

FM Broadcasting for Holiday Displays

Fm Broadcasting – Overview

- Advantages:
 - People can enjoy the music in their vehicles during inclement weather
 - Better sounding audio quality
 - Audio volume of the display can be controlled to avoid disturbing neighbors

Fm Broadcasting – Overview

- Disadvantages:
 - Increased cost
 - Legal issues
 - Potential interference issues in impacted neighborhood

Radio Broadcasting

- Types:
 - Licensed
 - Unlicensed
 - AM
 - FM

Licensed Broadcasting

- AM
 - 250 watts ERP minimum
 - 25 mile coverage area (radius)
- FM
 - 100 watts minimum
 - 4 miles coverage area (radius)

Licensed Broadcasting

- There are defined minimum hours of operation for licensed stations
- Types of licensed stations:
 - Commercial
 - Noncommercial
 - Educational

Licensed FM Broadcasting

- Commercial FM broadcast stations operate from 92.1 – 107.9 Mhz
- Noncommercial FM broadcast stations operate from 88.1 – 91.9 Mhz
- Educational FM broadcast stations operate throughout the entire band, although most operate 88.1 – 91.9 Mhz

Low Power Broadcasting – the Law

- There are 2 types of low power AM and FM broadcasting:
 - Licensed
 - Unlicensed
- For the remainder of this presentation we will deal with FM broadcasting

Low Power Broadcasting – the Law

- Created under a new law in January 2000
- Licensed low power FM stations operate with a minimum of 1 watt, a maximum of 100 watts, ERP
- They are allowed to cover about a 3.5 mile radius

Low Power Broadcasting – the Law

- Low power FM radio licenses are available only to:
 - Noncommercial educational entities
 - Public safety/travellers' information entities
- They are **NOT** available to private individuals/commercial operators

Low Power Broadcasting – the Law

- That leaves us with unlicensed FM broadcast operation, as defined by Part 15 of the FCC rules (47 Code of Federal Regulations, Section 15.239)
- Part 15 governs other non-licensed transmissions as well, including wireless telephones, wireless internet, garage door remotes, etc.

Low Power Broadcasting – the Law

- Part 15 allows unlicensed FM broadcast:
 - **With an operational radius of 61 meters (200 feet)**
 - Actual measured **received** signal strength is limited to 250uv/meter at 3 meters from the antenna
 - With sufficient antenna height that signal can be detected at 1.9uv 1200 plus feet (1/4 mile) away (modern FM receivers can receive 1.7 uv signals)
 - That violates the 200 foot range limit in Part 15, as described above

Low Power Broadcasting – the Law

- Unlicensed broadcasters may not cause any interference to licensed station operation, or operations must be shut down
- That means within your 200 foot range, you must have a clear frequency to operate, even under Part 15!
- Unlicensed transmitters must accept interference from other (electronic) devices
- Part 15 FM broadcast operations are allowed between 88.1 – 107.9 Mhz only.

Low Power Broadcasting – the Law

- Penalties for exceeding Part 15 allowances:
 - \$10,000 per day of operation, to a maximum of \$75,000
 - Equipment may be (usually is) confiscated
 - If it can be demonstrated the transmitter was “willfully and knowingly” operated outside of the allowances of operation under Part 15, there are criminal fines and imprisonment that may be imposed.
- **It just isn't worth taking any chances!**

Low Power Broadcasting – the Law

- In summary, it's not the actual equipment that is legal/illegal, but rather the installation and operation of the equipment that may violate the law.
- Use the kits as intended, with whip antennas, and you **should** be safe.
- If in doubt check the transmitters range. If 200 feet or less you **will** be safe.

