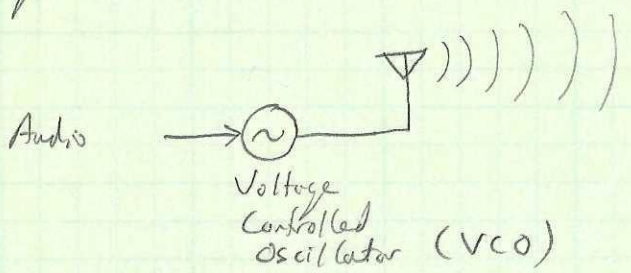
Transmitters, Power Amps, and FCC Rules and Regulations

Simplest FM Transmitter (TX)



Problems / Issues

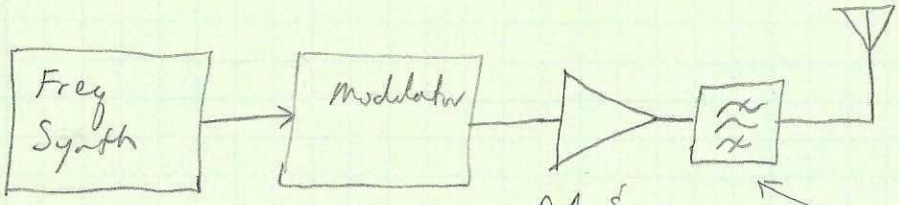
1) Frequency Drift
2) Small Output Power (Range)
3) Harmonic Emissions
4) Oscillator "Pulling" (Freq shift w/ Load Variations)

Solutions

1) Add crystal control / Freq Synthesizer
2) Add Power Amp
3) Add Harmonic Filter (BPF @ output)
4) Check / obey FCC Rules

Radio Transmitters

Typical Frequency Synthesized TX



FCC Rules & Regulations

- Define allowable Freqs
- Set Power & Antenna Height Limits
- Other (see handout)

Power Amps

Main Performance Parameters

Output Power

Gain

Efficiency $= \eta = P_{out}/P_{DC}$

or Power Added Efficiency (PAE) $= \dfrac{P_{out} - P_{in}}{P_{DC}}$

Power Dissipation $= P_{DC} - P_{out}$

Types

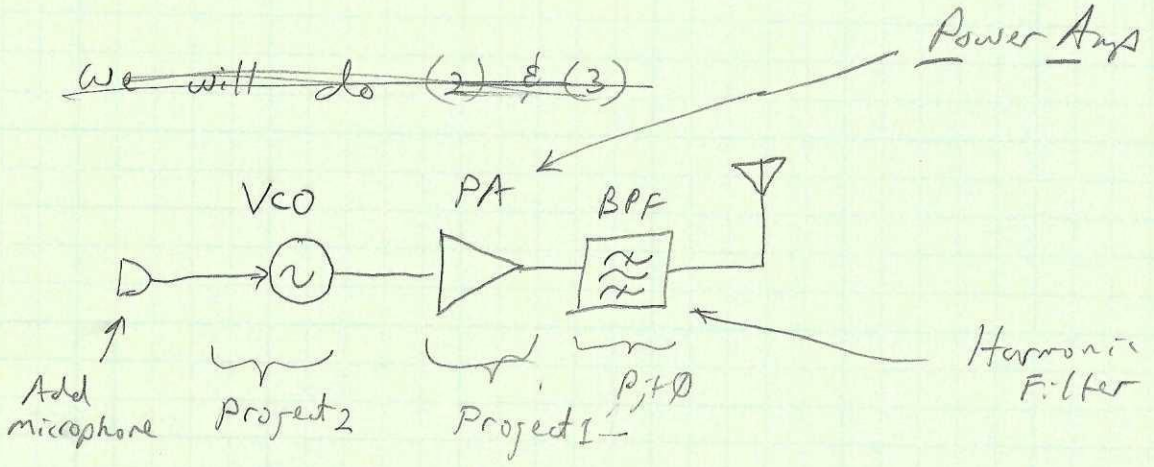
Class A — Used for drivers or high linearity; $\eta << 50\%$

Class C, D, E, F, ... S, ... — Non-linear, but high efficiency ($\eta > 50\%$ typ)

