

Technical Requirements for LPFM Station Operations
and

Guide to Filling Out FCC FORM 318
SECTION V: ENGINEERING SPECIFICATIONS

TECHNICAL REQUIREMENTS FOR LPFM STATION OPERATION

While the FCC hopes that LPFM stations will have relatively simple operations, nonetheless the Commission is requiring LPFM stations to meet most of the same legal and technical requirements that all educational, noncommercial FM stations must meet. Most of these operating requirements are simple and inexpensive, but they include having to participate in the EAS (Emergency Alert System) by installing special equipment, and keeping such records and logs as the FCC might require to ensure that your transmitter is operating properly without causing interference. [For detailed up-to-date operating requirements of non-commercial public radio stations, contact the National Federation of Community Broadcasters.]

GETTING STARTED

There are three main technical elements that are needed to operate a radio station:

1. A physical place to hang an FM *antenna*.
2. A place to install a *transmitter*.
3. A location for your *broadcast studio*.

To apply for an LPFM license, you MUST have a location to install your antenna and transmitter. You do not need a studio location to fill in the application. But eventually you will need a studio site before you go on the air.

Transmission Facilities

The **antenna** and the **transmitter** are your broadcast transmitting elements. This is where your signal originates and goes out into the airwaves. These two pieces of equipment are usually (but not always) installed in proximity to each other. For LPFM, the FCC requires that your transmitter and antenna be located within 10 miles of where your organization functions.

- An FM antenna is similar to a television antenna that you might put on a roof to improve TV reception. It can be installed on a mast or pole secured to the roof of a building, on a freestanding tower, or on some other structure that elevates it above the ground. This can be anywhere from 100 to 1000 feet or higher, if it is on a hill or mountain.
- The signal reaches the radiating elements of the antenna through a special cable that is connected to the transmitter. The cable leaves the transmitter and must be long enough to reach the antenna, feeding the broadcast signal.
- The transmitter is generally located in a closet or room on or near the roof, somewhere else in the same building as the antenna, or in a shack or building on the ground under the tower.
- The antenna does not need its own power. It gets its power from the transmission signal and is designed to be outside.
- The transmitter needs electricity and must be inside, protected from the weather.
- Both your antenna and your transmitter must be “tuned” to the frequency you are assigned by the FCC, so that the signal is broadcast on the correct channel and only that channel. When you purchase your transmitter, you will tell the manufacturer your frequency and it will arrive pre-tuned or with instructions on how to tune it. LPFM antennas are broadband, and will be able to transmit from any frequency you are assigned. The manufacturer will tell you if it needs to be pre-tuned.

Broadcast Studio

The programs you broadcast originate from a **control room**, also called a **broadcast studio**. This is the place where the microphones, CD players, cassette machines, and other equipment is located so people can produce live and recorded radio programs. Most commercial and many non-commercial public radio stations have several control rooms and studios, where they can record, edit, mix and broadcast programs all at the same time. But a radio studio does not need to be either expensive or complicated to sound good and be easy to use.

- You do not need an FCC license or any permissions to build and run a radio production studio.
- You do not need any kind of special room. The studio can be in its own dedicated room, in a closet, or even in a corner of a room that is used for other purposes. The main condition is that it be quiet enough that the room noise does not overly distract from your radio broadcast, or be too confusing to listeners.
- Consumer quality equipment, such as CD players and cassette decks, is adequate for most broadcast uses that you might have.
- However, if you intend to learn or teach more advanced radio skills or production techniques, or use some equipment very heavily, you might want to invest in ‘professional quality’ equipment which is more expensive but designed for long-term durability.

To be heard on the radio, the programs that you originate in your studio must travel to the transmitter in one way or another, by cable, or through the air.