Low Power Equipment

- There are a number of FM transmitter kits/assembled kits available today
- Look for transmitters with:
 - Frequencies that are PLL controlled, and switch selectable
 - Audio input limiters, (AGCs, adjustable audio potentiometers, etc.) to prevent distortion
 - 75 Khz deviation, to allow maximum audio clarity without distortion

UX300 USB FM Transmitter



UX300 USB FM Transmitter

- The UX300 **USB FM Transmitter** is a USB device intended to transmit audio from your desktop computer or notebook to nearby FM radios all over your home or office without cables or wires. This USB transmitter is a truly plug-and-play device and is simply connected to your computer via the supplied USB cable. No drivers are needed. The transmitter installs itself within seconds as soon as you plug it into your computer.
- The USB FM transmitter appears as a sound card to your computer and any audio produced by the computer will be transmitted over the USB connection to the transmitter for reception on any standard FM radio. Power for the transmitter is provided through the USB port and therefore there are no batteries required

UX300 USB FM Transmitter

- Specifications:
- FCC Certified (FCC ID: SCSUX300)
- 30 to 50 foot Range
- Plug-and-Play USB device
- Transmission frequencies:
106.7, 106.9, 107.1, 107.3, 107.5, 107.7, 107.9 MHz
- Zero-drift Phase-Locked-Loop (PLL) Design
- Output power: 250 μ V @ 3m (Limited per Part 15 FCC regulations)
- Frequency Response: 40 Hz - 15 KHz
- Channel Separation: 40 dB (Typical)
- Total Harmonic Distortion: 0.1% (Typical)

