for high quality, FM reception products and is justifiably proud of the FT-101. To many, its functional capabilities embody 'high end' tradition, with some referring to it as "a breath of fresh air". Many agree it has been a long time since they have seen an FM tuner with more inherent and useful features, at such a popular price. Most mentioned seems to be that the FT-101's design promotes the efficiency of the tuner rather than complex operating 'gadgetry'. Need we say more?

1.1 Why Analog/Digital?

For the uninitiated, analog/digital means simply that tuning is accomplished by a voltage-controlled, local oscillator (L.O.) circuit. The station frequency readout is shown in digital form, instead of being interpreted from a 'slide-rule' dial with a moving pointer (cursor.)

This tuning method was chosen over the trendy,frequency synthesis arrangement for a number of reasons. Unlike frequency synthesis, which usually offers fine tuning in increments of no better than 5KHz, analog tuning has an almost infinite tuning capability. Therefore, if an interference problem presents itself on the station frequency, an analog tuner may be detuned slightly (perhaps 1 or 2KHz.) to minimize the interference. Whereas, the frequency synthesis tuner, with its 5KHz may not be quite so effective.

Accurate tuning being key to best stereo reception may be academic. The way it is accomplished is not. With the FT-101, tuning accuracy is accomplished with the 'center tune' meter which responds to the actual signal. With frequency synthesis, its pre-programmed microprocessor has already established where the station should be and tunes to that point automatically. While this type of system may be quite efficient, it presupposes that *all* FM stations are *always* on frequency. Again, with the FT-101 being able to fine-tune each station accurately, you are assured of the quietest signal and maximum stereo separation.

As a result of its tuning accuracy and performance specifications, the FT-101 has been dubbed a 'reference tuner' and is recommended for use in situations requiring such a useful capability.

1.2 The Technical Side

Playing a key role in the FT-101's design is *balance of function.* Equal attention has been given to sensitivity, selectivity and frequency response. It is your assurance of the ultimate in FM-stereo that is crystal clear and rich in its original ambience.

For a stereo FM tuner, the most important sensitivity specification is the amount of signal required for 50dB quieting in stereo. Continuous, independent laboratory testing of the FT-101 has placed that level at around 34.0dBf or 27.5 microvolts. This is accomplished using a 3 stage, MOSFET front end, offering extremely low noise characteristics and a highly respectable Signal-to-Noise ratio of better than 70dB.

Being able to function equally effectively in heavily-signalled, urban areas, as well as the less-congested suburbs, is much less of a task for the FT-101 than for many other FM tuners. The key is 'selective IF Band switching' which provides a nominal Adjacent Channel Rejection of 20dB (upwards of 30dB at 107MHz), along with a remarkable 80dB+ of Alternate Channel Selectivity. This maintains excellent separation of the weaker, more distant station signals that are often found sandwiched between stronger, local stations. Along with eliminating third order intermodulation, it also relieves much of the annoyance caused by bass modulation override from adjacent stations.

Capture Ratio is the tuner's ability to place undivided attention on the strongest signal presented on the tuned frequency. The FT-101's 1.5db does an impressive job of rejecting unwanted, on-frequency, signal interference such as multipath and also sporadic signals resulting from troposheric scatter interference.

NOTE: Such an extraordinary level of selectivity is obtained by some designs at the expense of fidelity through added distortion. Not so in the case of the FT-101. Nominal distortion has been maintained to very respectable levels through the use of *group delay* ceramic filtering. This method assures maximum interference rejection without adding distortion.

2.0 SETTING UP — A More Detailed Approach

2.1 Find a suitable location for the tuner within the shortest possible reach of your preamp. Avoid hot spots. An unusual amount of heat could possibly disrupt the accuracy of the tuner's frequency display circuitry. However, with the clock circuit not being an integral part of the tuning circuit, the actual tuning function will not be disrupted, except visually.

2.2 Cable length is important. The shorter the cable the less will be the loss of frequency response between tuner and preamp. If you wish to replace the cables supplied for slightly longer or shorter ones, make sure they are good quality, audio frequency cables.

2.3 Connect the audio cables between the tuner's "HI Output" terminals and your preamp's "tuner input" terminals. If you have both low and high impedance inputs, use the high impedance terminals. However, with the tuner's output at 600 ohms, it should work relatively equally well into both a high and low impedance input. You may wish to experiment though to determine which input is best for you, sonically.

