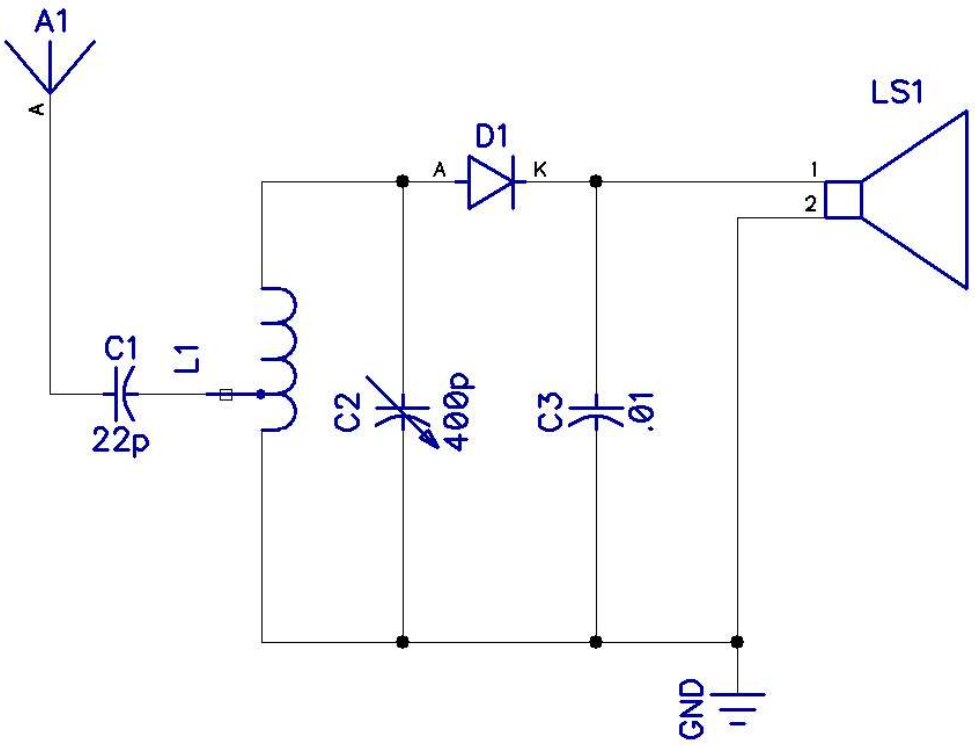
HOW TO BUILD AN AM RADIO RECEIVER

Posted by Graham Lambert | DIY Electronics | 1



In this article, we will first talk about radio frequencies and amplitude modulation. Then we will build three different AM radio receivers in order of increasing complexity. The first AM radio has no amplifier and only relies on resonance to create sound. The second AM receiver has a transistor amplifier, and the final AM receiver circuit uses an LM386 amplifier chip.

INTRODUCTION TO AM RADIO RECEIVERS

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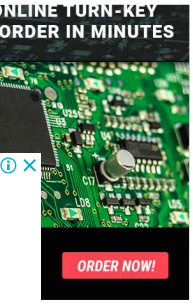
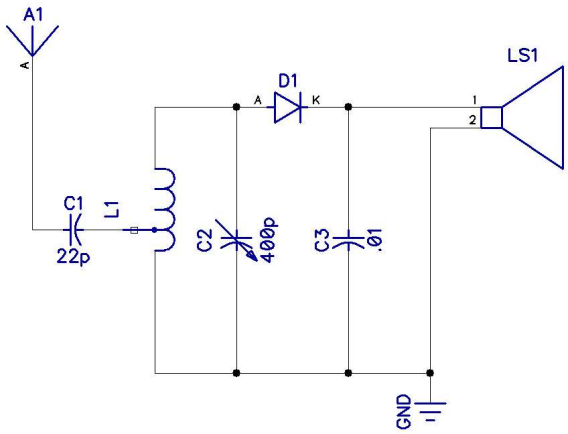


Medium wave and short wave were the main broadcast radio bands until the advent of FM. But they are still popular as they have more channel space than FM stations and offer longer range coverage, especially at night via the ionosphere. AM receivers are also simple and easy to build.

Radio stations in the medium wave and short wave bands transmit their signals using Amplitude Modulation (AM). This means that the transmitter radio (or carrier) signal is modulated with the music or speech content in a manner that the amplitude of the carrier is varied in relation to the incoming speech or music. AM is also used on all aircraft radios from 108 to 136MHz.

