Good Websites:

A- Infos radio Project- share audio files of breaking news with activists around the world. http://www.radio4all.org/radio/

[Radio For All] he grand nexus of Free Radio websites and movement information. www.radio4all.org

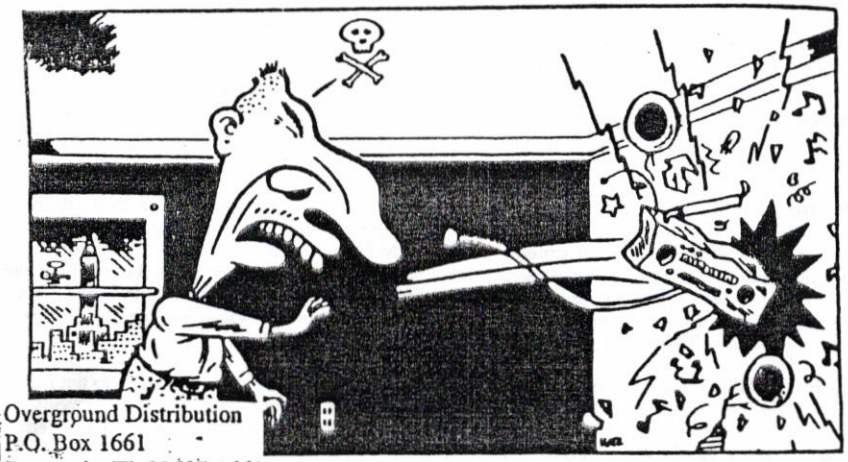
[Rogue Radio Research] Scholarly study of microradio. Site contains original research on micro radio, general and specific guides, information, and anotated links to micro radio and related resources. http://www.roguecom.com/rogueradio/

[Lorenzo Milam's books] How to get your own copy of the classic *Sex and Broadcasting*. Lorenzo Milam did in the sixties and seventies what we are trying to do today. His books have shown us how it's done- must read!

About.com Radio Microradio and Free Radio information and links. Most thorough and up-to-date information about everything pirate radio and LPFM here. Just about everything you could imagine you can find here. http://prateradio.about.com/tvradio/prateradio/?once=true&

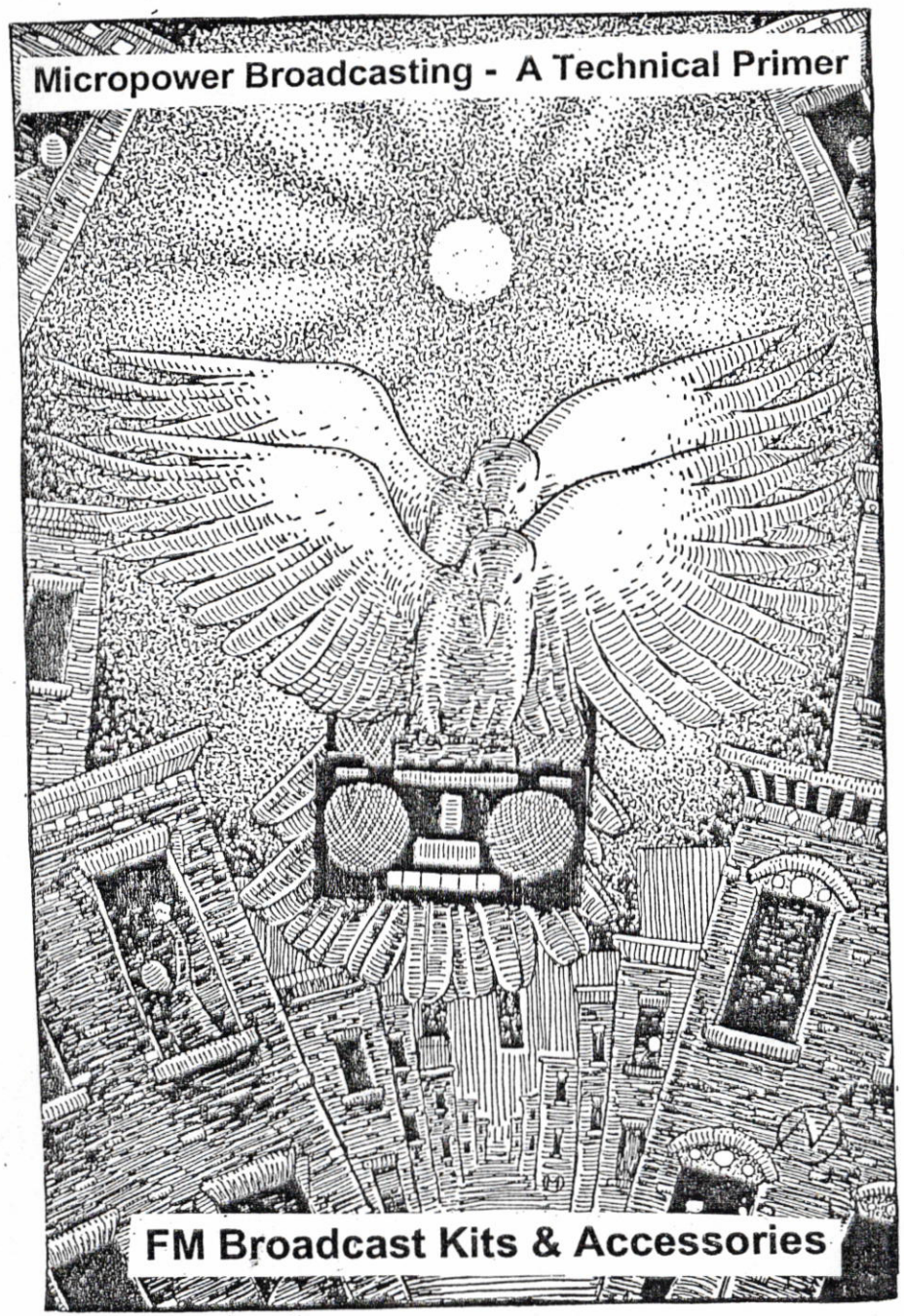
Jeremy Lansman- One of the pioneers of the Community Radio movement, a friends of Prometheus from way up in Alaska! Interesting articles debunking interference claims and other low-power resources. **[http://www.kyes.com/rw/index.html]**

Beginners Guide to Low Power Broadcasting By Rick Harrison. A Good basic all over look at the technical issues of low-power radio. Very thorough.
http://www.freespeech.org/lowpower/guide.html



Overground Distribution
P.O. Box 1661
Pensacola, FL 32597-1661

Pirate Radio



Americans for Radio Diversity: Based in Minneapolis, ARD started to oppose the sale of local stations to chains. They have commented extensively to the FCC, participated in Low power radio tours, helped applicants in their region, and spearheaded a campaign to hold NPR accountable for its dastardly stand on LPFM. Most useful documents- current headlines in media and democracy, on their main page (www.radiodiversity.com) Their un-pledge page is: http://www.radiodiversity.com/unpledge.html

Media Access Project. MAP has played a key role by lending their inside-the-beltway legitimacy to the LPFM movement. They specialize in producing literature and negotiating out the finer points of the implementation of low power radio with the FCC. Their focus is on advocacy and research for the LPFM movement as a whole, as opposed to direct services for individual applicants. Most useful document- their sample, filled out application, available as a .pdf from http://www.microradio.org/apply.htm, www.mediaaccess.org

Community Media Services CMS is Nan Rubin, a 25 year veteran of community radio media. She is a consultant for the Methodist Church to help all sorts of groups apply for and build radio stations. She is especially familiar with the Native American radio world.
She produced excellent, accessible literature on how to fill out the technical parts of the FCC low power radio application, and a good introductory piece on building radio stations. Available at http://www.microradio.org/apply.htm

Low Power Radio Coalition LPRC focuses on organizing in colleges, among musicians, and helping the low power radio movement survive the special interest dominated halls of Congress. They can help you set up meetings with your elected representatives and explain the excruciating minutiae of our somewhat democratic system of government. Most helpful documents: They maintain a website with easy, documentable ways to make your voice heard in Congress. http://congress.nw.dc.us/lpr/ Their email bulletins have information on Congress that is always up –to the-minute. .