The FT-101 is equipped with both "HI" and "LO" output jacks. This is to eliminate intermodulation problems caused when preamps requiring relatively low input drive are switched to a source other than the FM tuner. If you are experiencing intermodulation problems, switch the cables to the "LO" output jacks.

2.4 Connect your FM antenna cable to the tuner's "Antenna In" terminal. This takes the 'F' type connector used with 75 ohm coaxial cable. If your antenna cable is the flat, 300 ohm, twin-lead, adapt it for the tuner by using the matching transformer supplied.

2.5 Locate a 120vac power source; preferably one that is switched on with your audio system. This may be available on the rear apron of the preamp and/or amp.

3.0 OPERATION

3.1 With the tuner's power switch turned 'off', turn your system's power 'on'.

3.2 Place all of the tuner's four function switches in the left position and turn the power switch 'on'. Unless the frequency display is set to a particular station, you should hear only noise. If a station is being received, rotate the tuning control until noise is heard. Move the MUTE switch to the 'on' position. The tuner should now be fully quieted with no noise or station signal audible.

3.3 Leave the MUTE circuit 'on' and tune to a strong, stereo signal. As you do, observe the action of both the MULTIPATH and RF INPUT signal meters. Throughout this exercise, the STEREO light should *not* be illuminated. Having reached your station, fine tune the signal by placing the 'center tune' meter pointer directly in the center.

3.4 Place the MODE switch in the 'STEREO' position. The STEREO light should now be illuminated and the audio should be in stereo.

3.5 With the station properly tuned, switch the A.F.C. control 'on'. This will lock the tuner's circuitry onto the signal and maintain the proper frequency.

Note: The A.F.C. circuit will attempt to 'seize' onto the strongest signal available. Therefore, when tuned to a weak signal where the signal from an overly strong adjacent station may be interfering it is recommended that the A.F.C. switch be left 'off'.

3.6 The I.F. BAND switch is usually left in the 'WIDE' position unless you are having difficulty with an adjacent station signal. If you are experiencing interference from an adjacent station, switch to 'NARROW'. The interference should disappear. When switching to narrow, it is recommended that you switch the A.F.C. control to 'off'. Please see 'NOTE', Sec. 3.5.

4.0 RECEPTION TECHNIQUES

4.1 Perhaps the most important part of any reception system is the antenna. If you recall the ancient crystal receivers in use when radio was a pup, you will also recall it was the efficiency of the antenna that determined reception distance and station clarity. Many modern receivers and tuners now have such phenomenal sensitivity that weak signals can be received clearly with only a small antenna. However, along with such sensitivity comes the need for a metal cabinet to shield against stray interference. With such shielding, some type of antenna may be required for even the strongest signal.

4.2 The most appropriate antenna is one that is tuned to receive the FM broadcast band of 88 through 108MHz. The best placement is the highest possible location. Care must be taken that it be kept away from obstructions such as walls, chimneys etc. Also, it should not be placed near metal of any type, including furniture, eavestroughing, railings, beside TV masts or near their guy wiring. Such influences can reflect signals and create multipath problems. Or, the antenna could become detuned, thereby sapping its efficiency

Of the FM broadcast band antennas avilable, the following are most common;

Bidirectional Folded Dipole — (See FIG.4) This is perhaps the most commonly used FM antenna. It is also the basic element in any yagi antenna. The dipole receives in a direction at right angles to its length. With two flat sides it receives equally well from front and back. However, as the angle changes from the center towards the outside (or ends), its sensitivity falls off markedly.

You have also seen this design in its crudest form as the ubiquitous 79 cent 'wire dipole' found packed with just about every other FM tuner and receiver. As specialists in the field of FM reception we feel it most important to point you in the right direction with an antenna that will provide the best possible signal for an initial installation. That is why the 'Silver Ribbon' dipole is packed with your FT-101. It will also illustrate to you just how efficiently a good, 'folded dipole' works.

Aside from having considerably less gain than the unidirectional antenna, it is similar and must be rotated for best reception. Although, being bidirectional, it need be rotated only half as far.