MS-100S FM Transmitter



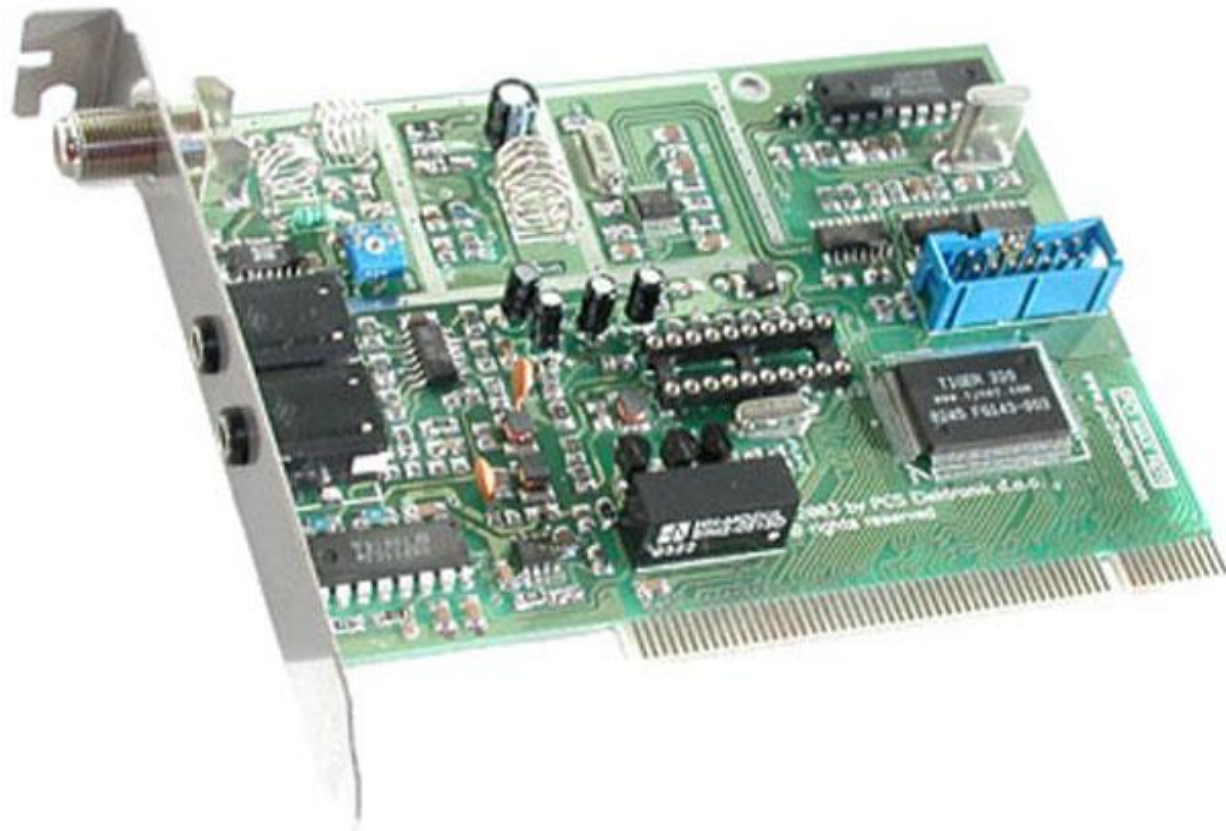
MS-100S FM Transmitter

- The MS-100S is a professional quality stereo FM transmitter operating in the commercial FM broadcast band (88.1 - 107.5 MHz) and can be used in a wide variety of applications. Its outstanding RF and audio performances, ... make the MS-100S stand out from FM broadcasting systems. The MS-100S features our latest technology innovation called DAFP technology (Direct Access Frequency Programmation). This new digital technology allows the end user to program the frequency without any manual tuning inside the unit. The stereo generator section of the MS-100S features a full digital circuitry that allows a stereo separation of over 40 dB. Near CD sound quality broadcasting is now a reality with the MS-100S.

MS-100S FM Transmitter

- SPECIFICATIONS:
- Modulation: FM, 75 KHz deviation
- Frequency selection: 88.1 - 107.5 MHz
- Frequency precision: .005% Crystal.
- RF power: 250 μ V/m@3m.(FCC Part 1& DOC RSS-210),
1 milliwatt (DOC RSS-123)
- Spurious rejection: 45 dB min.
- Frequency response: 20-15 KHz
- Stereo separation: 40 dB min. THD: .05% max.
- Signal to noise ratio: 70 dB min.
- Input sensitivity: -15dBm to +15dBm (unbalanced)
- Dynamic range: 80 dB min.

PCI-Max FM Transmitter



PCI-Max FM Transmitter

- **NOTE:** The PCI-Max does not meet the standards set forth in the [FCC Part 15 Regulations](#), and as such may be illegal to use in certain countries. Please check with your local authorities to confirm whether or not this unit is legal to use in your area.
- Power Output: 0 - 300mW (0.3 watts)
- Power Requirements: None, it runs off your PC power
- Stereo sound, digital stereo encoder completely built-in
- Stereo Specs: Better than 50dB. S/N > -60dB
- Works with PCI slot under Windows 95, 98, ME, XP, 2000 etc..
- Frequency Range: 88 - 108 MHz in 50kHz steps
- Freq. Stability: Excellent, it's PLL controlled (+/- 1kHz)

FM10C FM Transmitter



FM10C FM Transmitter

- The Ramsey FM10C is tunable anywhere in standard FM band... 88 to 108 MHz
- It operates on 5 to 15 VDC
- It has settable pre-emphasis of 50 or 75 uSec for use anywhere in the world
- It is an easy to build, low cost transmitter, and includes a matching case set!
- It tunes through the entire 88-108MHz band in three separate ranges with a tuned LC circuit.

FM25B FM Transmitter



FM25B FM Transmitter

- Need professional quality features but can't justify the cost of a commercial FM exciter? The FM25B is the answer! A cut above the rest, the FM25B features a PIC microprocessor for easy frequency programming without the need for look-up tables or complicated formulas! The transmit frequency is easily set using DIP switches, no need for tuning coils or "tweaking" to work with today's digital receivers. Frequency drift is a thing of the past with PLL control making your signal rock solid all the time - just like commercial stations. The FM25B's real claim to fame however is the use of the latest cutting edge stereo generator on the market.