HOW TO BUILD A SIMPLE AM RADIO

Shown below is a simple (and magical if you have ever built one) crystal radio circuit. Building this is an excellent start in understanding how AM radios work:



A crystal AM radio

The diode is ideally a germanium diode, like the OA81, as it has a lower forward volt drop. But any diode will work, only with less volume. The LS is a high-impedance piezoelectric headphone like the vintage 2000Ω "crystal earpiece".

Capacitor C2 is a variable capacitor of about 300pF to 500pF.

L1 is a coil wound on a ferrite rod with about 50 to 60 turns. The tap is at about 5 to 10 turns to be coupled to the antenna. Use magnet wire to wind the coil if possible.

For this radio work well, you will need a good earth connection and at least 20m of wire as high as possible outdoors as an antenna. What's truly amazing here is that this circuit will work without any batteries and provide hours of AM listening fun.

HOW THE AM RADIO CIRCUIT WORKS

When the reactance (AC resistance) of capacitor C2 is the same as the reactance of the coil L1, resonance occurs at the frequency $f=1/2\pi\sqrt{(LC)}$.

For example, with L1 equal to 300 uH and C2 equal to 100 pF:

$F = 1/2\pi\sqrt{((0.0003\ H)*(0.000000000001\ F))} = 919kHz.$

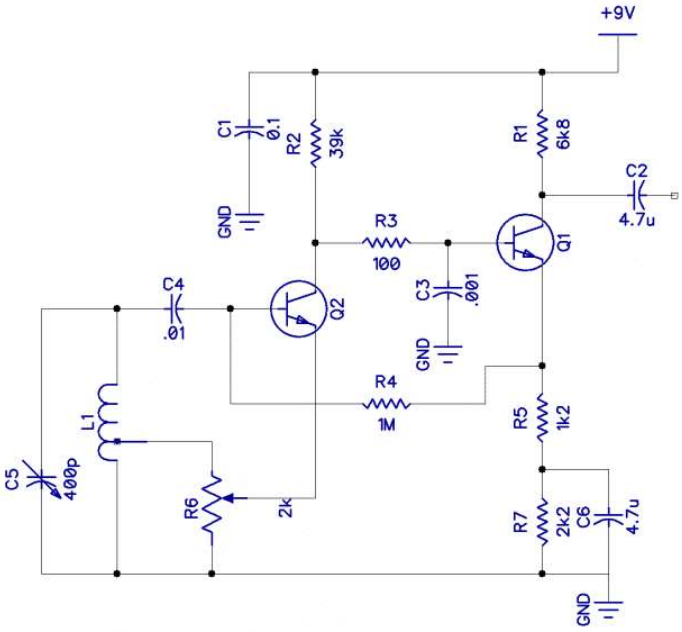
If they are in parallel (as in our circuit), the combined impedance is very high, and if they are in series, resonance also occurs but the combined impedance is very low. The ratio of this dynamic impedance to any loss resistance present is called Q. The greater the Q, the more selective the circuit becomes.

This increase in selectivity enables the circuit to tune into the station you want. If the selectivity is low, you would hear other neighboring stations at the same time. (C1 is a small capacitor as well as the tap to prevent the antenna from damping the Q of the tuned circuit).

The diode D1 rectifies and recovers the modulation and the capacitor C3 bypasses the radio (RF) part-leaving the original modulated audio. By changing the

TRANSISTOR AMPLIFIED AM RADIO

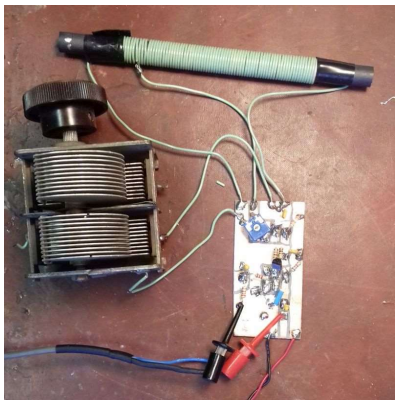
Before the advent of easy-to-use amplifier IC's such as the LM386, receivers were made from designs using discreet components. A popular choice was the regenerative receiver shown below.