Unidirectional Dipole — (See FIG. 2) This is a folded dipole with one, tuned element added. This added element acts as a reflector to allow concentration in the direction opposite where the 'reflector' is installed. The dipole element is now at what is refered to as the 'forward end'. The unidirectional dipole has about double the gain of a single dipole.

This type of antenna is particularly useful where the desired stations are in one general direction and you are situated in their 'fringe zone'.

Vertical 1/2 wave — (see FIG. 5 This antenna is the newest and perhaps the most revolutionary design on the market today. There are a number of distinct advantages offered by this design, over the dipole. First, it is fully omnidirectional in receptive capability. Second, it is receptive only to the vertically-polarized portion of the signal and is somewhat less sensitive to multipath interference. Another advantage is the gain provided, which is approximately similar to that derived from the previously-mentioned, 'unidirectional dipole'. This antenna, referred to as the MAGNUM DYNALAB model ST-2, is available from your MAGNUM DYNALAB dealer.

With this antenna being a 1/2 wave design, no 'ground' is necessary for its function. It can be installed on a mast or on any surface, including that of a car, truck or boat. As a matter of fact, it will work equally in your hand, if held up by the base.

Turnstile (crossed dipole) — (See FIG. 3 This antenna came to pass as an attempt to establish an omnidirectional receive pattern, without the need for rotating the antenna. Unfortunately, tests conducted on this design showed a reduction in efficiency (about -3dB) when compared with the results obtained with a single, bidirectional dipole. The vertical antenna mentioned above would be worth considering in place of this antenna.

Multi-element Yagi — (See FIG. 1) This is a unidirectional antenna capable of pulling in very distant stations due to its high gain. You will note that it resembles the unidirectional dipole mentioned above. However, 'director units have been added forward of the dipole. Their purpose is to further refine the antenna's forward directivity, thereby providing even more 'forward gain'.

Along with this antenna's directivity may come the need for it to be rotated each time you tune to a station that is 'around the compass' from the one tuned previously. A good quality antenna of this type*, mounted high on a mast, should provide you with the best, unaided, FM reception possible.

* It should also be mentioned here that both the 'log periodic' and 'collinear array' designs have high gain and directivity as well.

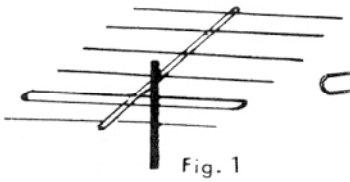


Fig. 1

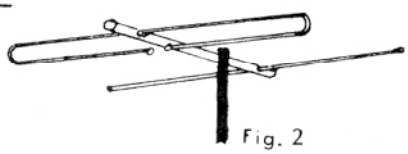


Fig. 2

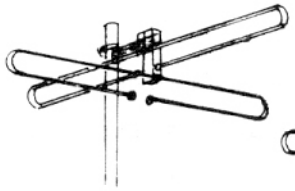


Fig. 3

Fig. 4

Fig. 5

4.3 ANTENNA DOWNLEAD CABLING

There are two types of cable in general use for home-type, FM antennas. One is the flat, twin-lead cable that has been used since TV was introduced. The second type is the more recently-popularized, 75 ohm coaxial cable; also referred to as RG59/U cable.

Speaking generally, the better grade of 300 ohm twin lead has about 1/2 the losses that occur in a like grade of 75 ohm coaxial cable. However, the coaxial cable provides (a) much better protection against interference pickup and, (b) a much easier and less expensive installation. The tradeoff of slightly less signal for a quieter and less costly installation is a small price to pay in some cases.

FM listeners who are not bothered by local interference may want to take advantage of the higher signal yield (over the use of coaxial cable) by using a good grade of 300 ohm twin lead when a long run of lead-in cable is necessary.

Two major contributors to lasting antenna efficiency are; a neat, well-thought-out cable run and, (b) clean, tight connections that have been protected against the elements. For coaxial cable, a little silicone grease on the connection will help avoid corrosive buildup. For 300 ohm twin lead, the avoidance of running the cable near metal is important. If it must go over eavestroughing, pipes etc., make sure it is 'stood off' a distance of at least 4 inches to avoid detuning itself or picking up interference that is being conducted through the metal.

N.B. The reference to 300 ohm twin lead excludes the shielded variety. This type has about same loss factor as coaxial lead-in.