Microradio Implementation Project MIP is the largest of the clearinghouse organizations, sponsored by the United Church of Christ. They do outreach to organizations that should know about LPFM, support a good website with very accessible applications, and are all around involved in all elements of the low power issue. The difference between MIP and Prometheus? Not a lot- though you'd probably rather bring one of the MIP folks home to show your mother for a date. Prometheus sprung from the pirate radio milieu, and though we are now working exclusively on licensed radio, our roots as buccaneers of the airwaves still show. Prometheus is more publicly combative with organizations like NAB and NPR. We focus our work and outreach on public access centers, activist organizations and so on, while MIP focuses on ethnic business associations and churches. We are more likely to tell you how to wire your audio section together with coat hangers and chewing gum, while MIP is more likely to refer such questions to a licensed engineer. Our literature is informal, goofy and fraught with run-on sentences, while there's is probably better to present to the board of directors. Our groups often collaborate closely.

Prometheus Radio Project: And of course there's us- a media activist group focused on Microradio, but connected to all struggles for more democratic communications. We provide service similar (if a little rougher around the edges) to MIP, we comment on FCC proposals, organize conferences and demonstrations, letter writing drives and Independent Media Centers. We do outreach to find good people and notify them of the LPFM opportunity, and we take to the road a lot and meet applicants and give public talks about a range of media democracy issues, especially LPFM. Our website is www.prometheus.tao.ca

Amherst Alliance Amhersts' members submitted the first petition for Rulemaking to the FCC on Low Power FM. They are advocates of expanding the service to accept commercial stations. Amherst is closely connected to The Radio Free Richmond project, which is an excellent web resource. http://members.aol.com/wrfr
Most helpful documents: WRFRs video on LPFM

Christian Community FM This organization focuses on Christian applicants for LPFM, offering a wide range of services for the faithful: Most helpful documents: website with info on applicants and MX situations

Self-promotion by DJ of his/her own book, record, or other project ..... subtract 4 for each minute it goes on

Use of the pretentious non-word "musics" ..... subtract 20

DJ referring to what he/she is doing as "radio art" ..... subtract 25

Prank phone call made live on the air, if it's entertaining ..... add 30
(If to a government or corporate official ..... add an additional 25)

College stations: DJ talking about self for more than two minutes consecutively, unless it's really funny ..... subtract 20

College show underwritten by local "hip" record store ..... subtract 25

College DJ mispronouncing person or place name during news reading ..... subtract 25

Gratuitous reference to fellow DJs by name, or other "in" station reference ..... subtract 20

Joking or bantering with station colleague who is off mic (i.e., inaudible) ..... subtract 5 for each 5 seconds it goes on

During public station fundraising drive: Excessive repetition of pledge-line number ..... subtract 5 for each mention more than 6 per half-hour

Denunciation of people who listen but don't pledge as "ripping the station off," etc. ..... subtract 30

Either of the following offered as membership premiums: coffee mug, tote bag ..... subtract 20

Anything at all that makes you laugh uncontrollably (I'm assuming this isn't easy to do) ..... add 50

Each Christmas song played during Christmas season ..... subtract 1/2
("Santa Claus Is Coming to Town" by Bruce Springsteen ..... subtract an additional 15)

Any holiday song played during the wrong season ..... add 25

SCORING:

-500 or lower:	Even worse than I thought
-200 – -499:	About average
-1 – -199:	Not bad at all
0 or greater:	Check your math

An (admittedly biased) guide to organizations working on Low Power Radio:

National Lawyers Guild Committee on Democratic Communications
NLGCDC has been involved in the struggle for community radio since the late 80s, having done legal support work for Mbanna Kantako, Steven Dunifer and others. They are chiefly responsible for the Broadcast signal labs study that convinced the FCC that LPFM was technically viable. They offer legal services to applicants. Most helpful documents: the CDC LPFM FAQ, (http://www.nlgcdc.org/faq.htm) and the Licensing Project 5 step application process. (http://www.nlgcdc.org/licensing.htm)

Micropower Broadcasting - A Technical Primer

Many people still assume that an FM broadcast station consists of rooms full of equipment costing tens of thousands of dollars. The Micropower Broadcasting, Free Radio Movement has shown this to be untrue. Micropower broadcasting uses FM transmitters whose power output is in the range of 1/2 to 40 watts. Such transmitters have a physical size that is not greater than that of your average brick. These transmitters combined with other equipment including inexpensive audio mixers, consumer audio gear, a power supply, filter and antenna enable any community to put its own voice on the air at an average cost of $1000-$1500. This is far more affordable than the tens or hundreds of thousands required by the current FCC regulatory structure.

All of the technical aspects of putting together a micropower broadcasting station are covered in the following material. It is important to note that the main argument the FCC uses against micropower broadcasting is the issue of interference with other broadcast services. Interference is a valid concern. By using equipment that is frequency stable and properly fitted with harmonic suppression filters along with good operating procedures and standards, the FCC's argument can be effectively neutralized.

Further, the technical aspects of micropower broadcasting require some basic knowledge in the areas of electronics and broadcast practices. Hopefully, this primer will be able to convey some of this knowledge to you. If you are unsure of your abilities try to find someone who has the technical experience to help you. It is hoped that as this movement grows a network of people with the required technical skills will be formed to assist in the process of empowering every community with its own voice. If you are a person with engineering or technical experience, please contact Free Radio Berkeley to become part of this network.

FINDING A FREQUENCY

Before you can proceed any further you must determine if there are any available frequencies in your area. Due to frequency congestion in the large urban metroplexes such as Chicago, Boston, LA, NYC, etc. this may be a bit difficult. You will need several items to do a frequency search: a listing of the all the FM radio stations within a 50-70 mile radius of your area; and a digitally tuned radio. There is a database on the world wide web which can be searched for FM radio stations in any given area. Web site is: www.jagunet.com/~kodis/station.html

Channel separation is the biggest problem. FM broadcast frequencies are assigned a frequency channel 200 kilohertz wide. Good broadcasting practice requires that at least one channel of separation must exist on either side of the frequency you intend to use. In other words, if you have picked out 90.5 as a possible frequency then 90.3 and 90.7 should be clear of any receivable signals. This is why a digital receiver is an important item for the frequency search.

Once you have a complete listing of all the FM radio stations look for possible frequencies with the appropriate channel spacing. Depending on topography, distance and the output power of the other stations certain "used" frequencies may in fact be open. Compile a list of the possible frequencies. Then, using a digital FM receiver with an external antenna, scan and check these frequencies. Do this from a number of locations and at varied times within the area you propose to cover. In most cases weak, intermittent, or static filled signals can be ignored and counted as either usable or providing the necessary channel separation. Hopefully you will find at least one or two usable frequencies. If you live in a more rural area or some distance from a large urban area, finding a usable frequency should not be very difficult. 87.9 can be used as a frequency under two conditions. One, if there is not an existing station on 88.1, and two if there is not a TV Channel 6 being used in your area.

After compiling your list of possible frequencies have your friends check them out on their receivers or radios as well. It is helpful to do this since a variety of different receivers will more accurately reflect the listening conditions in your area. After all of this you should have a workable list of frequencies to use.

LOCATION OF STUDIO AND TRANSMITTER

Before you set up the station an adequate location must be found. Since the antenna will be there as well a site with adequate elevation is required. Ideally the top of a hill or a spot somewhere on the side of hill overlooking the area of coverage is best. FM transmission is "line of sight" the transmitting antenna and receiving antenna must be able to "see" each other. Therefore, any large obstructions will have a tendency to block the signal path. Keep this in mind when choosing your location. If your site is a 1 to 3 story building, a 30 foot push up style mast attached and guyed to the roof or a TV antenna style tower bracketed to the side of the building will be needed to provide adequate height for the antenna. At the very least you need to have the antenna at least 40-50 feet above the ground. In some areas a building permit may be needed to attach a mast or tower to a building.

It is good practice to keep the transmitter some distance from the audio studio since the radio frequency emissions from the transmitter can get into the audio equipment and cause noise and hum. Your transmitter should be set up in another room, attic space, etc. as close to the antenna as possible. Keep the distance from the transmitter to antenna as short as possible to minimize signal loss in the coaxial cable feeding the antenna.

These are some of the basic issues regarding site selection. Landlords, room mates, leases etc. are your problem.

FM TRANSMITTERS

FM is an abbreviation for Frequency Modulation. Modulation is how information is imparted to a radio frequency signal. In the case of FM the audio signal modulates what is called the carrier frequency (which is the frequency of the broadcast signal) by causing it to shift up and down ever so slightly in response to the level of the audio signal. An FM radio receives this signal and extracts the audio information from the radio frequency carrier by a process called demodulation.