FM25B FM Transmitter

- It has synthesized frequency selection from 88 to 108 MHz for no frequency drift!
- Professional quality for exercise clubs, drive-ins, etc.
- It has adjustable RF output power
- It is microprocessor controlled
- It is the ideal campus or school radio station
- It has no annoying hum – and even better stereo separation than the original!
- It features Line In and Loop Out 1/8" Stereo jacks!
- It features a F style antenna output jack

FM30 FM Transmitter



FM30 FM Transmitter

- FM30:
- PLL synthesized for drift free operation
- Front panel digital control and display of all settings and parameters
- Professional metal case for noise-free operation
- EMI filtering on audio and power inputs
- Super audio quality, rivals commercial broadcasts
- Available in kit or factory assembled versions

FM30 FM Transmitter

- **Frequency Range:** 87.9-108.1 MHz
- **Power Output:** 0-25mW, BNC (FM30) <- **LEGAL**
0-1.0W, BNC (FM35WT) <- **WAY ILLEGAL!!**
- **Audio Inputs:** Line level left and right
Controls: Power on/off
- **Digital Controls:** Frequency, 256 step audio level, 256 step RF output level, 256 step audio balance, mono/stereo
- **Setup Digital Display:** Setup frequency, setup audio levels, setup audio balance, setup RF output level, setup mono/stereo, save settings
- **Normal Digital Display:** Frequency, RF power output, quality of signal
- **VCO Lock Display:** Front panel LED

FM100B FM Transmitter



FM100B FM Transmitter

- Built-in mixer - 2 line inputs and one microphone input, line level monitor output
- Precision active low-pass "brick wall" audio filter
- Clean, filtered RF output suitable for RF amplification
- Frequency range 88.0 to 108.0 MHz, 100 KHz steps

FM100B FM Transmitter

- The included frequency display and audio level meters assist in easy operation. The "B" version now includes some additional functionality including a line level monitor output, improved stereo separation, spectral purity, audio clarity, and adjustable RF Output.
- Sound quality is impressive, and equal to or better than most commercial stations. Low pass input filtering plus peak limiters put maximum "punch" in your audio, and prevent overmodulation distortion.