IMPORTANT: If you are using more than one piece of coaxial cable in your installation, make sure that you use cables whose specifications match exactly. As an example, you should avoid mixing RG59/U cable with coaxial cable referred to simply as "75 ohm", or "RG59/U type". Have your present cable type verified and matched by having the cable specs. cross-referenced. Only cable with the "RG59/U" spec (without the word "type" following it) can be relied upon to match exactly with other cables having the same spec..

4.5 GAIN AND WHAT IT MEANS

The perfect antenna receives equally well in *every* direction. However, such an antenna design exists only in theory and is referred to as an 'isotropic radiator' (see FIG. 7). Because our main concentration is on the area above ground level, methods have been discovered to improve antenna efficiency. One is by transferring its receptive capability from one direction and 'adding' it, electrically, to the antenna's receptive capability in another direction.

The best example of this is the yagi antenna referred to earlier. In this case, they have taken a dipole antenna and added a reflector behind the dipole to establish a concentration in one direction. The reflector's location is now called the "back". To the front have been added 'director' elements that establish a *tuned* attitude towards an established band of frequencies. They further 'shape' the antenna's directivity by moving its concentration, electrically, to a more forward location. As a result, the antenna has been 'desensitized' to signals arriving at it from the sides and back and has become 'ultra-sensitive' to signals arriving at a narrow beam angle from the front. The amount by which it has become sensitive in relation to that of a single dipole is called 'gain'. In terms of signal voltage, each 6dB of gain represents a doubling of the signal voltage over that derived using the reference dipole.

5.0 HOW THE FM SIGNAL GETS TO YOU

Once the signal leaves the transmitter it moves outward over the terrain. With no hills, mountains or buildings to block its progress, it will continue until it dies naturally. This occurrence can be expressed in the formula $1.42\sqrt{h}$ where 'h' is the height of the transmitting antenna. This calculates the expected ground coverage of a signal, assuming it is not obstructed.

Similarly, the actual distance over which an unobstructed signal can be received relies on the height of the receiving antenna. To determine what kind of reception you should expect, apply the formula of $1.42\sqrt{h}$ to this information and add this result to that derived from the transmitting antenna result. If the total is less than the actual direct-line distance between your location and the transmitter site, you are not within the area of ground wave coverage.

Reception outside the ground wave coverage area must be classified as unreliable. However, reception in the areas referred to as "fringe" and "deep fringe" (see FIG. 8) is possible in many cases through the use of a 'gain' antenna, such as the yagi mentioned in section 4.2. To that, one could also add an antenna signal amplifier (booster) such as the MAGNUM DYNALAB "Signal Sleuth'.

IMPORTANT: It must be clearly understood that height is the key to distance, not gain or signal power.

6.0 FACTORS AFFECTING FM RECEPTION

The most obvious is the one just mentioned, distance. The FM broadcast band signal, being very high frequency (VHF) in nature, is available only within line-of-sight. Beyond that it is said to continue its travel into the atmosphere. However, a phenomenon known as diffraction causes the signal to 'hug' the earth to a distance (if unobstructed) of approximately 30% (possibly more) beyond line-of-sight (see FIG. 8). It is this phenomenon that determines the quality of signal reception within the fringe and deep fringe zones.

Interference problems generally increase as the distance between the transmitting and receiving antennas increase. Along with noise that can find itself 'mixed' inseparably with the signal, there is fluttering and fading of the signal caused by aircraft flying within that area and also by atmospherics. As well, there is 'tropospheric scatter' which causes part of a distant signal to be reflected (refracted) back down to earth some distance away (see fig. 8). This is often evident when a temperature inversion is somewhere overhead in the signal's path. Such a phenomenon can create reception where there was none before, or it can disrupt reception of a local station already on that frequency.

The obstructions to an FM signal range from small buildings to mountains. Dependant on the signal's strength when meeting such an obstruction, the result could be partial absorption or reflection. However, this would depend on the physical properties of the obstruction.