Modulation of the signal takes place within the FM broadcast transmitter. The transmitter consists of several different sections: the oscillator, phase locked loop, and gain stages. Generation of the broadcast carrier frequency is the responsibility of the oscillator section. Tuning (as distinct from modulation) or changing the frequency of the oscillator section is either done electronically or manually. For a practical radio station that will be operated for more than a few minutes, it is almost essential to have the tuning done under electronic control since free running or manually tuned oscillators will drift in frequency due to temperature and inherent design limitations. This is an important consideration is selecting a transmitter. Since one of the goals is to deprive the FCC of technical objections to micropower broadcasting it is critical to have transmitters that stay on frequency and do not drift. This, of course, rules out using transmitters based on free running oscillators.

Frequency control brings us to the next section. Oscillator frequency drift is corrected by a circuit known as a phase lock loop (PLL) controller. In essence, it compares the output frequency of the oscillator to a reference frequency. When the frequency starts to drift it applies a correction voltage to the oscillator which is voltage tuned, keeping it locked to the desired frequency. In a PLL circuit the frequency is selected by setting a series of small switches either on or off according to the frequency setting chart that comes with the transmitter. In some cases the switch array may be replaced by 4 dial-up switches that show a number for the FM frequency of transmission, i.e. 100.1 for 100.1 MHz. Even simpler, some units have a display like a digital radio with up and down buttons for changing frequency.

One part of the oscillator section, the voltage tuning circuit, serves a dual purpose. As described above it allows the oscillator to be electronically tuned. In addition, it is the means by which the broadcast carrier frequency is modulated by an audio signal. When the audio signal is applied to this section the variations in the audio signal voltage will cause the frequency of the oscillator to shift up and down. Frequency shifts brought about by audio modulation are ignored by the PLL controller due to the inherent nature of the circuit design. It is important not to over modulate the transmitter by applying an audio signal whose level is too great. Many transmitters are equipped with an input level control which allows one to adjust the degree of modulation. Further control of the audio level is provided by a compressor/limiter which is discussed in the studio section.

As the modulation level increases the amount of space occupied by the FM signal grows as well. It must be kept within a certain boundary or interference with adjacent FM broadcast channels will result. FCC regulations stipulate a maximum spread of plus or minus 75,000 cycles centered about the carrier frequency. Each FM channel is 200,000 cycles wide. Over modulation- the spreading of the broadcast signal beyond these boundaries- is known as splatter and must be avoided by controlling the modulation level. As a result the signal will be distorted and interference with adjacent channels will take place.

Following the oscillator section are a series of gain stages which buffer and amplify the signal, bringing it to a sufficient strength for FM broadcast purposes. In most cases this will be 1/2 to 1 watt of output power. This level is sufficient for a broadcast radius of 1-2 miles depending on circumstances. For increased power a separate amplifier or series of amplifiers are used to raise the power level even higher. Amplifiers are covered in the next part of this primer.

Transmitters are available in kit form from a number of different sources including Free Radio Berkeley, Progressive Concepts, Panaxis and Ramsey. Assembly requires a fair degree of technical skill and knowledge in most cases. Free Radio Berkeley offers an almost fully assembled 1/2 watt PLL transmitter kit requiring a minimal amount of assembly. Kits from Ramsey are rather debatable in terms of broadcast quality. An English firm Veronica makes some rather nice kits as well.

AMPLIFIERS

Although 1/2 to 1 watt may be perfectly adequate for very localized neighborhood radio coverage, higher power will be required to cover larger areas such as a town or a portion of a large urban area. In order to increase the output power of a low power FM exciter or transmitter an amplifier or series of amplifiers are connected to the output of the transmitter. Amplifiers are also referred to as amps, and should not be confused with the unit of current also called amps.

Amplifiers are much simpler in design and construction than a transmitter. Most of the amplifiers used in micropower broadcasting employ only one active device, an RF power transistor, per stage of amplification. By convention most broadcast amplifiers have an input and output impedance of 50 ohms. This is similar to audio speakers having an impedance between 4 and 8 ohms. When an RF amplifier with a 50 ohm input impedance is attached to the 50 ohm output impedance of a transmitter this matching of impedances assures a maximum flow of electrical energy or power between the two units.

A mismatch between any elements in the chain from transmitter to amplifier to filter to antenna will reduce the efficiency of the entire system and may result in damage if the difference is rather large. Imagine the results if a high pressure water pipe 4 inches in diameter is forced to feed into a 1/2" water pipe with no decrease in the action of the pump feeding the 4 inch pipe. In an RF amplifier the RF power transistor will heat up and self-destruct under analogous conditions.

Piece of non-Western music played for no reason (i.e., not part of a special or specialty show) ..... add 25
Any Beatles song except "Old Brown Shoe" ..... subtract 25
"Jesus Was Way Cool" by King Missile ..... subtract 50
Any record not easily purchasable ..... add 15
Any piece of music longer than six minutes ..... add 20
Any piece of music longer than 14 minutes ..... subtract 20
Song so bad you have to change the station before it's over ..... subtract 30
(If intentional ..... add 10 instead)
Song promoting shoplifting or other blatantly illegal act ..... add 35
Heavy metal song that actually frightens you ..... add 20
Cynical attempt to feign affinity with wage-slave listeners ("Thank God it's Friday," reference to Wednesday as "Hump Day," etc.) ..... subtract 40
Bona-fide pirate station received ..... add 45
(If station plays any record you've heard on a commercial station in the past three weeks ..... subtract 30 instead)
DJ coughing, sneezing, etc. on mic ..... add 20
(If trying to be arty ..... subtract 25 instead)
DJ reading poetry on the air ..... subtract 20
(If DJ's own poetry ..... subtract an additional 15)
A half-hour or more of continuous music without bragging about it ..... add 20
Patriotic remark of any kind ..... subtract 30
Anti-Cuba remark ..... subtract 25
Pro-Cuba remark ..... subtract 25
Racist remark or joke ..... subtract 35
Anti-American remark ..... add 35
(If DJ is a Third World Nationalist type ..... subtract 30 instead)
Anti-cop remark ..... add 35
Use of the expression "politically correct" by right-wing talk-show creep ..... subtract 30
Anti–music business remark ..... add 20
(If by someone selling "alternative" product ..... subtract 25 instead)
Anti-drug remark or advertisement ..... subtract 40
Advertisement read personally by DJ (unless comically flubbed or deliberately sabotaged) ..... subtract 25
Any discussion of the weather ..... subtract 15
Jazz shows only: Excessive time spent reading personnel or session information for a track ..... subtract 4 for each minute over 1 minute
Approving references to Satan or Satanism by anyone 15 or younger ..... add 40
Approving references to Satan or Satanism by anyone older than 17 ..... subtract 25

How Awful Is the Radio in Your City? Take This Simple Test

Dave Mandl

Listen to local radio for four consecutive hours (come on, you can do it!), randomly changing the station every so often. Start with 500 points, and add or subtract points as indicated for each occurrence of an event listed here. Then check your city's score against the scale below—the lower the score, the more awful.

Each advertisement ..... subtract 2
Public station: Pseudo-classy "underwriting" ad by prestige-seeking corporation or foundation ..... subtract 10
Any straight-faced claim that station is "the best" ("The Best Music," "San Diego's Best Rock," etc.) ..... subtract 20
Purportedly "non-stop" music that is in fact interrupted ..... subtract 25
The word "relaxing" used in description of station's format ..... subtract 20
The phrase "Classic Rock" used in any way ..... subtract 20
Contest requiring listeners to embarrass themselves by answering their phones with asinine promotional slogan ..... subtract 25
Station giving out 900 number for requests, polls, or anything ..... subtract 25
Violation of FCC regulations (obscenity, failure to air legal station ID when required, etc.) ..... add 20
(If obviously deliberate ..... add an additional 10)
Live in-studio interview with band or author that is not trying to sell anything (tour, new record, book, etc.) ..... add 30
Interview with really stupid band with nothing to say ..... subtract 25
(If they take calls live on the air ..... subtract an additional 15)
Kids' show actually produced by kids ..... add 30
Any song you've heard played on the radio in the past three days ... subtract 20
"Stairway to Heaven," "Bohemian Rhapsody," "Won't Get Fooled Again," or any other '70s stadium-rock anthem ..... subtract 30
Any song or other recording featuring sounds of people having sex, but only if it includes men ..... add 25
Any song by Nick Drake ..... add 30
Any piece of music from a Touch cassette ..... add 30

An RF power amplifier consists of an RF power transistor and a handful of passive components, usually capacitors and inductors which are connected in a particular topology that transforms the 50 ohm input and output impedances of the amplifier to the much lower input and output impedances of the RF power transistor. Detailed circuit theory of this interaction between the components is not covered in this primer.