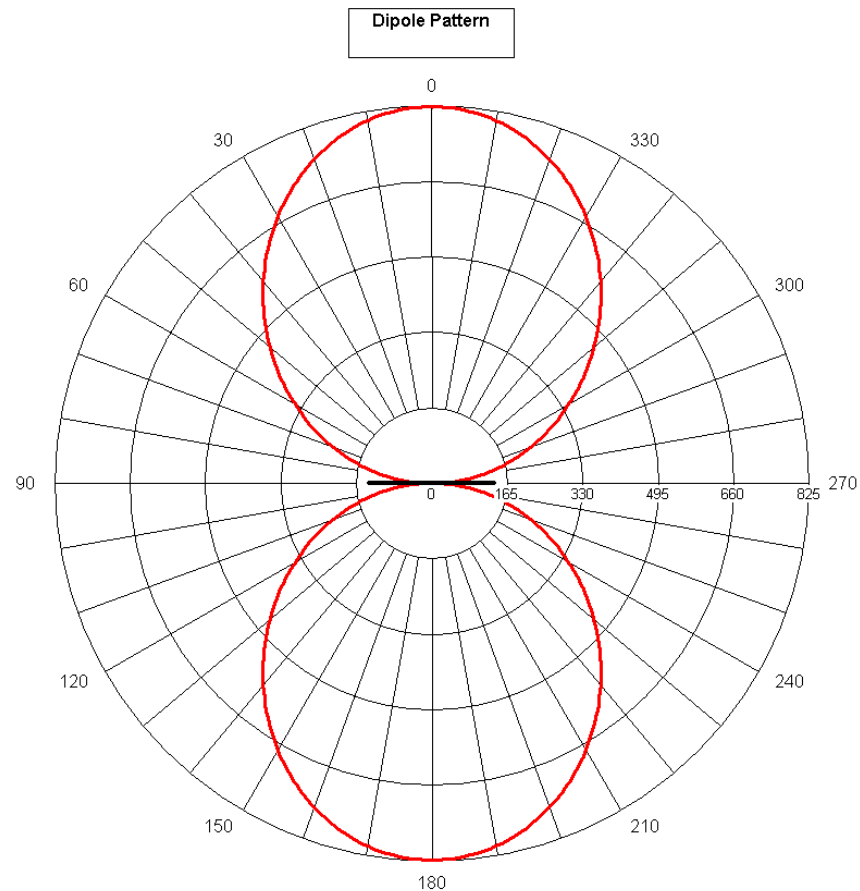
Antennas – the Simple Dipole



Dipole Antenna Lengths

- Dipole frequency – length list
- Frequencies world wide can be found in the [ABE Engineers Handbook \(455 kB\)](#).
- Channel # - Frequency - Length (inches)
- Channel 6 (82-88 Mhz) 72”
- FM (88.1-107.9 Mhz) 57”