- Try to locate your studio as close to the transmitter as possible. If you can, put the studios in a room nearby where the transmitter is located. Then, connecting the equipment in your studio to your transmitter might only need some cables.
- If this is not possible, try to put your studio in the same building as the transmitter. Often, studios are located on one floor of a building and the transmitter is on the roof. The cable between them is run through an elevator shaft, stairway, or other conduit that connects them.
- You might have to locate your studio in another building or some other place distant from the transmitter. In this instance, you will need an *STL – Studio to Transmitter Link* – that will connect your program signal to the transmitter in a reliable way.
- There are several ways to set up an STL. One of the simplest is to get a land line to provide a dedicated connection between your studio and your transmitter. This is arranged through a phone service provider and is similar to getting a regular dial-up phone line, but with better quality. There are also other technical solutions, such as using a microwave link, which requires a different kind of license from the FCC. The most cost-effective and reliable method for your station will depend on the particular circumstance and location of your facilities. [You will probably need an engineer to help set up an STL.]

When these three elements – antenna, transmitter, and studio -- are hooked up and turned on, you're on the air!!!

HOW MUCH WILL IT COST?

regular audio equipment, you can get help from a friendly local musician, sound technician, audiophile or radio producer who knows audio recording and would be pleased to advise you about putting together an appropriate complement of studio equipment.

Hiring Broadcast Engineers

It is likely that at some point during your station construction, you will need a broadcast engineer to assist you with an on-site installation or facilities problem, such as transmitter testing or installing an STL. You might want to make friends with one of the engineers who work for the local commercial or public broadcast station. (Often engineers will work for several stations at the same time.) Most of them will work on an hourly basis for specific projects or emergencies, or on a contract basis for a longer term project. Many of them might be willing to advise you as a volunteer, or charge you only nominal fees.

You can also look for free or inexpensive help from other local technical folks – amateur (ham) radio operators, musicians, producers, computer technicians –

Then they will try to fit your station into the spaces between these separations. This is actually a complex calculation that must take into account several interrelated factors, including geographic location of the antenna, its height above average terrain (because FM is line-of-sight, the higher an antenna, the further its signal will reach) and the power of the signal (anywhere between 1-100 watts.)

Based on your proposed antenna location, the FCC will determine if there is an available frequency. The new stations will be licensed to operate anywhere they fit in the FM band, not only in the portion of the band dedicated for noncommercial public radio use, and will be assigned frequency allocations separated from existing stations by at least two channels (first and second adjacent channels).

In a change from general practice, the new stations do NOT have to be geographically separated from stations three channels away (third adjacent channel.) For example, under the rules for existing full power stations, if a station is operating on 93.5 FM, there can be no other station nearby on 93.7 (first adjacent channel) 93.9 (second adjacent channel) or 94.1 (third adjacent channel.) According to the LPFM rules, a new station CAN be licensed at 94.1 in the vicinity of the full power station. [This is the rule change that the National Association of Broadcasters is trying very hard to overturn.]

Where Should You Put your Antenna?

This is the most important part of SECTION V, because it will determine if your proposed station can be awarded a frequency on the FM dial.

FM signals travel in *line-of-sight*, which means that the higher the antenna is off the ground, the further the signal will travel. Any physical obstruction in its way will stop the signal. FM antennas are relatively small and light-weight, and can easily be attached to a wide variety of supporting structures without any special reinforcement, such as telephone poles, metal or wooden masts, water towers, elevated roof-top structures, and existing towers. So be flexible in looking for a good location.