OK for FM, FSK, PSK

Midterm Project / Demos

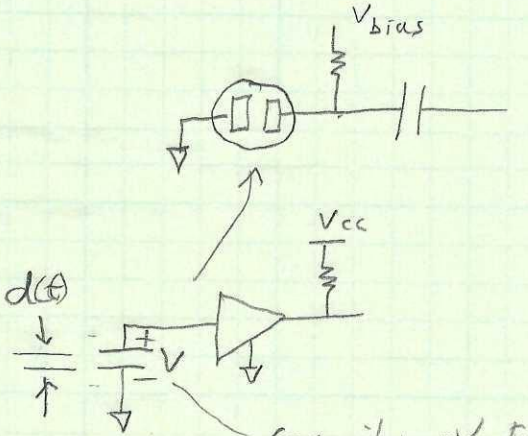
~~We will do (2) & (3)~~



Microphones

- Dynamic

- Electret Condensor



Show Data sheet.

Capacitor w/ Fixed Charge & movable plate (diagram)

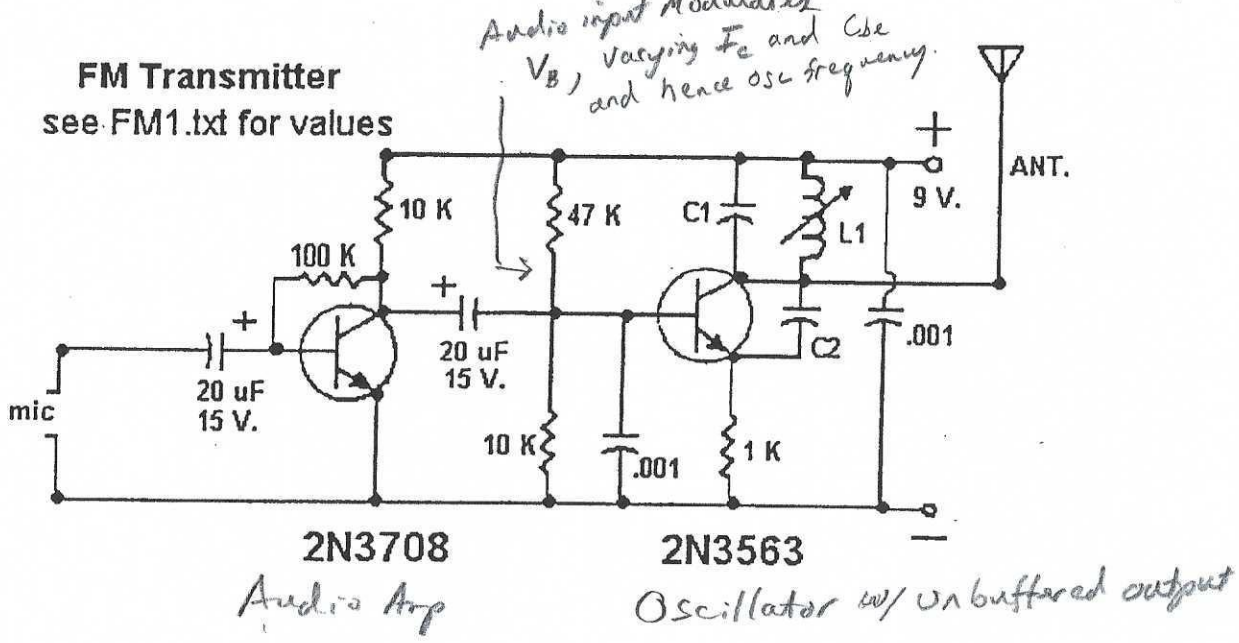
$Q = CV \Rightarrow V = \frac{Q}{C}$ with $C = \frac{\epsilon A}{d}$

$\Rightarrow V(t) = \frac{Q}{\epsilon A} d(t)$

GIF image 576x280 pixels

Examples from Web

http://www.ecnet.ne...ers/bsngd/fmxm1.gif



http://www.ecnet.net/users/bsngd/fm1.txt

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Values for FM Transmitter

mic is a magnetic mic for all three versions

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30-40 MHz range

L1 - 7.75 to 8 turns no. 24 enam on .25 inch form
with ferrite slug
C1 - 15-20 pF trimmer capacitor
C2 - 10-15 pF trimmer capacitor
ant.- 38" wire

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40-50 MHz range

L1 - 6.75 turns no. 24 enam on .25 inch form
with ferrite slug
C1 - 10-20 pF trimmer capacitor
C2 - 10-15 pF trimmer capacitor
ant.- 37" wire

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90-100 MHz range

L1 - 6.5 turns no. 26 enam on .25 inch form
with ferrite slug
C1 - 5.6 pF capacitor
C2 - 3.3 pF capacitor
ant.- 20" wire

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Elliott Sound Products

But maybe not low enough to be legal ...