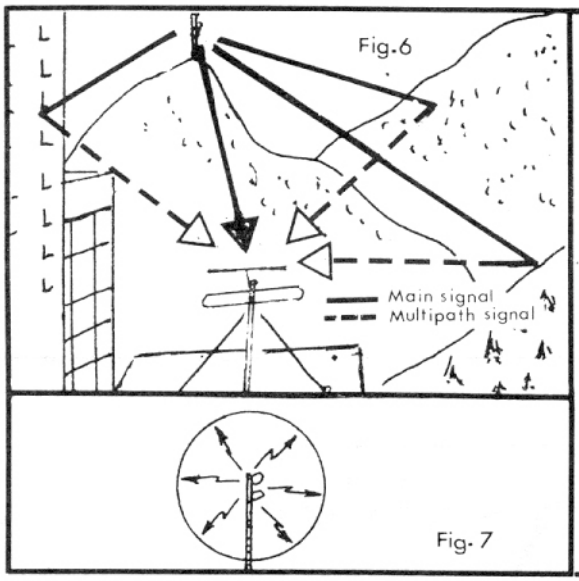
If some of the signal were to be reflected, you could end up with the main signal, plus any number of reflected signals, each of which is now out of step with the main signal (see FIG. 6). We refer to these extraneous signals as "multipath interference". It is one or more of these multipath signals arriving at your antenna out of time/phase synch with the main signal that can disrupt the quality of the signal, thereby rendering it very 'fuzzy', and usually unlistenable.

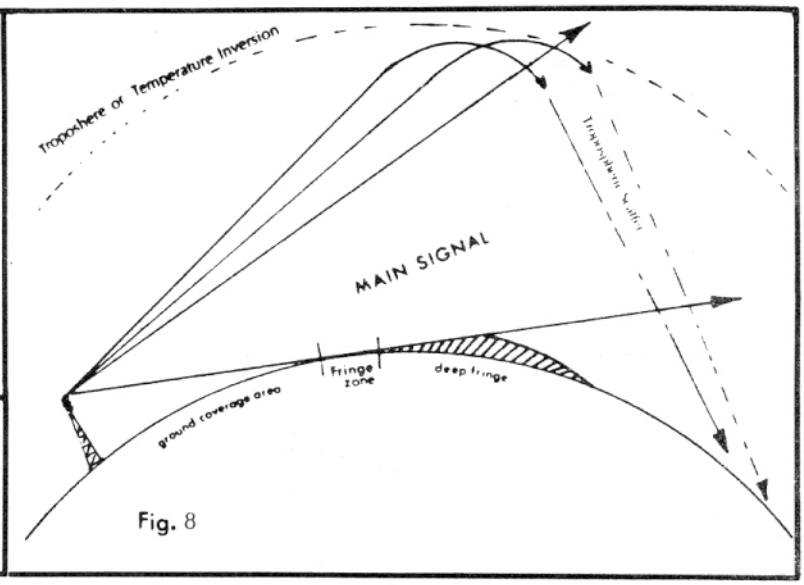
Aside from noise generated within the locale of the antenna, most other types of interference are easily dealt with by the characteristics inherent in a good FM tuner design. The problem is that interference can make itself known at different points within the tuner's circuitry.

The circuit's ability to deal with interference from other station signals lies mainly in its selectivity. This includes *Adjacent Channel Rejection* which deals with interference within 200KHz of the tuned frequency and *Alternate Channel Selectivity,* which deals with interference from 200KHz throughout the 400KHz region. The effectiveness of each of these functions depends on the capability of the tuner's front end and IF to establish a tight pass band for the selected station frequency, without adding distortion.

A few tuners do not have this circuitry as it detracts from the front end's sensitivity. As a result, they can easily 'saturate' if connected to a high gain antenna that applies equal gain across the band. Any strong station could present problems by appearing as an 'image' at more than one point on the dial.

Finally, a good *Sensitivity* figure puts the tuner in a position to pull in most stations so that they can be heard in their intended stereo. This is expressed in terms of dBf or microvolts(μv). While there are three different references used to express sensitivity; "IHF", "usable" and "50dB quieting", the latter, expressed in terms of 'mono' and 'stereo' is the most significant. It is at the 50dB quieting level that the signal will be quiet enough to provide audio worth listening to.





7.0 FM RECEPTION AIDS & ACCESSORIES

There is no question, the two factors affecting FM reception the most are; (a) the type of antenna used, and (b) its height above the ground. With the antenna being the most important consideration of the two, one must understand that there is nothing 'magic' about radio reception. It is therefore important to bear in mind that the most efficient antenna will, by design, present as much receptive surface as possible to the arriving signal. As a result, antennas with more tuned elements, or with the longest possible tuned, single element, will do the best job.