- The FCC requires that your antenna be located **within 10 miles** of your offices or campus.
- **Try to find the highest location possible for your antenna**, such as a spot above other buildings, on top of a hill, or some other place where the signal will not readily hit a geographic feature or large solid object. This might be a pole on the roof of your own building, the roof of a higher building nearby, or some other tall structure in the vicinity. You can also use an existing tower, either one on a roof top, or freestanding on the ground.
- LPFM antennas are small and lightweight, much like a TV antenna that one puts on a roof to improve reception. They do not need a large supporting structure or special reinforcement to hold them up, and they will have little wind load. You can mount them on a mast or something similar to get elevation.
- If you do not own or control the location where you want to mount the antenna, offer to put up a pole or small tower to elevate your antenna. In some cases, you should be prepared to offer compensation or pay rent.
- Along with the antenna site, you must secure a place nearby for your transmitter. A 100 watt FM transmitter is not very large or heavy – the box is roughly the size of a desk top computer. It can sit on a shelf or table, or be installed in a rack. The location must have electricity, but does not demand any special power requirements, and it must be inside protected from the weather. Be prepared to pay the electric bill.

FINDING YOUR ANTENNA COORDINATES AND BROADCAST CHANNEL

Determine Your Antenna Location – Once you know where you want to put your antenna, you need two important pieces of information to fill out the TECH BOX. The FCC needs this information to determine if there is an available frequency at your proposed location in relation to existing stations in your area .

1. **GEOGRAPHIC COORDINATES OF YOUR ANTENNA LOCATION** – the FCC needs the **exact geographic coordinates in longitude and latitude** of your antenna location using North American Datum 27 (NAD 27) coordinates.
2. **HEIGHT OF YOUR ANTENNA** – the FCC also needs the **exact height** of your antenna **above the ground and above sea level.**

Find Your Antenna Coordinates

- If you are going to use an existing tower, the owner or any other station at that location will have the coordinates readily available.
- You can get the information yourself. Site elevation and coordinates can be determined from a **[U.S.G.S. 7.5 minute topographical quadrangle map](#)** for your location. These are maps prepared by the U.S. Geological Survey with precise topographical features, including geographic coordinates and terrain elevations. The maps are available for all areas of the country, including cities.

You can find these maps in many local libraries, at some map stores, and at many camping goods stores that cater to hikers and orienteering. **The U.S.G.S. has an on-line list of all the locations where these maps are sold. You can also order them directly for a few dollars. (<http://mapping.usgs.gov/esic/usimage/dealers.html>)**

- With the map, scale off your designated antenna location against the latitude (horizontal) and longitude (vertical) reference marks on the map. **Coordinates must be determined to the nearest 1 second (degrees, minutes, seconds = DDD MM SS).**
- Once you have found your antenna coordinates on this map, you can also determine the elevation by reading the elevation lines closest to the marked location. Elevations are given in **height above mean sea level.**
- **[Differential GPS \(Global Positioning System\) receivers](#)** provide another alternative for accurate determination of coordinates, but the GPS coordinates **must then be converted** to the NAD27 coordinate system. (**<http://www.fcc.gov/mmb/asd/welcomeALT.html>**)

Using the FCC CHANNEL FINDER

When you know your coordinates, you are ready to use the FCC CHANNEL FINDER program.

You can access it on-line at: **http://www.fcc.gov/mmb/asd/lpfm/lpfm_channel_finder.html**

The FCC has created the Channel Finder Program to determine whether the NAD 27 coordinates of the proposed transmitter site meet the spacing requirements adopted by the Commission. **Using the program is NOT an application for a LPFM station. Application Form 318 must be filed.**

Finding out if there is an available channel for your location is an important step.

According to the FCC, applications that do not meet the minimum separation requirements of 47 CFR 73.807 and 73.825 with respect to licenses and construction permits will be returned without an opportunity to submit a corrective amendment. LPFM applications also must be spaced properly with respect to FM station applications on file as of the release date of the Public Notice announcing the dates for the LPFM application filing window.

Running the Channel Finder will tell you if there is an available frequency at your designated antenna location.

- Employees of the Audio Services Division of the FCC or other Commission staff cannot assist in finding your coordinates or running the program. If you have any doubts or questions, consult a licensed engineer.
- The FCC has made clear that inaccurate coordinates may result in dismissal of the application by the staff. Geographic coordinates may be verified by the staff or other interested parties.
- The FCC also cautions applicants to consider if local zoning or other land use restrictions might affect whether and how quickly an LPFM station can be constructed upon FCC grant of a construction permit. However, zoning or land use information or approval is **not** needed to file FCC Form 318 with the Commission for an LPFM construction permit.