Dipole Antenna Patterns



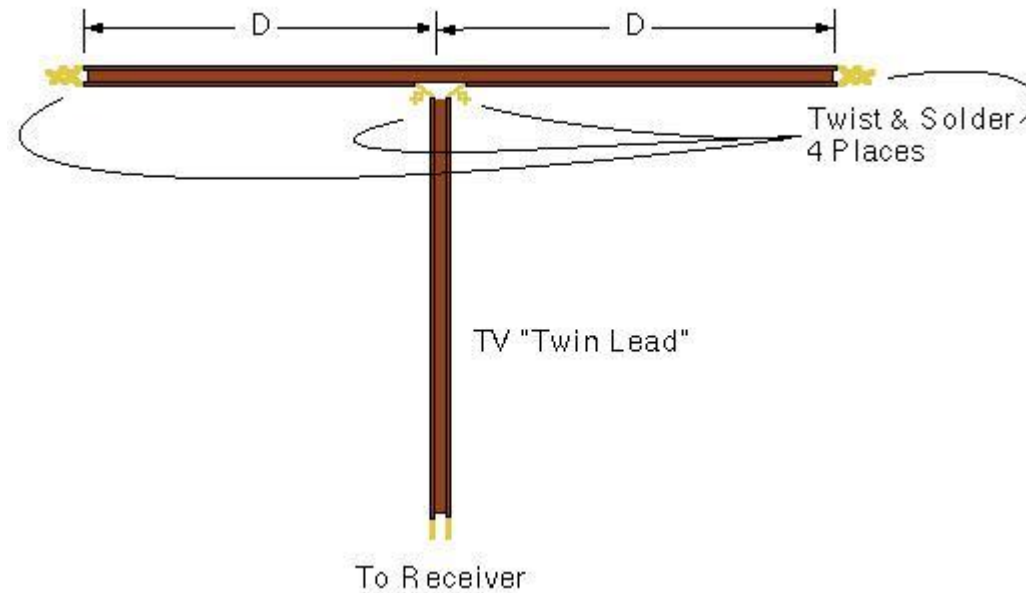
Commercial Vertical Antenna



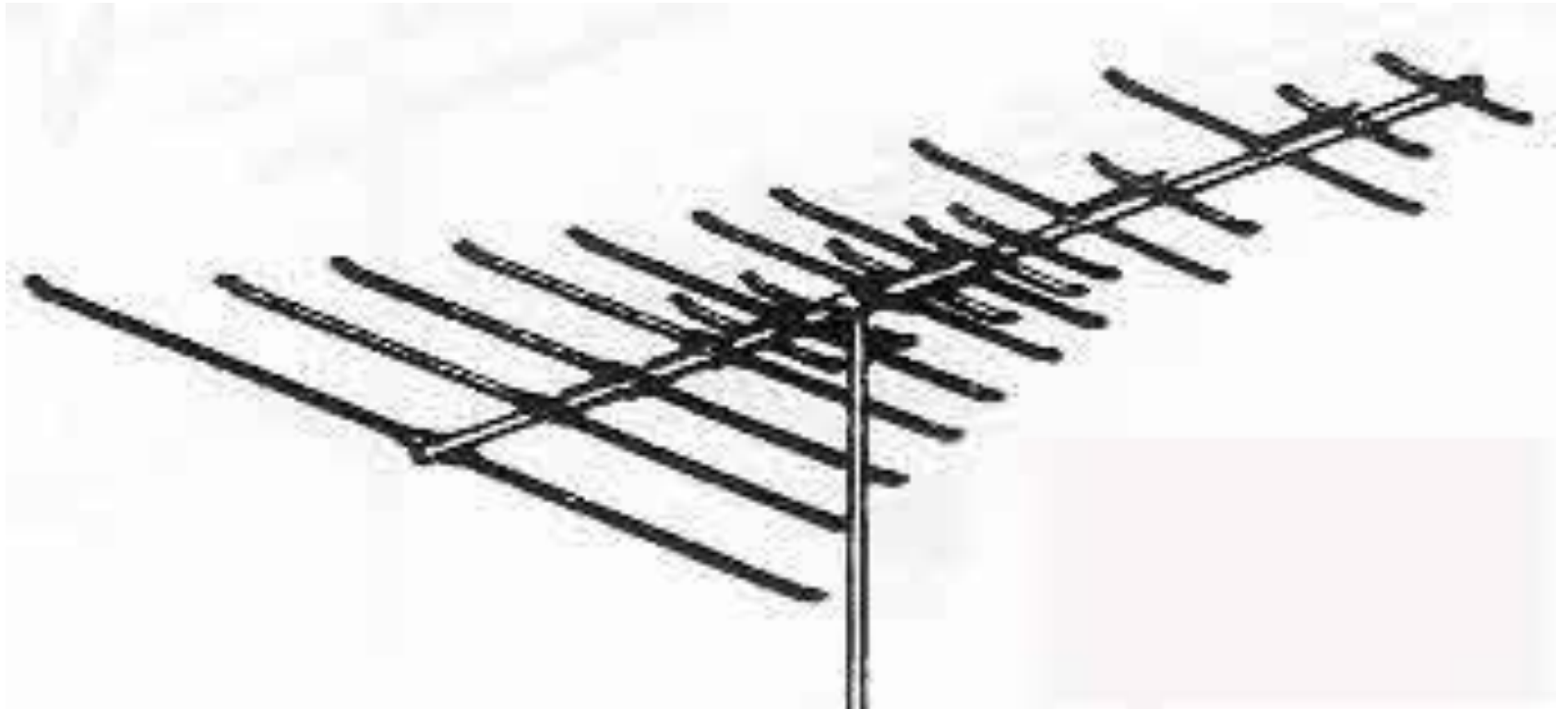
Commercial Vertical Antenna

- Frequency: 88-110 MHz
- Gain: 3.4 dBi
- Maximum power: 200 Watts
- VSWR: Less than 1.5:1
- Length: 7' 7"
- Weight: 2.4 Lbs.