Amplifiers can be categorized as either narrow band or broad band. Narrow band amplifiers are tuned to one specific frequency. Broad band amplifiers are able to work over a specified range of frequencies without tuning. Most of the amplifiers that have been used in micropower broadcasting are of the first type. A tunable amplifier can be a bit of a problem for those without much experience. In a typical tuned stage amplifier there will be two tuning capacitors in the input stage and two more in the output stage. If not correctly adjusted the transistor can produce unwanted sideband spurs at other frequencies both within and outside of the FM band.

To make set up easier for the average micropower broadcaster a broad band amplifier is preferable or one with a minimal amount of tuning stages. Several designs are available. One rather popular one is a 20-24 watt amplifier using a Phillips BGY33 broad band power amplifier module. It is a rather rugged device that requires no tuning and produces a full 20-24 watts output for 250 milliwatts of drive from the transmitter. Free Radio Berkeley has a kit based on this device. This kit includes an output filter as well which other vendors may not include in their kits. Regardless of the source, the BGY33 is not the most efficient device and requires a good sized heat sink for proper dissipation of heat, and the use of a cooling fan is strongly suggested as well.

If you buy a kit or transmitter package based on this device be certain to determine from the manufacturer that the BGY33 is mounted directly to the heat sink, not to a chassis panel with a heat sink on the other side of the chassis panel. It must directly contact the heat sink with a layer of heat sink heat compound between the module mounting flange and the heat sink surface.

Broad band designs are not as a common due to the degree of design experience required to create a functional unit. It seems a number of kit providers are content not to optimize and improve their amplifier designs. Free Radio Berkeley is now offering amplifiers that are either no tune or minimal tune designs in several different ranges of power. Certain broad band designs may be too wide in their range of frequency coverage and will amplify the harmonics equally well. For FM broadcast purposes the width of frequency coverage should be for only the FM band, about 20-25 Megahertz wide.

Selecting the right amount of power is rather important since you should only use enough power to cover the desired area. Unfortunately there is not an easy answer to the question of how much area a certain amount of power cover. Antenna height is very critical, 5 watts at 50 feet will not go as far as 5 watts at 500 feet. Assuming you do not have a 10 story building or a convenient 500 foot hill to site your antenna and transmitter on, experience in urban environments has yielded the following rough guidelines. With an antenna approximately 50 feet above the ground. 1/2 to 1 watt will yield an effective range of 1 to 3 miles, 5-6 watts will cover out to about 1-5 miles, 10-15 watts will cover up to 8 miles, 20-24 watts will cover up to 10-12 miles and 30-40 watts will cover up to 15 miles. Coverage will vary depending on terrain, obstructions, type of antenna, etc. If your antenna is very high above average terrain you will be able to go much further than the figures given above. Quality of the radios receiving your signal will be a determining factor as well. Since the power levels are rather low in comparison to other stations an external antenna on the receiver is highly suggested, especially an outdoor one.

It is very important to provide adequate cooling for RF amplifiers. This means using a properly sized heat sink and an external cooling fan. Heat sinks have heat dissipating fins which must be placed in an upward pointing direction. Overheating will cause premature failure of the transistor. A cooling fan, usually a 4 to 5 inch square box fan, will offer extra insurance. It should be placed so that the air flows over the fins of the heat sink.

Under no circumstances should an amplifier/transmitter be operated without a proper load attached to the output. Failure to do so can destroy the output transistor. When testing and tuning, a dummy load is used to present a load of 50 ohms to the transmitter/amplifier. It is very bad practice to tune a unit with an antenna attached. Use a dummy load of proper wattage rating to match the transmitter output wattage.

An output filter must be used between the transmitter/amplifier and the antenna. Some amplifier kits come with a filter included, such as the 20 Watt FRB amplifier. These do not need an additional filter. More on this in the filter section.

Heavy gauge (12-16 AWG) insulated stranded wire is used to connect the amplifier to the power supply. Observe correct polarity when making the connection. Reversing the polarity will result in catastrophic failure of the transmitter. Red is positive and black is negative or ground.

POWER SUPPLIES-

Most of the transmitters and amplifiers used in micro broadcasting require an input voltage of 12 to 14 volts DC. Higher power amplifiers (above 40 watts) require 24-28 volts DC. In a fixed location the voltage is provided by a power supply which transforms the house voltage of 110 volts AC to the proper DC voltage.

Power supplies are not only measured in terms of their voltage but current as well. A higher power amplifier is going to require a greater amount of input power as compared to a lower power amplifier. Output current is measured and specified as amps. A power supply is selected on the basis of its continuous current output which should be higher than the actual requirements of the amplifier. Power supplies operated at their fully rated output will have a tendency to overheat under continuous operation. An amplifier which requires 8 amps will need a power supply with a 10 to 12 amp continuos capacity. In most cases the following ratings are suggested for transmitters requiring 13.8 volts.

1-5 Watt Transmitter	2-3 Amps
10-15 Watt Transmitter	5-6 Amps
20-24 BGY33 Based Unit	10 Amps
40 Watt Transmitter	12 Amps

Any power supply you use must have a regulated voltage output along with protection circuitry. Some reasonably priced brands include Pyramid, Triplite and Astron. Do not use any of the wall transformer type of power supplies. Such units are not adequate for this application. Higher power transmitters require power supplies with an output voltage of 28 volts. Astron is the best manufacturer of this type of power supply. A 75 watt transmitter will require a power supply with a current rating of 6-8 amps and 28 volts.

For mobile applications voltage can be fed from the cigarette lighter socket of a car with the correct plug and heavy gauge wiring. This may not work well in some newer vehicles with are reported to have some sort of current limit protection on the lighter socket. Check with an auto mechanic about this if you are in doubt. Electrical systems on newer vehicles are rather sensitive and can be damaged if not properly understood.

Another problem with mobile operation is battery drain. A 20-40 watt transmitter running for 4-5 hours can deplete the battery to the point where the vehicle may not start. It is better to have a separate battery running parallel to the charging system with an Isolator. Isolators are available from Recreational Vehicle accessory suppliers. Use a high capacity deep discharge type of battery.

Lead acid batteries are not very benign. Acid can leak and spill on people, clothing and equipment. It is best to keep the battery in a plastic battery box. Vapors from the battery are explosive in confined areas. Keep this in mind for mobile vehicle operations. You might consider using a gell cell type of battery which is sealed and can not leak. These are a bit pricey but have far fewer problems. A good quality gel charger must be used to ensure battery longevity.

Smaller gel cell batteries work really well for setting up a low power (6 watts or less) transmitter on a street corner as a public demonstration of micropower radio. In Berkeley a 6 watt micropower station is set up at the local flea market as a community demonstration on weekends. It is called Flea Radio Berkeley. Transmitters can be set up at demonstrations and rallies so motorists can tune their radios to the frequency which is displayed on large banners near the streets and listen in on what is happening. This has worked very well. Use your imagination to show how micropower broadcasting can be brought into the community.

FILTERS

Although it is rather simple in design and construction a filter is one of the most important elements in broadcasting. No matter what, a proper filter must be used between the transmitter and antenna. Use of a filter will help deprive the FCC of one of its main arguments against micropower broadcasting - interference with other broadcast services.

A proper filter reduces or eliminates harmonics from your broadcast signal. Harmonics are produced by the transmitter and are multiples of the fundamental frequency you are tuned for. For example, if you broadcast at 104.1, you may produce a harmonic at 208.2, and (less likely) 312.6 and so on. Most filter designs are of the low pass type. They let frequencies below a certain frequency pass through unaffected. As the frequency increases and goes beyond that point the filter begins to attenuate any frequency that is higher than the set point. The degree of attenuation increases with the frequency. By the time the frequency of the first harmonic is reached it will be severely attenuated. This is very important since the first harmonic from an FM transmitter falls in the high VHF TV band. Failure to reduce this harmonic will cause interference to neighboring TV sets.

You do not want to generate complaints from folks who engage in the odious habit of watching TV. Noble sentiments, such as telling them to smash their TV if they have a problem will not suffice. Use a filter. Complaints increase the possibility of the FCC showing up at your door. One needs to be good broadcast neighbor and an asset to the community

Harmonics further up the scale can cause interference to other mobile and emergency radio services. Not desirable either.

Transmitters with output power ratings of less than 25 watts will need at least a 7 pole design. Higher power units will need a 9 pole design. An increase in number of poles increase the degree of attenuation. Representative designs are shown. If you build one of these put it in a metal, well shielded enclosure.