A two-transistor regenerative receiver

Rectification of the AM signal takes place inside Q2, and R3. Transistors Q1 and Q2 can be any NPN transistor. Capacitor C3 removes any remaining RF components. Some of the demodulated signals are fed back as positive feedback through R4 into the tap of L1 via the regeneration control R6. This will have the effect of starting to oscillate. The idea is to adjust potentiometer R6 to a point where oscillation is about to start and back off a bit. This has the effect of greatly increasing the sensitivity and selectivity of the receiver. R5 generates some negative feedback, which improves the audio quality.

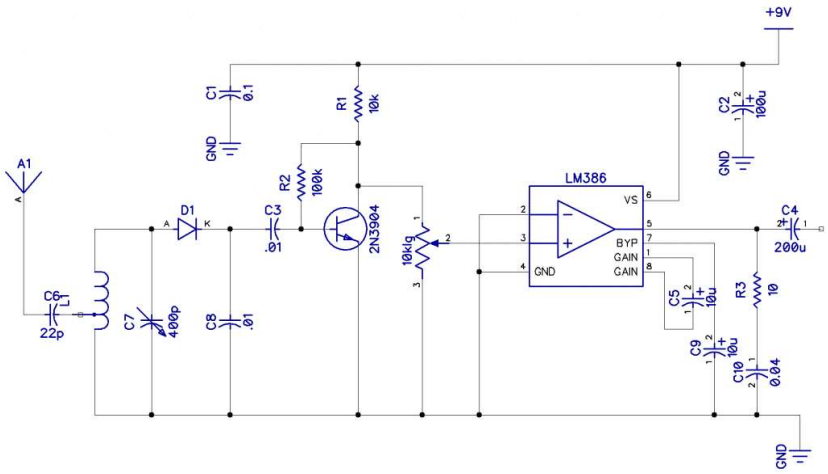
Variable capacitor C5 and coil L1 are the tuned circuit. Coil L1 is 60 turns on a 1 cm diameter ferrite rod (about 300uH) with 5 turns added for the tap. In the prototype board below, I am only using one half of the variable capacitor.



Regenerative radio breadboard

Close up of the PCB

to work without an antenna or a good earth connection. Also, the LM386 provides enough amplification power to drive a small speaker.

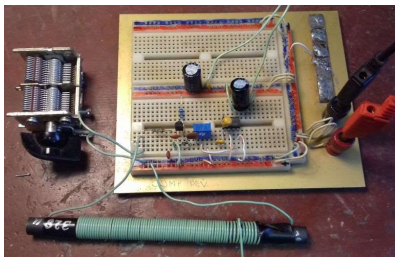


AM radio with LM386 amplifier

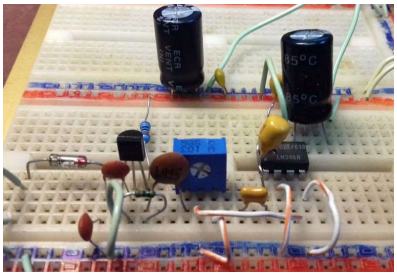
Capacitors C5 and C9 set the overall gain of the LM386. If you find the gain too high, you can adjust it following the instructions in our article on how to Build a Great Sounding Audio Amplifier (with Bass Boost). The article also discusses how to tweak an LM386 amplifier circuit to get better sound.

Resistor R3 and capacitor C10 prevent unwanted instability of the LM386's output by providing a known load at frequencies above audio.

The 2N3904 transistor provides a moderately high impedance to the tuned circuit giving good selectivity.



Breadboard of the LM386 radio



Detail of the breadboard

In conclusion, making your own AM receiver can be easy and gives a lot of rewarding listening pleasure. All of the above circuits were built and tested and

with crocodile clips. Sliding one sheet over the other makes a variable cap provided they don't make electrical contact.

If you don't want to go through the process of sourcing all of the parts for building these AM radios, there are some really cool DIY radio kits on Amazon.

Thanks for reading and be sure to leave a comment below if you have questions about anything!

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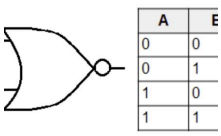

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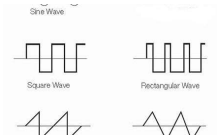

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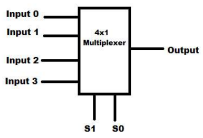

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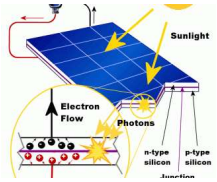

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1 COMMENT

Erik van Zijst on March 28, 2022 at 7:54 am

is wrong in that there's too many zeros. 100pF is 0.000,000,000,1 (not 0.000,000,000,001).

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