Folded Dipole Antennas



FM/VHF Yagi Antennas



Discone Antennas



Coaxial Cable

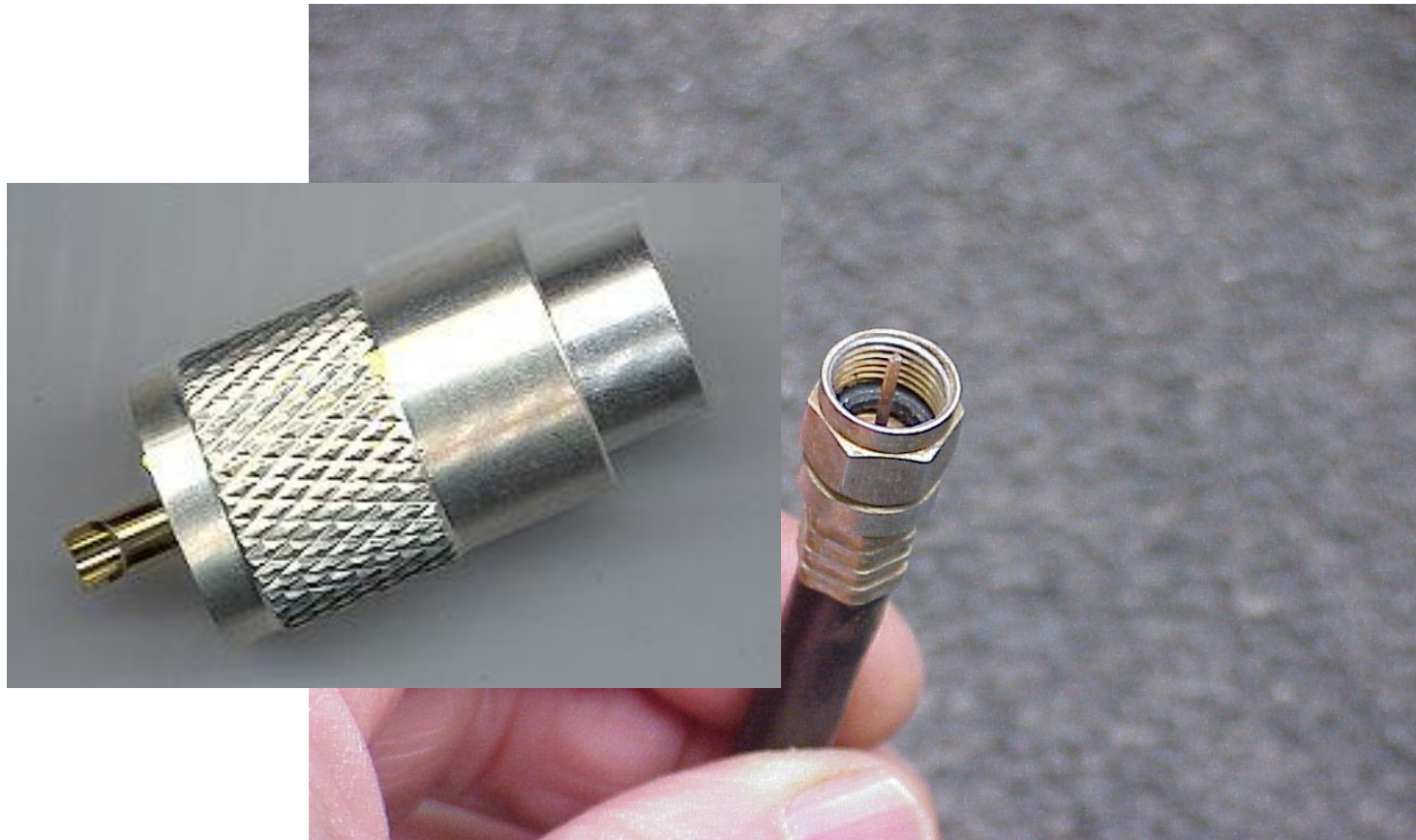


Coaxial Cable

- Types:

- RG8/213 .405 inches - 50 ohms
- RG8X .242 inches - 52 ohms
- RG58 .195 inches - 53.5 ohms
- RG6 .266 inches - 75 ohms
- RG59 .242 inches - 73 ohms

Coaxial Cable Connectors



Audio Cables



FM Broadcasting - Summary

- We began with a review of the FCC laws applicable to FM broadcasting
- Discussion focused on unlicensed (Part 15) FM broadcasting useful for our displays
- Currently available FM equipment, both assembled and in kit form, was reviewed
- We concluded with a discussion on the types of antennas, RF and audio cables available to get our FM stations “on-the-air”