Not really related to filters but an important side issue is the use of FM frequencies at the bottom and top ends of the band. Do not use 87.9 to 88.3 or so if their is a channel 6 TV frequency being used in your local area. Television sets have notoriously poor selectivity and your signal might end up coming in on the sound carrier of the TV if channel six is being used. At the top end of the band do not go any higher than 106 MHz if the transmitter is near an airport. In fact, do everything possible not be too close - at least several miles and away from the flight path(s). Even though interference possibilities are minimal there is not any point in taking chances since the FCC has claimed airplanes will fall from the sky if micropower broadcasting is given free reign! Corner cutting corporate airline maintenance polices most likely pose a greater danger to public safety than micropower broadcasting, however

ANTENNAS

An antenna's primary purpose is to radiate the FM broadcast signal from the transmitter to surrounding FM radio receivers. In order to do this several conditions must be met. First, the antenna must be tuned to the frequency being transmitted. Secondly, it must be sited and oriented properly.

A: They will have to go to court to obtain a warrant to enter your home. But, if they have probable cause to believe you are currently engaging in illegal activities of any sort, they, with the assistance of the local police, can enter your home without a warrant to prevent those activities from continuing. Basically, they need either a warrant, or probable cause to believe a crime is going on at the time they are entering your home.

Q) If I do not cooperate with their investigation, and they threaten to arrest me, or have me arrested, should I cooperate with them?

A: If they have a legal basis for arresting you, it is very likely that they will prosecute you regardless of what you say. Therefore, what you say will only assist them in making a stronger case against you. Do not speak to them without a lawyer there.

Q) If they have an arrest or a search warrant, should I let them in my house?

A: Yes. Give them your name and address, and tell them that you want to have your lawyer contacted immediately before you answer any more questions. If you are arrested, you have a right to make several telephone calls within 3 hours of booking.

Q) Other than an FCC fine for engaging in illegal transmissions, what other risks do I take in engaging in micro-radio broadcasts.

A: Section 501 of the Act provides that violations of the Act can result in the imposition of a $10,000 fine or by imprisonment for a term not exceeding one year, or both. A second conviction results in a potentially longer sentence. If you are prosecuted under this section of the Act, and you are indigent (unable to hire an attorney), the court will have to appoint one for you.

Q) Are there any other penalties that can be imposed upon me for "illegal broadcasts."

A: Under Section 510 of the Act, the FCC can attempt to have your communicating equipment seized and forfeited for violation of the requirements set forth in the Act. Once again, if they attempt to do this, you will be given notice of action against you, and have an opportunity to appear in court to fight the FCC's proposed action. Realize, though, that they will try to keep your equipment and any other property they can justify retaining until the proceedings are completed. You have a right to seek return of your property from the court at any time.

Q) If the FCC agents ask me if I knew I was engaged in illegal activities, should I deny any knowledge of FCC laws or any illegal activities?

A: No. You will have plenty of time to answer their accusations after you have spoken with an attorney. It is a separate crime to lie to law enforcement officials about material facts. Remain silent.

Q) If I am considering broadcasting over micro-radio, is there anything I can do ahead of time to minimize the liklihood of prosecution?

A: Yes. Speak with an attorney before you are approached by law enforcement to discuss the different aspects of FCC law. Arrange ahead of time for someone to represent you when and if the situation arises, so that you will already have prepared a strategy of defense.

Q) What can I do if the FCC agents try to harass me by going to my landlord, or some other source to apply pressure on me?

A: So long as there is no proof that you have violated the law, you cannot be prosecuted or evicted. If there is evidence of misconduct, you might have to defend yourself in court. Depending upon what the FCC said or did, you might be able to raise a defense involving selective prosecution or other equivalent argument. If the conduct of the agents is clearly harassment, rather than a proper investigation, you can file a complaint with the F.C.C. or possibly a civil action against them.

Q) If I want to legally pursue FCC licensing for a new FM station, what should I do?

A: It isn't the purpose of this Q and A sheet to advocate or discourage non-licensed broadcast operations. A person cited by the FCC for illegal broadcasting will find it virtually impossible to later obtain permission to get a license. If you want to pursue the licensing procedure, see the procedures set forth in the Code of Federal Regulations, Title 47, Part

Samson S-12 hypercardoid microphone - $60.
An excellent low impedance unit for the broadcast studio. 25 foot XLR cable is $18.00

VARIOUS & SUNDRY ITEMS

Tweak stick - $2.50

Essential to tuning transmitters and amplifiers. Non-conductive body with tiny metal blade at end. In tuning these transmitters and amplifiers a metal screwdriver will cause false tuning to happen due to the interactive effects of the metal and the holder of the screwdriver with the circuit. A plastic TV tuning tool kit can be found at Radio Shack as well

Seizing the Airwaves - $13.00
A Free Radio Handbook by Ron Sakolsky and Stephen Dunifer. Let us conjure up a vision of a Wild Radio Stampede disrupting the territorialized lines of Authority artificially drawn in the air surrounding Mother Earth..... Within this book, the myriad voices of the Free Radio Movement come alive with the same urgency that has challenged both corporate and governmental control of radio-activity. If seizing the airwaves is a crime, then welcome to the millennial police state.

ORDERING INFORMATION

Proceeds from the sales of these kits go to the furtherance of micropower broadcasting, bringing a voice of empowerment to every community. Please add $6.00 for handling and shipping for 1-2 kits and $3.00 for each additional kit. $6.00 for the 2.5 & 7 amp power supply and for each brick enclosure and $15.00 for the 14 amp power supply. Normal shipment is either UPS ground or priority mail depending on size and weight. COD orders add $8.00. Air mail to other countries, $12.00 per kit. We ship within 2-3 weeks after receipt of order, sometimes sooner depending on the work load.

Payment to be made out to Free Radio Berkeley. Foreign orders please payby money order drawn on US bank

Free Radio Berkeley, 1442 A Walnut St., #406 Berkeley, CA 94709. (510) 549-0732

Email: xmtrman@pacbell.net
Check our web site for more information and the latest updates -
www.freeradio.org

WHAT TO DO WHEN THE FCC KNOCKS ON YOUR DOOR

Produced by the Committee on Democratic Communications — A National Committee of the National Lawyers Guild

NOTE: The following discussion assumes that you are not a licensed broadcaster.

Q) If FCC agents knock on my door and say they want to talk with me, do I have to answer their questions?

A: No. You have a right to say that you want a lawyer present when and if you speak with them, and that if they will give you their names, you will be back in touch with them. Unless you have been licensed to broadcast, the FCC has no right to "inspect" your home.

Q) If they say they have a right to enter my house without a warrant to see if I have broadcasting equipment, do I have to let them in?

A: No. Under Section 303(n) of Title 47 U.S.C., the FCC has a right to inspect any transmitting devices that must be licensed under the Act. Nonetheless, they must have permission to enter your home, or some other basis for entering beyond their mere supervisorial powers. With proper notice, they do have a right to inspect your communications devices. If they have given you notice of a pending investigation, contact a lawyer immediately.-

Q) If they have evidence that I am "illegally" broadcasting from my home, can they enter anyway, even without a warrant or without my permission?

At FM frequencies the radio waves travel in a straight line until an obstacle is met. This is known as line of sight transmission. If the receiving antenna and transmitting antenna can "see" each other and the path distance is not too great to attenuate the signal, then the broadcast signal can be received. Radio signal strength is based on the inverse square law. Double the distance and the signal strength will be 1/4 of what it was.

Since FM broadcast transmissions are line of sight, the height of the antenna is very important. Increasing the height is more effective than doubling or tripling the power. Due to the curvature of the earth the higher the antenna the greater the distance to the horizon. Increased height will place the antenna above obstructions which otherwise would block the signal. Your antenna should be at least 40-50 feet above the ground. Count yourself lucky if you can site the antenna on a hill or a ten story building.

An antenna is rough tuned by adjusting the length of the radiating element(s). Many antenna designs are based on or derived from what is called a dipole, two radiating elements whose length is roughly equivalent to 1/4 of the wavelength of the desired frequency of transmission. Wavelength in inches is determined by dividing 11811 by the frequency in megahertz. The result is either divided by 4 or multiplied by .25 to yield the 1/4 wavelength. A correction factor of .9 to .95, depending on the diameter of the element, is multiplied times the 1/4 wavelength resulting in the approximate length of each element.

Fine tuning the antenna requires the use of an SWR power meter. SWR is an abbreviation for standing wave ratio which is the ratio between power going into the antenna and the power being reflected back by the antenna. A properly tuned antenna is going to reflect very little power back. Correct use of an SWR meter is described a bit further down in this section. IF you can afford $100 get a dual needle meter which shows both reflected and forward power at the same time. A good brand is Daiwa.