Converting your Frequency to a Channel Number

Each FM frequency has a corresponding channel, from 88.1 FM = Channel 201, to 107.9 FM = Channel 2=300. If you have successfully found a frequency, then you must convert it to the correct

FILLING OUT ENGINEERING SECTION V OF FCC APPLICATION FORM 318

Once you have found a frequency and determined its channel, you are ready to fill out SECTION V. **Be certain you have a copy of the “Instructions for FCC Form 318” issued by the FCC.** These instructions are dense because they are written in the legal language of the FCC, but you will need the Worksheets that are part of the document.

If you are uncertain about doing this correctly or you want help, we recommend that you hire a professional broadcast engineer or other experienced person fill out the application form on your behalf. They know how to get proper FCC frequencies using geographic coordinates and elevation above sea level. You will have to provide them with specific information, such as street address, and the height of the building where you want to put the antenna. They can figure out the rest.

The TECH BOX

Question 1. Class

Check the Box for LPFM 100

Question 2. Channel

If you have found a frequency using the FCC CHANNEL FINDER program, you can convert the frequency to the correct channel using the FCC Channel Conversion chart. Write/type the channel number on the line indicated.

Question 3. Antenna Coordinates

The proposed antenna site must be specified using North American Datum 27 (NAD 27) coordinates. You can determine these coordinates using a **7.5 minute series topographic map from the U.S. Geological Survey.**

Fill in the boxes with the correct longitude and latitude based on the location from the U.S.G.S. map. Coordinates must be to the nearest 1 second (degrees, minutes, seconds = DDD MM SS).

Question 4. Antenna Structure Registration Number

Most towers taller than 62 meters (200 feet) and located near airports are registered with the FAA.

- If you are **NOT** using one of these towers, (because you are putting your antenna on the roof of your building) check the box “Not Applicable”
- If you **are** putting your antenna on one of these towers, check the box “FAA Notification Filed with FAA.” (You do not need to file anything with the FAA – the tower owner is responsible.)

Question 5. Antenna Location Site Elevation Above Mean Sea Level

Determine the **ground elevation** of your antenna location from the same U.S.G.S. maps that helped you locate longitude and latitude.

This will be the height of your antenna location above Mean Sea Level. This elevation must be recorded in **meters**, rounded to the nearest whole number. Enter the number in Box 5.

Question 6. Overall Tower Height Above General Ground Level

This elevation is simply the height of your antenna *above the ground*. It will be **the total height of your building or tower, plus anything added to support the antenna**. It must be recorded in **meters**, rounded to the nearest whole number.

Question 7. Height of Antenna Radiation Center Above Ground Level

This elevation will be the same or very close to the answer in Question 6 but may vary by a meter or two. A single LPFM antenna will have 1, 2, or possibly more radiating elements (called ‘bays’ or ‘antenna array.’) If there is more than one, they are mounted a few feet apart on the support structure or tower. The center of radiation is *the middle* of this array.

- If you are using a single bay antenna, your center of radiation will be the *same* as your antenna height above the ground. (Most LPFM antennas will have only one antenna bay.)

- If you are going to use an antenna with 2 or more bays, the center of radiation will be slightly lower than the top of the antenna. Determine it by measuring the distance from the ground to the point *half-way* between the top of the antenna and the bottom, based on how much space is between each bay when it is mounted. (The antenna manufacturer will know the spacing between bays.) It must be recorded in **meters**, rounded to the nearest whole number.
[See diagrams.]

Question 8. Power and Height Limitations

Check the “Yes” box. This acknowledges that the FCC will determine the authorization for your operating parameters, including power and height (i.e. based on the height of your antenna, you may be authorized to operate at a power less than 100 watts.)