Project 54

Low Power FM Transmitter

Rod Elliott (ESP)

Introduction

This article should satisfy those who might want to build a low power FM transmitter. It is designed to use an input from another sound source (such as a guitar or microphone), and transmits on the commercial FM band - it is actually quite powerful, so make sure that you don't use it to transmit anything sensitive - it could easily be picked up from several hundred metres away.

The FM band is 88 to 108MHz, and although it is getting fairly crowded nearly everywhere, you should still be able to find a blank spot on the dial.

NOTE: A few people have had trouble with this circuit. The biggest problem is not knowing if it is even oscillating, since the frequency is outside the range of most simple oscilloscopes. See Project 74 for a simple RF probe that will (or should) tell you that you have a useful signal at the antenna. If so, then you know it oscillates, and just have to find out at what frequency. This may require the use of an RF frequency counter if you just cannot locate the FM band.

Description

The circuit of the transmitter is shown in Figure 1, and as you can see it is quite simple. The first stage is the oscillator, and is tuned with the variable capacitor. Select an unused frequency, and carefully adjust C3 until the background noise stops (you have to disable the FM receiver's mute circuit to hear this).

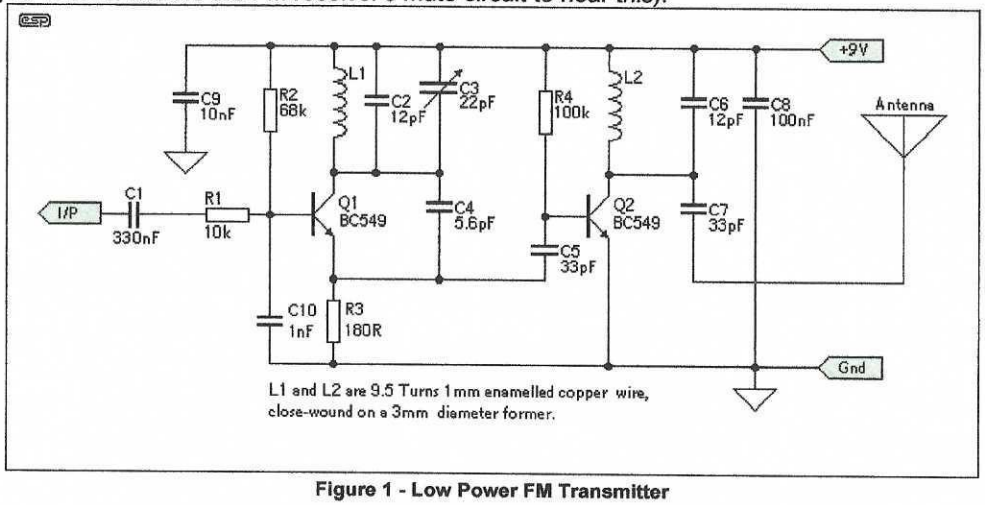

Figure 1 - Low Power FM Transmitter

Because the trimmer cap is very sensitive, make the final frequency adjustment on the receiver. When assembling the circuit, make sure the rotor of C3 is connected to the +9V supply. This ensures that there will be minimal frequency disturbance when the screwdriver touches the adjustment shaft. You can use a small piece of non copper-clad circuit board to make a screwdriver - this will not alter the frequency.

The frequency stability is improved considerably by adding a capacitor from the base of Q1 to ground. This ensures that the transistor operates in true common base at RF. A value of 1nF (ceramic) as shown is suitable, and will also limit the HF response to 15 kHz - this is a benefit for a simple circuit like this, and even commercial FM is usually limited to a 15kHz bandwidth.

Capacitors

All capacitors must be ceramic (with the exception of C1, see below), with C2 and C6 preferably being N750 (Negative temperature coefficient, 750 parts per million per degree Celsius). The others should be NPO types, since temperature