A dipole with tuning stubs is one of the easiest antennas to make and tune. Two dipoles can be combined on a 10 foot mast if they are spaced 3/4 of a wavelength from center to center with the elements vertical and fed with a phasing harness. A phasing harness consists of two 1.25 wavelength pieces of 75 ohm coaxial cable (RG11) cut to a length that is the product of the 1.25 wavelength times the velocity factor (supplied by the manufacturer) of the cable. A PL259 plug is attached to the end of each cable. These are connected to a 259 T adapter with the center socket being the connection for the feed cable coming from the transmitter. The other ends go respectively to each dipole. Such an arrangement will increase the power going into the antenna by a factor of 2.

Besides the dipole a number of other antenna designs are employed in micropower broadcasting. Each one has a characteristic pattern of coverage. Antennas can be broken down into two basic types - omnidirectional and directional. Under most circumstances the omni is the antenna of choice for micropower broadcasting. Polarization is another aspect to consider but does not play that big of a role in most cases. Antennas can be vertical, horizontal or circular in polarization. Most micro broadcast antennas are vertically polarized. In theory a vertically oriented receiving antenna will receive better if the transmitting antenna is vertically oriented as well. Obstructions in the receiving environment will have a tendency to bounce the signal around so that the signal will be not be exactly vertically polarized when it hits the receiving antenna, particularly in a car that is moving. Commercial broadcasters employ circular polarization which yields both vertical and horizontal components to the signal. It is said that this is best for car radios. This may be true given the dependence of commercial broadcasters on "drive time" as a peak listening period.

A single radiating element vertically oriented will have a rather high angle of radiation where a good portion of the signal is going up to the sky at angle of around 35 degrees or more. When you combine two vertical elements such as two dipoles you reduce the angle of radiation to a point where the signal is more concentrated in the horizontal plane. This is what accounts for the apparent doubling of radiated power when you use two dipoles phased together. Power output from the antenna or antenna array is known as effective radiated power (ERP) and is usually equal to or greater than the input power.

Several vertical element antenna designs have a lower angle of radiation even though they only use one element. These are the J-Pole and the Slim Jim designs. Having a signal pattern that is more compressed into the horizontal plane makes the Slim Jim ideal for urban environments. Both can be easily constructed from 1/2" copper pipe and fittings. Plans are available from FRB directly or the FRB web site: www.freeradio.org.

Another class of antennas are the 1/4 and 5/8 wave ground plane antennas. A commercially manufactured 5/8 ground plane for FM broadcast purposes is available for around $100. It is an ideal antenna for those want an easy to tune and assemble antenna. Set up time is less than 15 minutes. Plans for these antennas are available from FRB.

Directional antennas are not usually required for micropower broadcasting. If the area you wish to cover lies in one particular direction you might consider the use of such an antenna. An easy way to do this is to put a reflecting screen 1/4 of a wavelength behind a vertical dipole. The screen will need to be bit taller than the total length of the elements and about 2-3 feet wide. This will yield a nice directional pattern with a fair amount of power gain. Your pattern will be about 60-70 degrees wide. Another type of directional antenna is the yagi which has a basic dipole as the radiating element but additional elements as reflectors and directors. A yagi can be a bit difficult to build for those not well versed in antenna design and construction. Your best choice is a dipole with a reflector.

For those who wish for a practical design that can be built and put to use the following is a basic dipole antenna which can be constructed from common hardware store items. It uses 1/2 inch copper water pipe and fittings along with aluminum tubing. A half inch plastic threaded T is used with a copper 1/2 inch threaded to 1/2 inch slip adapters at all three points. An aluminum tube 9/16 of inch or so in diameter will fit into this slip adapter and is attached with two #6 self tapping sheet metal screws. This tubing is 20 inches long. Another piece of

aluminum tubing 15 inches long with a diameter small enough to slip inside the other tubing is used as the adjustable tuning element. Four slots 90 degrees apart and 1 1/2 inches long are cut into in one end of the larger tubing. A small diameter hose clamp is slipped over that end. With the smaller tubing inserted inside the hose clamp is tightened to hold it in place. This is repeated for the second element. A copper half inch thread to slip adapter is soldered to one end of a 36 inch piece of 1/2 inchcopper tubing which is the support arm for the dipole. A copper T is soldered to the other end. Then, two 3 inch pieces of 1/2 inch copper tubing are soldered to the T fitting. This allows easy clamping to a mast. A solder lug is attached to each element using one of the self tapping screws holding the elements to the slip fittings. Your coaxial cable will be attached to these solder lugs. Center conductor to one, braid or shield to the other. You can get a little fancier and make an aluminum bracket to hold an SO239 socket and attach this to the T connector.

Once you have it all put together as shown in the diagram it is time to tune it. Adjust the element lengths to the 1/4 wave length you arrived at with the above formula. Tighten the clamps so the tuning stubs can barely slide back and forth. Mark each stub where it enters the larger tubing. Using either hose clamps or U clamps attach the antenna to the end of a mast piece 10 feet long. The element to which the braid or shield of the coax is attached must be pointing down Support the mast so that it stands straight up with the antenna at the top. It is best to do this outside.

Set up your transmitter and connect an SWR/Power meter between the transmitter and the antenna. Adjust your meter to read SWR according to the directions that came with it. SWR is the ratio of power coming from the transmitter and the power reflected back from the antenna. A properly tuned antenna will reflect very little power back, resulting in a very low SWR ratio. Too much reflected power can damage the transmitter.

Turn on the transmitter and observe the SWR or amount of reflected power. Shut the transmitter off if the level is very high and check your connections. Rough tuning the antenna by measurements should have brought the readings down to a fairly low level. Turn off the transmitter and adjust each tubing stub up or down about 1/4 of an inch. Turn the transmitter back on and note the readings. If the reflected power and SWR ratio went lower you went the right direction in either increasing or decreasing the length of the stubs. Turn off the transmitter and continue another 1/4 inch in the same direction or the opposite direction if the SWR ratio and reflected power increased. Turn the transmitter on again. If the reading is lower continue to go in the same direction in 1/4 inch increments being sure to turn off the transmitter to make the adjustments. Continue to do this cycle until you have reached the lowest possible reading. At some point the readings will start to increase again. Stop there.

You can do this with two dipoles as mentioned earlier in this section. Each dipole is tuned by itself and then both are connected with a phasing harness when mounted to the mast section.

CONNECTORS AND CABLE

Radio frequency cables are referred to as coax as a generic term. It is short for coaxial. A coaxial cable consists of an inner conductor inside an insulating core. This is surrounded on the outside by a metal braid or foil, called the shield. This shield is in turn covered by an insulating jacket of plastic material. Coaxial cables are specified in terms of impedance which for most micropower broadcasting purposes is 50 ohms except for dipole phasing harnesses.

In the 50 ohm category there are a number of choices when selecting coaxial cable. The most important characteristic of coax is its level of signal attenuation. This depends on the length of the cable and its particular frequency response. RG58 coaxial cable has a high degree of attenuation and should only be used for short connections. RG8X or mini 8 works well for lengths under 50 feet and is suited for portable and mobile set ups since it is rather flexible. RG8 and its higher performance cousins such as 213 and Belden 9913 are the best for fixed installations. Belden 9913 has the lowest loss for any given length as compared to other variations of RG8. In fact, it has a loss figure at 100 MHz that compares well with commercial broadcast hard-line coax. It is rather stiff cable and must be installed correctly.

Coaxial cables do not take rough treatment very well, especially 9913. They must be carefully rolled up by hand, not wrapped between palm of hand and elbow like a rope. Kinks are to be avoided at all costs. When routing a cable keep the bends from being sharp and keep it away from circumstances where it can be pinched or slammed.

Three types of connectors are in general use - BNC, PL259 and N. Most micropower broadcasting equipment uses PL259 and its mating socket known as the SO239. Any connector will introduce some small degree of signal loss. N connectors are used where high performance and reliability are of most importance.

STUDIO SET UP

A typical broadcast studio consists of an audio mixer (DJ style works best), one or more CD players, one or more cassette tape decks, a turntable or two, several microphones, and a compressor/limiter. Optional items can include a cart machine and a phone patch.

Reasonable quality mixers start at $200 and go up in price from there. DJ styles are best since they have a large number of inputs available and support turntables without the need of external phono preamps. Any mixer you select should have least 2 or more microphone input channels. These should be low impedance inputs. Other features to look for include high visibility VU (level) meters, slide faders for each channel, switchable inputs for each channel, stereo or mono selection for the output signal, and an auxiliary output for an air check tape deck.