Question 9.

- a. **Interference** -- You must answer “yes”.
- b. **Short-spaced stations** – answer “N/A”

Question 10. TV Channel 6 Interference (Channel 201-220)

Because of a quirky technical condition on the television spectrum, there are special technical restrictions on FM radio frequencies in places near a Channel 6 TV station.

- If there is NO Channel 6 TV station within 60 miles of your proposed antenna location, answer “N/A”
- If there is a Channel 6 television station within 60 miles, AND the CHANNEL FINDER has given you an allocation **higher** than Channel 220, answer “Yes.”
- If there is a Channel 6 TV station within 60 miles, AND the CHANNEL FINDER has given you an allocation between 201 – 220, **you will need an engineer to assist you** in preparing an exhibit to meet any necessary restrictions.

Question 11. National Environmental Policy Act

Over time, broadcast stations have become subject to a range of urban and rural environmental regulations that have an impact on both personal health and environmental protection. This question is intended to ensure that all applicants certify that their proposed station will have no significant impact on the quality of the human environment. **The FCC has provided a worksheet as part of its instructions that must be submitted along with the application.**

Go to Worksheet # 2 - General Environmental Worksheet

This is a simple environmental assessment meant to guide you in relevant environmental questions.

In order to respond “Yes” to Question 11, you MUST answer “No” to all 8 questions on the worksheet. The worksheets must also be attached with the application.

You will answer “No” to the following questions about your new station:

1. Involves high intensity white lighting in residential neighborhoods.
2. Is located in an officially designated wilderness area or wildlife preserve.
3. Threatens the existence or habitat of endangered species.
4. Affect places significant to American history, architecture, etc.
5. Affects Indian religious sites.
6. Is located in a floodplain.
7. Requires construction changing surface features, i.e. filling wetlands, deforestation, etc.

8. Does not comply with the FCC guidelines on RF (Radio Frequency) exposure.

Question 8. is asked to determine that your antenna will not endanger anyone through harmful exposure to radio waves because it is mounted too close to where they might live or work. The danger level is based solely on the distance between your antenna and the rooftop or ground. Because exposure drops exponentially by distance, the higher the antenna is, the less it will generate harmful exposure. If it is above a certain height, there is no danger at all. That is why there are minimum distances specified. **The FCC has provided a worksheet that must be submitted along with the application.**

To fill out this question, go to Worksheet # 3 – RF Exposure Worksheet

Complete the calculations on the worksheet according to the instructions.

- If you are **NOT** putting your antenna on a tower with other broadcast stations, that is, mounting it alone on a rooftop or other structure, and it will not be near any other broadcast antennas, you must fill in the distances requested in **LP100 #1a** and **# 1b**.

- If you **ARE CO-LOCATING** your antenna on an existing tower with other stations, you must fill in the distances requested in **LP100 #2a** and **# 2b**.

When you have completed this worksheet, go back to complete Question 8 on the Environmental Worksheet.

When you have completed both worksheets, return to Question # 11 and answer “Yes.” This certifies that you are not subject to any additional environmental review.

- Most applicants will be able to check “No” in all boxes of Worksheet #2. If you have answered “Yes” to any of the questions, then you should consult an engineer to assist you with any additional exhibits that might be needed.

- If you cannot answer “No” to all the questions on Worksheet #2, or your are unable to conclude that your proposal will have no significant impact on the environment, you **MUST** check “No” in Question #11 and prepare a detailed Environment Assessment as an exhibit. The specific requirements for such an exhibit are outlined in detail in FCC INSTRUCTIONS FOR FCC FORM 318.

Preparer’s Certification

The last page of SECTION V is the certification by the person who prepared this part of the application, because it might be an engineer or someone different from whomever prepared the legal sections.

Fill out the form and **sign it in blue ink** so the FCC knows it is an original signature.

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