One reception aid that can provide some compensation for insufficient antenna gain is a good quality antenna signal booster amplifier. In this case we refer to the **MAGNUM DYNALAB** FM 'Signal Sleuth' antenna amplifier. Of all the antenna amps on the North American market, this unit is the only one providing adjustable signal gain and selective tuning. These are both very important considerations for the urban, suburban and deep fringe FM listeners alike. For both the urban and suburban listeners it provides extra gain control for both strong and weak stations and extra selectivity to help deal with heavy, intermodulation problems. For the deep fringe listener it gives needed signal gain without adding noise or noticeable amplification of adjacent signals.

SUMMING UP

The best possible stereo FM reception requires a good FM tuner and a good antenna placed reasonably high and in an unobstructed location. With your already having acquired the **MAGNUM DYNALAB** FT-101, half of that requirement has already been more than met.

FOR YOUR SAFETY The following message appears on the rear panel of this device. Please pay attention to it.

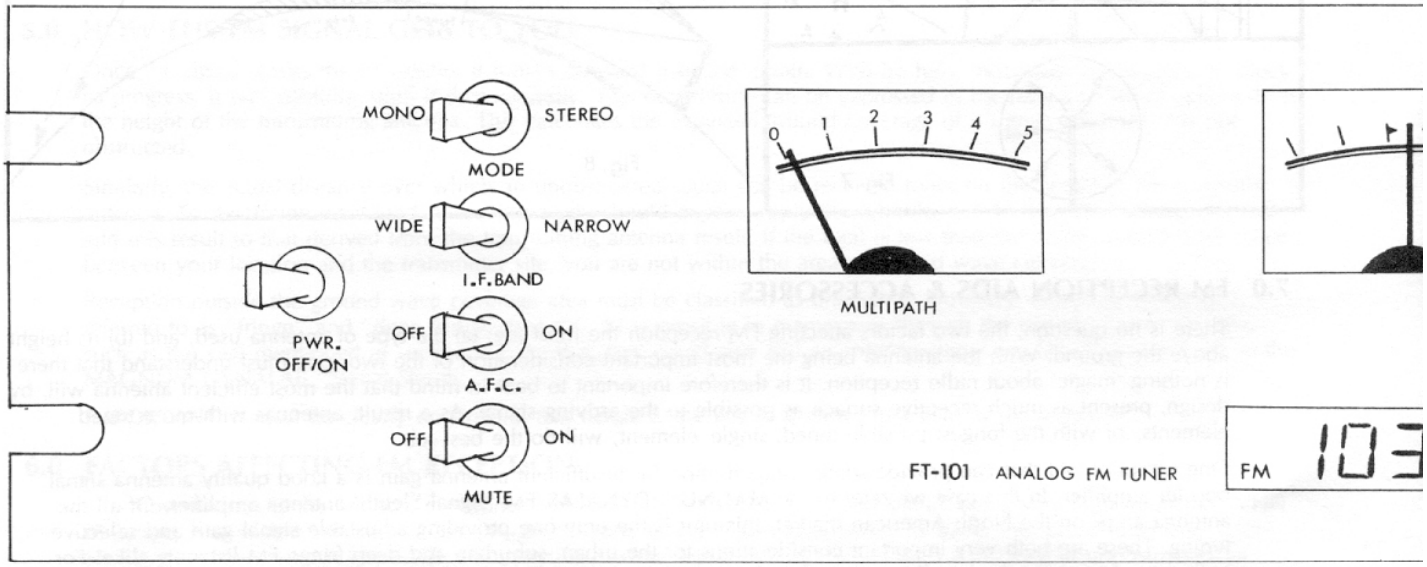
WARNING

TO PREVENT RISK OF SHOCK OR FIRE HAZARD, DO NOT OPEN CABINET OR EXPOSE DEVICE TO MOISTURE.

NO USER - SERVICEABLE PARTS INSIDE. REFER SERVICING TO QUALIFIED SERVICE PERSONNEL.

ATTENTION

RISQUE DE CHOC. NE PAS ENLEVER.



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