CD players and tape decks can be your average higher quality consumer audio gear. Day in and day out usage will eventually take their toll so pay for the extra warranty period when it is offered. When one wears out in 6 months or so just take it back under warranty for either repair or replacement.

diameter. Regardless of the type, all such cables exhibit a loss that increases with frequency of operation and the length of the cable. For most purposes we will concern ourselves with RG213 and RG8x (mini version of RG8). In very short runs RG58 can be used, but we prefer RG8x due to its lower loss and ability to stand a bit more abuse. RG213 has the lowest loss of the group. Under no circumstances should the cables be twisted, kinked or crushed, this will cause major problems. We supply both RG8X and RG213 in the following lengths. Each end is terminated with a PL259 plug.

RG8X: 25 feet - $15, 50 feet - $25, 75 feet- $35, 100 feet - $40

RG213: $00.75 ft in 25, 50, 75 and 100 ft lengths (custom lengths - $1.00 ft)

ENCLOSURES

BOX7

7 x 7 aluminum chassis punched and drilled for ½ watt PLL transmitter

with or without the 6 watt amp - $25

The Brick Enclosure

15 watt size -$45, 20-40 watt size -$60. 75 watt size - $75, 150 watt size - $95. Combined heat sink and enclosure made from extruded aluminum. Will support a ½ watt PLL on a slide-in plate in combination with the 15, 40, 75 or 150 watt amplifiers.

Rack Enclosure - $75

Will work for a 1 watt with or without stereo generator, 1 watt PLL & 6 watt amp with or without stereo generator, 1 watt PLL and 15 watt amp with or without stereo generator. Please specify which combination. Compact switching power supply for internal mounting - $50.

LIMITERS

A limiter is required to prevent over modulation of the FM signal. Over modulation will cause spurious emissions and interference with other signals plus sound very distorted. It is extremely important to prevent this.

Alesis Nanocompressor - $125

Comapct compressor limiter with good performance

Berhringer Autocom Limiter/Compressor - $195.00.

Professional audio limiter/compressor with lots of features.

MIXERS & MICROPHONES

We offer the entire Behringer and & Samson audio line including mixers.

Please inquire for catalog and pricing. Prices start at $175.

Basic 4 channel mono mixer kit - $45

An introductory level mixer kit that has two channels set for hi-z microphones and 2 channels for mono line level sources. Will operate on two 9 volt batteries. Two mixer circuit board can be ganged for 8 channels.

Optional led vu and headphone board kit - $35 and limiter circuit board kit- $35

Samson Mixpad 4 - $175

A good choice for portable and field operations. It features two XLR low impedance inputs with one stereo input for a CD player or tape unit. Power source is either AC or 9 volt batteries.

Pyramid PM4001 DJ Mixer - $165

Entry level DJ mixer with 1 XLR microphone input and 8 line level inputs including 2 phono.

Pyramid PM8200 DJ Mixer - $225

Pyramid's better quality mixer with 2 XLR microphone inputs and 3 turntable inputs plus 6 line level inputs.

Slim Jim - $20

SO239 connector and clamps. Works very well for urban areas where a powerful horizontal pattern is needed. If used at too great of height, an area surrounding the antenna will be skipped over due to its low angle of radiation. Even at a height of only about 12 feet mounted on a traffic sign pole this antenna was able send a 5 watt signal 2-3 miles. Requires soldering of copper pipe. Can be placed inside a 6" piece of black plastic pipe for concealment. Provides a gain of 2-3.

Dipole - $35

Easy and quick design. Includes the aluminum antenna elements.

POWER SUPPLIES

Unless you are planning on operating from a 12 volt lead acid battery or from the lighter socket in a vehicle you will need an AC operated DC power supply. Wall adapter units cannot be used. We have the following units available. Small switching type supplies for mounting inside the enclosure are available as well, see the no-tune PLL section. 2 amp 12 volt switcher - $30, 3 amp 24-28 volt switcher $40.

PS-3 - 2.5 Amp 13.8 V DC power supply - $40

PLL with a 6 watt Use this to power either the ¼ watt PLL transmitter or

a ½ watt amplifier

PS-7 - 6 Amp 13.8 V DC power - $50

Use this to power the the 15 watt amplifiers.

PS-14 - 12 Amp 13.8 V DC power supply - $80

Use this to power the 40 watt amplifier The above are Pyramid brand power supplies, We have higher quality Astron 13.8 volt DC power supplies available as well.

Astron 28-10 - 10 Amp 28 V DC power supply - $150

Use this to power a 75 watt amplifier

Astron 28-15 - 15 Amp 28 V DC power supply - $225

Use this to power a 150 watt amplifier

Switching 13.8 V 12 amp DC power supply - $125

A very compact lightweight power supply that is ¼ of the weight of the PS-14. Ideal for overseas shipments.

METERS

Power & SWR Meters

These are essential to the proper tuning and setting up of both transmitters and antennas. An antenna has to be fine tuned so that it accepts the full power of the transmitter and reflects the lowest amount possible back,

that ratio of forward power to reflected power is known as the standing wave ratio (SWR). The various stages of both transmitters and amplifiers have adjustable capacitors which are used to tune the unit to the frequency of operation. A power meter allows you to see the effect of these adjustments on the power level and to set everything at an optimum level.

Economy Power/SWR meter - $35

A compact in-line unit that works up to a frequency range of 150 MHz.

Daiwa Meters - Model CN-101 - $100 / 100 Model CN801H - $140

Dual cross needle meters that shows both forward and reflected power on the same meter face. Makes tuning up very easy, no need to switch back and forth between these two functions. The model CN801H has a large meter face that is very easy to read.

FREQUENCY COUNTER - $80

To accurately maintain your operating frequency a digital frequency counter is highly recommended. This unit is a 6 digit unit usable to 350 MHz.

COAXIAL CABLES

A coaxial cable is a special type of wiring that has an inner conductor surrounded by an insulating plastic sheath which is covered by a braid of copper wire that is then covered by a plastic jacket. The 75 ohm video cable used in home TV applications is one type of coaxial cable. For most RF purposes, 50 ohm cable is used. Quite a number of 50 ohm coaxial cables are available ranging from the rather small to cables over 1" in

DJ style turntables are the best choice for playing vinyl. Cheaper units just will not stand up to the wear and tear of daily usage. Select a heavy duty stylus as well.

Microphones should be fairy good quality vocal types. They can be either directional or omnidirectional. Directional microphones will pick up less ambient noise but need to be on axis with the person's mouth for best pick up. Since some folks do not pay attention to where the microphone is in relation to their mouth, an omnidirectional might be considered a better choice if this is the case. A distance of about 4 inches should be maintained between the microphone and mouth. Place a wind screen foam piece over each microphone. Some microphones have built-in shock and vibration isolation to keep bumps to the microphone from being audible. It is a good idea to use some sort of isolated holder for the DJ microphone. An old swing arm lamp can be adapted to hold a microphone.

For programmers who do a lot of reading on material on the air a headphone microphone is something to consider since it will maintain a uniform distance from mouth to microphone no matter where the head moves to. One drawback is that they tend to be a bit fragile in rough hands.

Headphones are essential for monitoring and curing up program material. You can either opt for high quality rugged units that are a bit costly or plan on replacing an inexpensive set every few months.

A limiter/compressor is an essential part of the audio chain. It is used to keep the audio signal from exceeding a preset level. Without this the transmitter will be overmodulated resulting in signal splatter and distortion. Signal splatter will cause interference with adjacent stations and distortion will send your listeners elsewhere.

Common to most limiter/compressors are a set of controls - input level, output level, ratio, threshold, attack and decay. To properly set up the mixer, limiter/compressor and transmitter you start with a steady audio source (a signal generator plugged into the board or a test tone CD, tape or record). You adjust the input level and master output level controls so that the meters are reading zero dB. Master level should be at mid position. Audio output goes from the mixer to the limiter/compressor and from there to the transmitter. Do not turn the transmitter on at this time.

Most limiter/compressors have indicator lights or meters to show how much gain reduction is being applied and the output level. Set the ratio control to the infinity setting, this enables hard limit function. Attack and decay can be set around mid position. Adjust the threshold and the input level until the gain reduction shows activity. Adjust the output level so that the indicator lights or meters show a 0 dB output level.

Turn the level input on the transmitter all the way down and power up the transmitter. Monitor the signal on good quality radio. Slowly turn the level control until you can hear the test tone. Compare the signal level to that of other stations. Your level should be slightly less since most other operations are using quite a bit of audio processing on their signal. You may have to make fine adjustments to the limiter/compressor to get things exactly right.

When everything is set up correctly any audio signals that exceed 0 dB on the board will be kept at that level by the compressor/limiter. You will need to listen carefully to the signal to make sure when a "hot" audio source exceeds this that the transmitted signal keeps an even level and does not distort or splatter. There will be some interplay between the output level and the threshold setting. Nor do you want a signal that is too low in level either since that will produce a weak sounding broadcast.

A very important consideration is to keep as much distance between the studio gear and the transmitter as possible. RF (radio frequency signals) will find their way into audio equipment and produce a hum or other types of noise. You can separate the two areas by using a low impedance cable between the limiter/compressor and the transmitter. This can be a long microphone cable with XLR connectors or a made up shielded 2 conductor cable with XLR connectors. You can have about 150 feet of cable maximum. A high impedance to low impedance transformer will be needed at one end or both depending on whether the limiter/compressor and transmitter have low or high impedance connections. These transformers usually have an XLR female connector on the low impedance side and a 1/4" phone plug on the high impedance side. If your transmitter has an RCA style input you will need the proper adapter to go from 1/4" phone plug to RCA plug.

Your studio should be arranged to provide easy access to all controls and equipment with plenty of table space. An L or horseshoe shape works well for the studio bench. An open area within the sight line of the operator should be provided so there will be a place for extra microphones and guests.

FINAL WORD

Although it seems like there is a lot to deal with in setting up a micropower station, it can be broken down into three areas- studio, transmitter and antenna. It should not be difficult to find someone with studio set-up experience to help with the project. Transmitters, particularly their construction and tuning, should be left to an experienced person. If such a person is not available there are a number of people who will assemble, test and tune your transmitter for whatever fee they have set. Stick to a commercial, easy to tune antenna such as the Comet if your skills are minimal. These can be purchased pre-tuned for an additional fee from FRB and L. D. Brewer. It is best to put most of the energy into organizing and setting up the station.

Experience has shown that once the technical operation is in place and running, it will require very little in the way of intervention except for routine maintenance (cleaning tape heads, dusting, etc.) and occasional replacement of a tape or CD player.

What requires most attention and "maintenance" is the human element, however. More time will be spent on this than any equipment. As a survival strategy it is best to involve as much of the community as possible in the radio station. The more diverse and greater number of voices the better. It is much easier for the FCC to shut down a "one man band" operation than something serving an entire community. Our focus is on empowering communities with their own collective voice, not creating vanity stations. Why imitate commercial radio ?

Before you commit to your first broadcast it would be advisable to have an attorney available who is sympathetic to the cause. Even though they may not be familiar with this aspect of the law there is a legal web site which offers all of the material used in the Free Radio Berkeley case. There are enough briefs and other materials available to bring an attorney up to speed. That web address is: www.368hayes/microradio. A web site, www.nlgcdc.org, for the National Lawyers Guild Committee on Democratic Communications puts you in touch with the group that is doing a lot of the legal work on micropower broadcasting. The central clearing house web site for the micropower movement is www.radio4all.org. Free Radio Berkeley's website is www.freeradio.org.

FM Broadcast Kits & Accessories

From Free Radio Berkeley

First, a word from our legal department:

For educational purposes only. These kits are offered for the furtherance of one's knowledge regarding radio frequency design and principles. At all times during operation the assembled unit must be connected to a dummy load. Part 73 of the FCC rules prohibits the unlicensed operation of these transmitters when connected to an antenna. All responsibilities for the ultimate use of these kits are born solely by the builder and/or operator.

All kits are complete and come with professionally manufactured, drilled and tinned PC boards. All coils are pre-wound. Each unit, unless specified, requires 12-14 volts for proper operation. Full instructions and diagrams included. Required tools include a 25-30 watt soldering iron with a fine tip, diagonal cutters, needle nose pliers, assorted screwdrivers and other small hand tools. Full assembly diagrams and instructions are included with each kit. Antenna construction diagrams are provided with each transmitter or amplifier order.

Certain kits are designed to work with each other. The 15, and 40 watt amplifiers are designed to be driven to full power with about ½-1 watt of input power, hence they work very well with the ½ watt PLL transmitter. If you wish to only boost a ½ watt signal to 5-7 watts then choose the 6 watt amplifier kit. An amplifier only increases the output power of a given input signal, it can not produce an FM signal whereas a transmitter or an exciter creates the FM signal at a suitable power level for possible further amplification by an RF amplifier.

TRANSMITTERS - EXCITERS

1 Watt Easy Tune PLL Transmitter/Exciter - $115

Our newest PLL kit design. Using wideband monolithic components from Minicircuits, this PLL covers the entire broadcast band by setting the 10 position dip switch. Only two tuning points to peak the power. This kit comes partially assembled with the surface mount components soldered on. It is available fully assembled for $195. Please note: this is a mono transmitter and requires an external stereo generator for stereo broadcast applications. Audio input is high impedance, line level. The RF output transistor is a heavy duty type, not the lighter duty type found in most comparable kits.

AMPLIFIERS

½ to 1 watt Amplifier - $35

½ to 1 watt output for an input power of 10 mw. Great for boosting lower power VFOs and low power Ramsey FM-10 type kits. Very compact size, 3 ½ X 1 ½ inches. An optional transistor can be substituted to take the power up to 1 ½ watts, add $5 for this option.

6 watt Broadband RF Amplifier - $40

Uses a rugged 6 watt transistor. It is designed to boost ½ to 1 watt transmitters to a bit higher output power, producing up to 8 watts of output power. A very small and compact circuit measuring 3 x 1 ½ inches. Easy, quick assembly with no tuning needed. Requires 12-14 volts DC at ¾ to 1 amp for operation.

15 watt RF Amplifier - $65

Uses a very high gain (14dB, power gain of at least 25X) RF transistor to boost a ½ watt input to 15 watts. Measures 2 ½ by 5 inches and fits into a 6 inch brick enclosure (available punched and drilled).Includes heat sink. Easy, point to point surface mount assembly. Requires 12-14 volts at 2 amps for operation.

30-40 Watt Amplifier - $110

30 to 40 watts of output power for an input of ½ watt. This is a two stage unit with a 5 watt and a 40 watt amplifier on the same board. Easy, large surface mount type assembly. Works very well with the ½ watt PLL transmitter. Requires 7 amps at 12-14 volts DC

75 Watt Power FET Amplifier $175 - 100 Watt FET AMP - $210

Uses a high power FET. The 75 watt requires 1-1 ½ watts to drive it to full power and the 100 needs 5 watts of drive. Requires a 6-7 amp 24-28 volt DC power supply.

FILTERS

It is absolutely imperative to use a filter to prevent interference from harmonics generated by the transmitter. Both these filters are low pass types which start to attenuate the signal at 108-110 MHz or so. Not using a filter will create problems and give the FCC ammunition to use against us.

7 Element Output Filter Kit - $15.00

A seven element low pass filter, composed of 4 coils and 3 capacitors, to flatten those harmonics. This one works well with the 6 watt and 15 watt amplifiers. Enclosure is $12.00

9 Element Heavy Duty Filer Kit - $30.00

A nine element low pass filter which will handle power levels to at least 100 watts. Use this filter with the 30 or 40 watt amplifiers. Enclosure is $15.00

DUMMY LOADS

Always use a dummy load when testing and tuning transmitters and amplifiers. A dummy load is a non-inductive resistive load which simulates an ideal antenna impedance of 50 ohms. Never use an antenna for testing and tuning transmitters.

20 Watt Dummy Load Kit - $15.00

Essential for tuning up and testing transmitters and amplifiers. Will handle 20 watts without any strain, higher powers for a briefer period of time. Presents a 50 ohm impedance. to the transmitter.

50 Watt Dummy Load - $40 500 Watt Dummy Load $75

Fully assembled commercial units. The 50 watt is a small bench unit while the 500 watt load is a "can antenna" style with the resistive element suspended in a bath of mineral oil in a one gallon can.

ANTENNAS

An FM broadcast station's signal strength is extremely dependent on having a properly tuned and positioned antenna. Tuning an antenna requires changing the length of one of more elements and/or the cable attachment point. An SWR meter is needed to properly tune the antenna.

Comet Antenna - $125.00

A commercially made antenna for the FM broadcast band. It is a 5/8 ground plane design that assembles quickly and easily. It tunes by sliding the inner element up and down. Has a gain of 2.

ANTENNA KITS

Some are partial kits, just go to your local plumbing supply or hardware store for the copper pipe and/or wire needed for completion. Full construction diagrams and instructions included.

J-Pole - $45

Works very well for urban areas. Very easy assembly. No soldering of copper pipe required for assembly. Can be adjusted for operation over the entire FM band. Includes the aluminum antenna elements.